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

B.Sc. DEGREE PROGRAMME

ST. JOSEPH'S CHOICE BASED CREDIT SEMESTER SYSTEM
(SJCBCSSUG)

MATHEMATICS
(CORE, OPEN & COMPLEMENTARY COURSES)

Course Outcome
(2019Admn Onwards)

COURSE OUTCOMES

CORE COURSES

SEMESTER I

GMAT1B01T: BASIC LOGIC AND CALCULUS

Credits: **4**
Contact Hours: **64 Hrs (4 Hrs/Week)**
Course Evaluation: **100 Marks (Internal: 20 + External: 80)**

COs	COURSE OUTCOMES
CO1	At the end of the course students get able to be familiar to the language of mathematics and they develop their own way of writing and explaining mathematics
CO2	Students experience the classical way of doing and enjoying mathematics in a much more logical way

SEMESTER II

GMAT2B02T: CALCULUS AND INFINITE SERIES

Credits: **4**
Contact Hours: **64 Hrs (4 Hrs/Week)**
Course Evaluation: **100 Marks (Internal: 20 + External: 80)**

COs	COURSE OUTCOMES
CO1	The students are introduced to the idea of improper integrals, their convergence and evaluation
CO2	This enables to study a related notion of convergence of a series, which is practically done by applying several different tests such as integral test, comparison test and so on
CO3	As a special case, a study on power series- their region of convergence, differentiation and integration etc., is also done

SEMESTER III

GMAT3B03T: GEOMETRY AND VECTOR CALCULUS

Credits: **4**
Contact Hours: **80 Hrs (5 Hrs/Week)**
Course Evaluation: **100 Marks (Internal: 20 + External: 80)**

COs	COURSE OUTCOMES
CO1	Recall several basic facts about parabola, hyperbola and ellipse (conics) such as their equation in standard form, focal length properties, and reflection properties, their tangents and normal
CO2	Recognise and classify conics
CO3	Explain several contexts of appearance of multivariable functions and their representation using graph and contour diagrams
CO4	Formulate and work on the idea of limit and continuity for functions of several variables
CO5	Explain the notion of partial derivative, their computation and interpretation
CO6	Explain chain rule for calculating partial derivatives
CO7	Get the idea of directional derivative, its evaluation, interpretation, and relationship with partial derivatives
CO8	Explain the concept of gradient, a few of its properties, application and interpretation

SEMESTER IV

GMAT4B04T: MULTIVARIABLE AND VECTOR CALCULUS

Credits: **4**
Contact Hours: **80 Hrs (5 Hrs/Week)**
Course Evaluation: **100 Marks (Internal: 20 + External: 80)**

COs	COURSE OUTCOMES

CO1	Understand the use of partial derivatives in getting information of tangent plane and normal line
CO2	Calculate the maximum and minimum values of a multivariable function using second derivative test and Lagrange multiplier method
CO3	Find a few real life applications of Lagrange multiplier method in optimization problems
CO4	Extend the notion of integral of a function of single variable to integral of functions of two and three variables
CO5	Address the practical problem of evaluation of double and triple integral using Fubini's theorem and change of variable formula
CO6	Realize the advantage of choosing other coordinate systems such as polar, spherical, cylindrical etc. in the evaluation of double and triple integrals
CO7	See a few applications of double and triple integral in the problem of finding out surface area, mass of lamina, volume, centre of mass and so on
CO8	Understand the notion of a vector field, the idea of curl and divergence of a vector field, their evaluation and interpretation
CO9	Understand the idea of line integral and surface integral and their evaluations
CO10	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

SEMESTER V

GMAT5B05T: ABSTRACT ALGEBRA

Credits: 4
Contact Hours: 80 Hrs (5 Hrs/Week)
Course Evaluation: 100 Marks (Internal: 20 + External: 80)

COs	COURSE OUTCOMES
CO1	At the end of the course students explain the general way in which algebraic structures are introduced and studied in an abstract fashion
CO2	Students enjoy the construction of algebraic structures and they begin to develop new algebraic structures by generalizing the well known examples

SEMESTER V
GMAT5B06T: REAL ANALYSIS

Credits: 4
Contact Hours: 80 Hrs (5 Hrs/Week)
Course Evaluation: 100 Marks (Internal: 20 + External: 80)

