ST. JOSEPH'S COLLEGE (AUTONOMOUS), DEVAGIRI, CALICUT

DEGREE OF
BACHELOR OF SCIENCE (B.Sc.)
HONOURS IN MATHEMATICS

(UNDER SJCBCSSUG 2019 SYSTEM)

Syllabus of Newly Proposed
(B.Sc.) Honours Mathematics

Course Outcome
(2022 Admissions Onwards)

Course outcome

Core Course

SEMESTER I
GMAH1B01T: THEORY OF EQUATION AND COMPLEX NUMBERS

Contact Hours	: 80 (5 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours
Course Evaluation	: 100 (Internal: 20 + External: 80)

Course Outcomes
- Use different ways of solving equations and they begin to prove many properties in their own way regarding numbers.
- Get idea of Complex numbers their properties, complex functions and special power functions.

SEMESTER I
GMAH1B02T: CALCULUS I

Contact Hours	: 80 (5 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours
Course Evaluation	: 100 (Internal: 20 + External: 80)

Course Outcomes
- To show how these ideas of differential calculus can be applied in the problem of sketching of curves and in the solution of some optimization problems of interest in real life.
- To understand the geometric problem of finding out the area of a planar region and practical way of evaluating the definite integral which establishes the close connection between the two branches of Calculus.
- To find the arc length of a plane curve, volume, and surface areas of solids and so on.
- To use integration as a powerful tool in solving problems in physics, chemistry, biology, engineering, economics, and other fields.

SEMESTER I
GMAH1B03T: PROBABILITY AND STATISTICS

Contact Hours	: 80 (5 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours

Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes
- Acquaintance with various methods of collecting data and get familiar with some elementary methods viz. Measures of central tendency.
- Understanding the basic concepts of probability and to find probabilities of various events.
- To recognize and evaluate the relationship between two quantitative variables through simple linear correlation and regression.

SEMESTER I
GMAH1B04T: COMPUTER FUNDAMENTAL & INTRODUCTION TO PROGRAMMING

Contact Hours : 96 (6 hrs./wk.)
Number of Credits : 4
Examination : 3 Hours
Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes
- Identifies basics of digital computing.
- Develops an in depth understanding of functional and logical concepts of C Programming.
- Provides exposure to problem solving through C Programming.

SEMESTER II
GMAH2B05T: TWO-DIMENSIONAL GEOMETRY

Contact Hours : 80 (5 hrs./wk.)
Number of Credits : 4
Examination : 3 Hours
Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes
- Find equation in various form of line, circle, ellipse, sphere, cones etc.
- Understand polar coordinates and its relationship with cartesian coordinates.
- Sketch various curves.

SEMESTER II
GMAH2B06T: CALCULUS II

Contact Hours : 80 (5 hrs./wk.)

Number of Credits : 4
Examination : 3 Hours
Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes
- To exponentially model a wide variety of phenomenon of interest in science, engineering, mathematics and economics.
- To practically apply several different tests such as integral test, comparison test and so on. As a special case, a study on power series- their region of convergence, differentiation, and integration etc., is also done.
- Understanding the basic concepts of probability and to find probabilities of various events.
- To get the idea of parametrization of curves; how to calculate the arc length, curvature etc.
- To recognize and evaluate the area of surface of revolution of a parametrized plane curve.

SEMESTER II
GMAH2B07T: NUMBER THEORY

Contact Hours : 80 (5 hrs./wk.)
Number of Credits : 4
Examination : 3 Hours
Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes
- Find quotients and remainders from integer division
- Apply Euclid's algorithm and backwards substitution
- Understand the definitions of congruence, residue classes and least residues add and subtract integers, modulo n, multiply integers and calculate powers, modulo n
- Determine multiplicative inverses, modulo n and use to solve linear congruence.

SEMESTER II
GMAH2B08T: DISTRIBUTION THEORY

Contact Hours : 80 (5 hrs./wk.)
Number of Credits : 4
Examination : 3 Hours
Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes
- Identify the characteristics of various discrete and continuous probability distributions

- Use discrete and continuous probability distributions including requirements, mean and variance and making decisions
- Identify the situations to which these distributions can be applied.
- Use of different distributions to solve simple practical problems.
- Use of standing normal distribution on appropriate area.
- Understand the importance of central limit theorem and laws of large numbers.

SEMESTER II
GMAH2B09T: INTRODUCTION TO PYTHON PROGRAMMING

Contact Hours	**: 80 (5 hrs./wk.)**
Number of Credits	**: 4**
Examination	**: 3 Hours**
Course Evaluation	**: 100 (Internal: 20 + External: 80)**

Course Outcomes
- Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.
- Express proficiency in the handling of strings and functions.
- Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples, and sets.