COs	COURSE OUTCOMES
CO1	To learn and deduce rigorously many properties of real number system by assuming a few fundamental facts about it as axioms. In particular they will learn to prove Archimedean property, density theorem, existence of a positive square root for positive numbers and so on and the learning will help them to appreciate the beauty of logical arguments and embolden them to apply it in similar and unknown problems
CO2	To know about sequences ,their limits, several basic and important theorems involving sequences and their applications . For example, they will learn how monotone convergence theorem can be used in establishing the divergence of the harmonic series, how it helps in the calculation of square root of positive numbers and how it establishes the existence of the transcendental number e (Euler constant)
CO3	To understand some basic topological properties of real number system such as the concept of open and closed sets, their properties, their characterization and so on
CO4	To get a rigorous introduction to algebraic, geometric and topological structures of complex number system, functions of complex variable, their limit and continuity and so on. Rich use of geometry, comparison between real and complex calculus-areas where they agree and where they differ, the study of mapping properties of a few important complex functions exploring the underlying geometry etc. will demystify student's belief that complex variable theory is incomprehensible

SEMESTER V
GMAT5B07T: NUMERICAL ANALYSIS

Credits: 3
Contact Hours: 64 Hrs (4 Hrs/Week)
Course Evaluation: 75 Marks (Internal: 15 + External: 60)

COs	COURSE OUTCOMES
CO1	Understand several methods such as bisection method, fixed point iteration method, regula falsi method etc. to find out the approximate numerical solutions of algebraic and transcendental equations with desired accuracy

CO2	Understand the concept of interpolation and also learn some well known interpolation techniques
CO3	Understand a few techniques for numerical differentiation and integration and also realize their merits and demerits
CO4	Find out numerical approximations to solutions of initial value problems and also to understand the efficiency of various methods

SEMESTER V
GMAT5B08T: THEORY OF EQUATIONS AND NUMBER THEORY

Credits: 3
Contact Hours: 64 Hrs (4 Hrs/Week)
Course Evaluation: 75 Marks (Internal: 15 + External: 60)

COs	COURSE OUTCOMES
CO1	At the end of the course students get used to different ways of solving equations and they begin to prove many properties in their own way regarding numbers
CO2	In fact the number theory course attracts students more towards pure mathematics and student enjoy mathematics as they enjoy poetry and they believe that they are poets

SEMESTER V
GMAT5B09T: LINEAR PROGRAMMING

Credits: 3
Contact Hours: 48 Hrs (3 Hrs/Week)
Course Evaluation: 75 Marks (Internal: 15 + External: 60)

COs	COURSE OUTCOMES
CO1	Solve linear programming problems geometrically
CO2	Understand the drawbacks of geometric methods
CO3	Solve LP problems more effectively using Simplex algorithm via. the use of condensed tableau of A.W. Tucker

CO4	Convert certain related problems, not directly solvable by simplex method, into a form that can be attacked by simplex method
CO5	Understand duality theory, a theory that establishes relationships between linear programming problems of maximization and minimization
CO6	Solve transportation and assignment problems by algorithms that take advantage of the simpler nature of these problems

SEMESTER VI

GMAT6B10T: ADVANCED REAL ANALYSIS

Credits: 5
Contact Hours: 80 Hrs (5 Hrs/Week)
Course Evaluation: 100 Marks (Internal: 20 + External: 80)

COs	COURSE OUTCOMES
CO1	State the definition of continuous functions, formulate sequential criteria for continuity and prove or disprove continuity of functions using this criteria
CO2	Understand several deep and fundamental results of continuous functions on intervals such as boundedness theorem, maximum-minimum theorem, intermediate value theorem, preservation of interval theorem and so on
CO3	Realise the difference between continuity and uniform continuity and equivalence of these ideas for functions on closed and bounded interval
CO4	Understand the significance of uniform continuity in continuous extension theorem
CO5	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
CO6	Understand a few basic and fundamental results of integration theory
CO7	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
CO8	Understand classes of functions that are always integrable
CO9	Understand two forms of fundamental theorem of calculus and their significance in the practical problem of evaluation of an integral
CO10	Find a justification for ‘change of variable formula’ used in the practical problem of evaluation of an integral
CO11	Prove convergence and divergence of sequences of functions and series
CO12	Understand the difference between point wise and uniform convergence of sequences and series of functions
CO13	Answer a few questions related to interchange of limits

CO14	Learn and find out examples/counter examples to prove or disprove the validity of several mathematical statements that arise naturally in the process/context of learning
CO15	Understand the notion of improper integrals, their convergence, principal value and evaluation

SEMESTER VI

GMAT6B11T: COMPLEX ANALYSIS

Credits: 5
Contact Hours: 80 Hrs (5 Hrs/Week)
Course Evaluation: 100 Marks (Internal: 20 + External: 80)