SEMESTER III
GMAH3B10T: REAL ANALYSIS I

Contact Hours	**: 80 (5 hrs./wk.)**
Number of Credits	**: 4**
Examination	**: 3 Hours**
Course Evaluation	**: 100 (Internal: 20 + External: 80)**

Course Outcomes
- Describe fundamental properties of the real numbers that lead to the formal development of real analysis.
- Comprehend rigorous arguments developing the theory underpinning real analysis.
- Demonstrate an understanding of limits and how they are used in sequences and series.

SEMESTER III
GMAH3B11T: CALCULUS III

Contact Hours	**: 80 (5 hrs./wk.)**
Number of Credits	**: 4**

Examination   **: 3 Hours**
Course Evaluation   **: 100 (Internal: 20 + External: 80)**

Course Outcomes

- Handle vectors in dealing with the problems involving geometry of lines, curves, planes and surfaces in space and have acquired the ability to sketch curves in plane and space given in vector valued form.
- Understand several contexts of the appearance of multivariable functions and their representation using graph and contour diagrams.
- Formulate and work on the idea of limit and continuity for functions of several variables.
- Understand the notion of partial derivatives, their computation and interpretation.
- Understand chain rule for calculating partial sums.
- Get the idea of directional derivative, its evaluation, interpretation and relationship between partial derivatives.
- Understand the concept of gradient, a few of its properties, application and interpretation.

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SEMESTER III

GMAH3B12T: DIFFERENTIAL EQUATIONS

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Contact Hours   **: 80 (5 hrs./wk.)**
Number of Credits   **: 4**
Examination   **: 3 Hours**
Course Evaluation   **: 100 (Internal: 20 + External: 80)**

Course Outcomes

- Students could identify a number of areas where the modeling process results in a differential equation.
- They will learn what an ODE is, what it means by its solution, how to classify DEs, what it means by an IVP and so on.
- They will learn to solve DEs that are in linear, separable and in exact forms and also to analyze the solution.
- They will learn a method to approximate the solution successively of a first order IVP.
- They will become familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients.
- Students acquire the knowledge of solving a differential equation using Laplace method which is especially suitable to deal with problems arising in the engineering field.
- Students learn the technique of solving partial differential equations using the method of separation of variables.

GMAH3B13T: STATISTICAL INFERENCE

Contact Hours	: 80 (5 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours
Course Evaluation	: 100 (Internal: 20 + External: 80)

Course Outcomes

- Understand the basic components of sampling and have the knowledge on exact sampling distributions.

- Understand the problem of statistical inference, problem of point estimation, Properties of point estimation.

- Understand the problem of statistical inference, the problem of Interval estimation. Construction of confidence Interval.

- Understand the problem of statistical inference, the problem of testing hypotheses.

- Apply the different testing tools like t-test, F-test, chi-square test, ANOVA etc. to analyze the relevant real life problems.

SEMESTER III
GMAH3B14T: ADVANCED PYTHON PROGRAMMING

Contact Hours	: 80 (5 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours
Course Evaluation	: 100 (Internal: 20 + External: 80)

Course Outcomes

- Develop an appreciation for what is involved in learning from data.
- Appreciate the importance of visualization in the data analytics solution.
- To understand the basic theory underlying machine learning.
- To be able to formulate machine learning problems corresponding to different applications.

SEMESTER IV
GMAH4B15T: REAL ANALYSIS II

Contact Hours	: 80 (5 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours
Course Evaluation	: 100 (Internal: 20 + External: 80)

Course Outcomes

- State the definition of continuous functions, formulate sequential criteria for continuity and prove or disprove continuity of functions using these criteria.

- Realize the difference between continuity and uniform continuity and equivalence of these ideas for functions on closed and bounded interval.

- Understand the significance of uniform continuity in continuous extension theorem.

- Develop the notion of Riemann integrability of a function using the idea of tagged partitions and calculate the integral value of some simple functions using the definition.

- Understand a few basic and fundamental results of integration theory

- Formulate Cauchy criteria for integrability and a few applications of it. In particular they learn to use Cauchy criteria in proving the non integrability of certain functions.

- Prove convergence and divergence of sequences of functions and series

- Understand the difference between point wise and uniform convergence of sequences and series of functions

SEMESTER IV
GMAH4B16T: CALCULUS IV

Contact Hours   : 80 (5 hrs./wk.)
Number of Credits   : 4
Examination   : 3 Hours
Course Evaluation   : 100 (Internal: 20 + External: 80)

Course Outcomes

- Understand the concept of gradient, a few of its properties, application and interpretation

- Understand the use of partial derivatives in getting information of tangent plane and normal line.

- Calculate the maximum and minimum values of a multivariable function using second derivative test and Lagrange multiplier method.

- Extend the notion of integral of a function of single variable to integral of functions of two and three variables.

- Address the practical problem of evaluation of double and triple integral using Fubini's theorem and change of variable formula.

- Realize the advantage of choosing other coordinate systems such as polar, spherical, cylindrical etc. in the evaluation of double and triple integrals.

- Understand the notion of a vector field, the idea of curl and divergence of a vector field, their evaluation and interpretation.

- Learn three major results viz. Green's theorem, Gauss's theorem and Stokes' theorem of multivariable calculus and their use in several areas and directions.

GMAH4B17T: LINEAR PROGRAMMING AND APPLICATIONS

Contact Hours : 80 (5 hrs./wk.)
Number of Credits : 4
Examination : 3 Hours
Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes
- To understand the drawbacks of geometric methods
- To solve LP problems more effectively using Simplex algorithm via. the use of condensed tableau of A.W. Tucker.
- To convert certain related problems, not directly solvable by simplex method, into a form that can be attacked by simplex method.
- To understand duality theory, a theory that establishes relationships between linear programming problems of maximization and minimization.
- To solve transportation and assignment problems by algorithms that take advantage of the simpler nature of these problems.
- To solve LP problems using Python Program.

SEMESTER IV
GMAH4B18T: NUMERICAL COMPUTING

Contact Hours : 80 (5 hrs./wk.)
Number of Credits : 4
Examination : 3 Hours
Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes
- Understand several methods such as bisection method, fixed point iteration method, regulafalsi method etc. to find out the approximate numerical solutions of algebraic and transcendental equations with desired accuracy.
- Understand the concept of interpolation and also learn some well-known interpolation techniques.
- Understand a few techniques for numerical differentiation and integration and also realize their merits and demerits.
- Find out numerical approximations to solutions of initial value problems and also to understand the efficiency of various methods.
- To solve the problems using Python Program.

GMAH4B19P: STATISTICAL DATA ANALYSIS USING R (PRACTICAL)

Contact Hours : 80 (5 hrs./wk.)
Number of Credits : 4
Examination : 2.5 Hours
Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes
- To carry out elementary statistical data analysis using Microsoft excel, R and SPSS
- To construct various graphs and tables for different kind of data sets
- To make valid conclusions and results based on statistical theory using small and large sample data

SEMESTER V
GMAH5B20T: ALGEBRA I

Contact Hours : 80 (5 hrs./wk.)
Number of Credits : 4
Examination : 3 Hours
Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes
- At the end of the course students explain the general way in which algebraic structures are introduced and studied in an abstract fashion.
- Students enjoy the construction of algebraic structures and they begin to develop new algebraic structures by generalizing the well-known examples.

SEMESTER V
GMAH5B21T: COMPLEX ANALYSIS

Contact Hours : 80 (5 hrs./wk.)
Number of Credits : 4
Examination : 3 Hours
Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes
- To understand the difference between differentiability and analyticity of a complex function and construct examples.
- To understand necessary and sufficient condition for checking analyticity.
- To know of harmonic functions and their connection with analytic functions.

- To know a few elementary analytic functions of complex analysis and their properties.
- To understand definition of complex integral, its properties and evaluation.
- To know a few fundamental results on contour integration theory such as Cauchy's theorem, Cauchy- Goursat theorem and their applications.
- To understand and apply Cauchy's integral formula and a few consequences of it such as Liouville's theorem, Morera's theorem and so forth in various situations.
- To see the application of Cauchy's integral formula in the derivation of power series expansion of an analytic function.
- To see another application of residue theory in locating the region of zeros of an analytic function.

SEMESTER V
GMAH5B22T: LINEAR ALGEBRA

Contact Hours	: 80 (5 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours
Course Evaluation	: 100 (Internal: 20 + External: 80)

Course Outcomes
- The student will come to understand the modern view of a matrix as a linear transformation.
- To find out the eigenvalues from the characteristic equation and the corresponding eigenvectors.
- To check whether diagonalization is possible and learn procedure for diagonalizing a given matrix
- To realize that there are matrices that cannot be diagonalized and even learn to check it.
- To learn that only symmetric matrices with real entries can be orthogonally diagonalized and using Gram-Schmidt process.