COs	COURSE OUTCOMES
CO1	To understand the difference between differentiability and analyticity of a complex function and construct examples
CO2	To understand necessary and sufficient condition for checking analyticity.
CO3	To know of harmonic functions and their connection with analytic functions
CO4	To know a few elementary analytic functions of complex analysis and their properties.
CO5	To understand definition of complex integral, its properties and evaluation.
CO6	To know a few fundamental results on contour integration theory such as Cauchy's theorem, Cauchy- Goursat theorem and their applications.
CO7	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.
CO8	To see the application of Cauchy's integral formula in the derivation of power series expansion of an analytic function.
CO9	To know a more general type of series expansion analogous to power series expansion *viz.Laurent's series expansion* for functions having *singularity*.
CO10	To understand how Laurent's series expansion lead to the concept of *residue*, which in turn provide another fruitful way to evaluate complex integrals and, in some cases, even real integrals.
CO11	To see another application of residue theory in locating the region of zeros of an analytic function

SEMESTER VI

GMAT6B12T: LINEAR ALGEBRA

Credits: **4**
Contact Hours: **80 Hrs (5 Hrs/Week)**
Course Evaluation: **100 Marks (Internal: 20 + External: 80)**

COs	COURSE OUTCOMES
CO1	Linear maps are introduced. The key result here is that for a linear map T, the dimension of the null space of T plus the dimension of the range of T equals the dimension of the domain of T.
CO2	The part of the theory of polynomials that will be needed to understand linear operators is presented.
CO3	The idea of studying a linear operator by restricting it to small subspaces to eigenvectors. The highlight is a simple proof that on complex vector spaces, eigenvalues always exist. This result is then used to show that each linear operator on a complex vector space has an upper-triangular matrix with respect to some basis. Similar techniques are used to show that every linear operator on a real vector space has an invariant subspace of dimension 1 or 2. This result is used to prove that every linear operator on an odd-dimensional real vector space has an eigenvalue. All this is done without defining determinants or characteristic polynomials.
CO4	Inner-product spaces are defined and their basic properties are developed along with standard tools such as orthonormal bases.
CO5	The novel approach of not relying on the concept of determinants leads the students to achieve the central goal of linear algebra: understanding the structure of linear operators on vector spaces

SEMESTER VI

GMAT6B13T: DIFFERENTIAL EQUATIONS

Credits: **4**
Contact Hours: **80 Hrs (5 Hrs/Week)**
Course Evaluation: **100 Marks (Internal: 20 + External: 80)**

COs	COURSE OUTCOMES
CO1	Students could identify a number of areas where the modeling process results in a differential equation
CO2	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.
CO3	They will learn to solve DEs that are in linear, separable and in exact forms and also to analyze the solution.
CO4	They will realize the basic differences between linear and nonlinear DEs and also basic results that guarantee a solution in each case.
CO5	They will learn a method to approximate the solution successively of a first order IVP
CO6	They will become familiar with the theory and method of solving a second order linear homogeneous and nonhomogeneous equation with constant coefficients
CO7	They will learn to find out a series solution for homogeneous equations with variable coefficients near ordinary points
CO8	Students acquire the knowledge of solving a differential equation using Laplace method which is especially suitable to deal with problems arising in engineering field
CO9	Students learn the technique of solving partial differential equations using the method of separation of variables

SEMESTER VI
ELECTIVE
GMAT6E01T: GRAPH THEORY

Credits: **2**
Contact Hours: **48 Hrs (3 Hrs/Week)**
Course Evaluation: **75Marks (Internal: 15 + External: 60)**

COs	COURSE OUTCOMES
CO1	Understand and apply the fundamental concepts in graph theory
CO2	Apply graph theory based tools in solving practical problems
CO3	Improve the proof writing skills.
CO4	Analyze properties of graphs
CO5	Understand trees and their properties
CO6	Distinguish between Eulerian and Hamiltonian graphs
CO7	Analyze planar graphs

SEMESTER VI
ELECTIVE
GMAT6E02T: TOPOLOGY OF METRIC SPACES

Credits: **2**
Contact Hours: **48 Hrs (3 Hrs/Week)**
Course Evaluation: **75Marks (Internal: 15 + External: 60)**

COs	COURSE OUTCOMES
CO1	The student will be able to perform simple theoretical analysis involving sets in metric and topological spaces and maps between these spaces
CO2	The students will be able to apply these concepts to other areas of mathematics

SEMESTER VI

GMAT6E03P: MATHEMATICAL PROGRAMMING WITH PYTHON AND LATEX

Credits: 2
Contact Hours: 48 Hrs (3 Hrs/Week)
Course Evaluation: 75Marks (Internal: 15 + External: 60)

COs	COURSE OUTCOMES
CO1	Understand basis of Python programming, apply Python programming in plotting mathematical functions, apply Python programming in numerical analysis, understands typesetting using Latex and apply Latex in writing equations

SEMESTER VI

GMAT6E04T: INTRODUCTION TO GEOMETRY

Credits: 2
Contact Hours: 48 Hrs (3 Hrs/Week)
Course Evaluation: 75Marks (Internal: 15 + External: 60)

COs	COURSE OUTCOMES
CO1	At the end of the course students develop rational thought, contributing to the thinking skills of logic, deductive reasoning and skills in problem solving

OPEN COURSES

SEMESTER V

GMAT5D01T: APPLIED CALCULUS

Credits: 3
Contact Hours: 48 Hrs (3 Hrs/Week)
Course Evaluation: 75Marks (Internal: 15 + External: 60)

COs	COURSE OUTCOMES
CO1	Identify the independent and dependent variables of a function and compute its domain and range.
CO2	Evaluate functions given by formulas at given points
CO3	Plot the graphs of straight lines and conics
CO4	Compute limits
CO5	Check continuity

CO6	Compute derivatives and write down the equation of the tangent line
CO7	Determine whether the function is increasing or decreasing using derivatives
CO8	Compute velocity and acceleration
CO9	Compute marginal cost/revenue/profit of production
CO10	Compute differential and use it to approximate the error occurred
CO11	Perform implicit differentiation
CO12	Compute convexity, concavity and points of inflection
CO13	Sketch curves
CO14	Determine extreme values
CO15	Determine the level of elasticity and use it for predicting the behaviour of revenue/cost/profit
CO16	Combine the techniques of model building with optimization techniques
CO17	Use exponential/logarithmic function to compute compound interest, radioactive decay etc
CO18	To compute the area under a curve, average value of a function using integration
CO19	Integrate using substitution
CO20	To estimate the future and present value of an income flow
CO21	To compute the survival and renewal functions
CO22	To compute anti derivative
CO23	To determine population density
CO24	To find the area and volume of surface of revolution

SEMESTER V

GMAT5D02T: DISCRETE MATHEMATICS FOR BASIC AND APPLIED SCIENCES

Credits: 3
Contact Hours: 48 Hrs (3 Hrs/Week)
Course Evaluation: 75Marks (Internal: 15 + External: 60)

COs	COURSE OUTCOMES
CO1	Identify correct and incorrect arguments

CO2	Understand the criteria for the evaluation of arguments
CO3	Understand the scientific way of decision making using the laws of logic
CO4	Understand the concept of algebraic structures in Mathematics
CO5	Identify a given algebraic structure as belonging to a particular family of structures and to state the characteristic properties of the members of the family
CO6	Understand the concept of groups and derive basic theorems on groups
CO7	Define the concept of Boolean algebra as an algebraic structure and list its properties
CO8	Understand the applications of Boolean algebra in switching circuits
CO9	Define a Graph and identify different classes of graphs
C10	Understand various applications of Graph theory

SEMESTER V

GMAT5D03T: LINEAR MATHEMATICAL MODELS

Credits: 3
Contact Hours: 48 Hrs (3 Hrs/Week)
Course Evaluation: 75Marks (Internal: 15 + External: 60)

COs	COURSE OUTCOMES
CO1	the students will be able to Understand the idea of slope of the lines, understand to find solution of Linear Systems by the Echelon Method and Gauss Jordan method
CO2	Gets an idea of matrices, understand how to add, subtract and multiplication of matrices and understand how find the inverse of a matrix
CO3	Understand the methods of solving linear programming problems geometrically and understands the drawbacks of geometric methods and to solve LP problems more effectively using Simplex method

CO4	Understand duality theory, a theory that establishes relationships between linear programming problems of maximization and minimization

SEMESTER V

GMAT5D04T: MATHEMATICS FOR DECISION MAKING

Credits: 3
Contact Hours: 48 Hrs (3 Hrs/Week)
Course Evaluation: 75Marks (Internal: 15 + External: 60)