SEMESTER V
GMAH5B23T: OBJECT ORIENTED PROGRAMMING WITH C++

Contact Hours	: 80 (5 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours
Course Evaluation	: 100 (Internal: 20 + External: 80)

Course Outcomes
- Able to develop programs with reusability, data abstraction and inheritance.
- Apply the principles of virtual functions and polymorphism.

- Handle exceptions in programming.
- Develop applications for a range of problems using object-oriented programming techniques.

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SEMESTER V
Elective 1
GMAH5E01T: TOPOLOGY

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Contact Hours : 80 (5 hrs./wk.)
Number of Credits : 4
Examination : 3 Hours
Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes
- Upon completing the course, students will be proficient in abstract notion of a toplogical space, where continuous function are defined in terms of open set not in the traditional $\varepsilon - \delta$ definition used in analysis.
- Upon completing the course, students will realize Intermediate value theorem is a statement about connectedness.

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SEMESTER V
Elective 2
GMAH5E02T: MATHEMATICAL FINANCE

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Contact Hours : 80 (5 hrs./wk.)
Number of Credits : 4
Examination : 3 Hours
Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes
- To understand the role of risk neutral probability measures the use of some elements of stochastic calculus in mathematical finance.
- To understand the concepts of The Arbitrage theorem to form a pricing model for the stocks.

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SEMESTER V
Elective 3
GMAH5E03T: DIFFERENTIAL GEOMETRY

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Contact Hours : 80 (5 hrs./wk.)
Number of Credits : 4
Examination : 3 Hours
Course Evaluation : 100 (Internal: 20 + External: 80)

Course Outcomes

- To recognize the concept of curves and surfaces
- To understand the concept of curvature of a surface and able to compute the curvature of space curves.
- To understand geodesic as a distance minimizing curves on surfaces and find the geodesic of various surfaces.

SEMESTER V
Elective 4
GMAH5E04T: MATHEMATICAL DOCUMENTATION USING LATEX

Contact Hours	: 80 (5 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours
Course Evaluation	: 100 (Internal: 20 + External: 80)

Course Outcomes

- To install and use LaTeX.
- To understands typesetting using Latex and apply Latex in writing equations.

SEMESTER VI
GMAH6B24T: ALGEBRA II

Contact Hours	: 80 (5 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours
Course Evaluation	: 100 (Internal: 20 + External: 80)

Course Outcomes

- At the end of the course students explain the general way in which algebraic structures are introduced and studied in an abstract fashion.
- Students enjoy the construction of algebraic structures and they begin to develop new algebraic structures by generalizing the well-known examples.

SEMESTER VI
GMAH6B25T: GRAPH THEORY

Contact Hours	: 80 (5 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours
Course Evaluation	: 100 (Internal: 20 + External: 80)

Course Outcomes

- To understand and apply the fundamental concepts in graph theory.

- To apply graph theory based tools in solving practical problems.
- To improve the proof writing skills.

<center>**SEMESTER VI**</center>

GMAH6B26T: DATA STRUCTURES USING C++

Contact Hours	: 64 (4 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours
Course Evaluation	: 100 (Internal: 20 + External: 80)

Course Outcomes
- Implement abstract data types using arrays and linked list.
- Apply the different linear data structures like stack and queue to various computing problems.
- Implement different types of trees and apply them to problem solutions.
- Discuss graph structure and understand various operations on graphs and their applicability.
- Analyse the various sorting and searching algorithms.
- Understand the hashing technique and hash functions.

<center>**SEMESTER VI**</center>
<center>**Elective 1**</center>

GMAH6E05T: MATHEMATICAL ECONOMICS

Contact Hours	: 80 (5 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours
Course Evaluation	: 100 (Internal: 20 + External: 80)

Course Outcomes
- To understand equilibrium analysis in Economics.
- To understand some Economic Applications of Integrals.

<center>**SEMESTER VI**</center>
<center>**Elective 2**</center>

GMAH6E06T: FUZZY MATHEMATICS

Contact Hours	: 80 (5 hrs./wk.)
Number of Credits	: 4
Examination	: 3 Hours
Course Evaluation	: 100 (Internal: 20 + External: 80)

Course Outcomes

- To understand the basics of fuzzy mathematics.
- To apply fuzzy set theory in modeling and analyzing uncertainty in decision problem.

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SEMESTER VI
Elective 3
GMAH6E07T: PROGRAMMING USING SCILAB

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Contact Hours   : 80 (5 hrs./wk.)
Number of Credits   : 4
Examination   : 3 Hours
Course Evaluation   : 100 (Internal: 20 + External: 80)

Course Outcomes

- To understand the basics of Scilab and commands.