COs	COURSE OUTCOMES
CO1	The student could understand the classifications of data. Student is also introduced to various data collection techniques
CO2	Student will learn to visualize various types of data with the use of frequency charts and appropriate graphs
CO3	Student understands concepts like measures of central tendency, measures of variation and measures of position
CO4	Student gets a clear understanding of basic probability concepts. Student learns conditional probability, addition rule and other basic theories in probability
CO5	Student will learn various probability distributions of discrete and continuous variables
CO6	Student learns about the normal distribution, which is an important continuous probability distribution in inferential statistics
CO7	Student understands the standard normal distribution and learns the conversion of normal variable to standard normal variable

COMPLEMENTARY COURSES

SEMESTER I

GMAT1C01T: MATHEMATICS-1

Credits: **3**
Contact Hours: **64 Hrs (4 Hrs/Week)**
Course Evaluation: **75Marks (Internal: 15 + External: 60)**

COs	COURSE OUTCOMES
CO1	The fundamental ideas of limit, continuity, and differentiability
CO2	Increasing and decreasing functions, local maxima, minima, concavity, and inflection points
CO3	How to apply these ideas in drawing the graphs of functions
CO4	To find the solution of maximum-minimum problems using the idea of derivatives
CO5	The Mean Value Theorem and L'Hospital rule
CO6	Riemann sums
CO7	Fundamental Theorem of Calculus and proof
CO8	To solve the area problem, the problem of finding the arc length of a plane curve, and volume of solids
CO9	Average values and the Mean Value Theorem for integrals

SEMESTER II

GMAT2C02T: MATHEMATICS-2

Credits: **3**
Contact Hours: **64 Hrs (4 Hrs/Week)**
Course Evaluation: **75Marks (Internal: 15 + External: 60)**

COs	COURSE OUTCOMES
CO1	Represent points in polar coordinates and convert from one system to another
CO2	Do the graphing in polar coordinates
CO3	Fid the derivatives and anti-derivatives of hyperbolic and inverse hyperbolic functions
CO4	Find the arc length and surface area of revolution using definite integrals
CO5	Find the improper integrals
CO6	Find the limit of sequences
CO7	Find the integral using the trapezoidal rule and Simpson's rule
CO8	Find the convergence and divergence of series
CO9	Solve a system of linear equations using matrix theory
C10	To Find the rank and inverse of a matrix using elementary row transformations
C11	Find the eigen values and the corresponding eigen vectors of a matrix
C12	To check whether a matrix is diagonalizable or not

SEMESTER III

GMAT3C03T: MATHEMATICS-3

Credits: **3**
Contact Hours: **80 Hrs (5 Hrs/Week)**
Course Evaluation: **75Marks (Internal: 15 + External: 60)**

COs	COURSE OUTCOMES
CO1	Work on the idea of limit, continuity, and derivative of vector-valued functions
CO2	Use partial derivatives to fiNd the tangent plane and normal line to a point on a surface
CO3	Understand the properties and applications of the gradient of a function
CO4	Apply double integral and triple integral to Find the mass of a lamina, center of mass, etc.
CO5	Evaluate curl and divergence of a vector Field
CO6	Understand line integral, surface integral, and triple integral
CO7	Learn the three important theorems: Green's theorem, Gauss's theorem, and Stokes's theorem and their applications
CO8	Learn about harmonic functions and their relation with analytic functions
CO9	Understand the definition and evaluation of complex integral
C10	Learn the fundamental results on contour integration such as Cauchy-Goursat Theorem
C11	Understand Cauchy's integral formula and apply it to derive Liouville's theorem and the Fundamental Theorem of Algebra

SEMESTER IV

GMAT4C04T: MATHEMATICS-4

Credits: **3**
Contact Hours: **80 Hrs (5 Hrs/Week)**
Course Evaluation: **75Marks (Internal: 15 + External: 60)**

COs	COURSE OUTCOMES
CO1	They learn the major classifications of differential equations
CO2	They learn the conditions for the existence of solution of first and second order Initial Value Problems
CO3	They learn how to formulate a mathematical model of a physical process
CO4	They learn to solve the first order differential equations that are of linear, separable, exact, and Bernoulli's forms
CO5	They learn about the numerical method of solving a differential equation using Euler's method.
CO6	They become familiar with the theory and method of solving second order linear homogeneous and non-homogeneous equations with constant coefficients
CO7	They learn the method of reduction of order to find a second solution of linear second order equation by reducing to linear first order equation
CO8	They learn the method of solution of Cauchy Euler equations
CO9	They learn about linear models and Boundary value problems
CO10	They acquire the knowledge of solving a differential equation using the Laplace method, which is useful to deal with problems in engineering
CO11	They are familiarized with the Fourier series
CO12	They learn the technique of solving partial differential equations using the method of separation of variables