SOPHIA COLLEGE, (AUTONOMOUS)

Affiliated to

UNIVERSITY OF MUMBAI

Programme: Mathematics

Programme Code:

Theory Course Code : SMAT111MN

Practical Course Code: SMAT111MNP

F.Y.B.S.C

(Syllabus for the Academic Year 2023-2024 based on the National Education Policy 2020)

Programme Outline: FYBSc (SEMESTER I)

Course Code	Unit No	Name of the Unit	Credits
SMAT111MN		CALCULUS-1	3
	1	Real Number System	
	2	Limits of a real valued function	
	3	Continuous functions	
SMAT111MNP		MATHEMATICS PRACTICALS	1
	1.	Calculus-1 based on the syllabus.	

Programme Outline: FYBSc (SEMESTER II)

Course Code	Unit No	Name of the Unit	Credits
SMAT111MN		CALCULUS-2	3
	1	Differentiation of real valued function of one variable	
	2	Applications of differentiation	
	3	Mean Value Theorems and their Applications	
SMAT111MNP		MATHEMATICS PRACTICAL	1
	1.	Calculus-2 based on the syllabus.	

Preamble:

Many people believe that mathematics is one of the most challenging subjects to learn in school. However, it is still very important in today's world. Mathematics is crucial to comprehending and resolving issues that arise in our daily lives, from the sophisticated systems that run our society to the everyday devices we utilise.

An essential component in the continual development of science and technology has been mathematics. The number of applications of mathematics used in practical problems has grown significantly in recent decades. The F.Y.B.Sc. Mathematics syllabus for Semesters I and II have been designed to demonstrate to students the fundamental concepts of mathematics while exposing them to rigorous techniques systematically. Calculus is applied and necessary in every potential field of study. Discrete Mathematics and Algebra encourage logical and mathematical reasoning.

Today, mathematics is an important instrument in many areas, including natural science, engineering, medicine, and the social sciences, used extensively throughout the world. New mathematical discoveries are inspired by and implemented by applied mathematics, the area of mathematics that deals with transferring mathematical knowledge to other domains.

PROGRAMME OBJECTIVES

PO 1	To develop in the learner a scientific temperament, critical thinking and logical reasoning.
PO 2	Along with domain knowledge of several disciplines in the scientific stream, to develop among the learners, the fundamental practical skills towards technical proficiency.
PO 3	To enable the students to gain employability in various professional courses, meet the requirements for industrial professions, and have an opportunity of pursuing entrepreneurship.

PO4	To enable the learners to comprehend a wide range of social and environmental challenges and develop solutions-oriented strategies to issues through numerical and analytical skills.

PROGRAMME SPECIFIC OUTCOMES

PSO 1	The learner will be able to use logical and critical thinking abilities in problem solving and develop the habit of self-learning by the end of the course.
PSO 2	The learner will be able to create and apply quantitative models that emerge in business, social science, and other areas.
PSO 3	The learner will be able to analyse the abstract mathematical concepts and use them to solve numerous issues that arise in various areas of mathematics and associated disciplines
PSO 4	The learner will be able to identify trends and make a distinction between the problems' core components and non-essential ones.
PSO 5	The learner will be able to utilise technological expertise to address certain theoretical and applied issues in mathematics and other fields.
PSO 6	The learner will be able to convert verbally supplied information into a mathematical form, choose and use the proper mathematical formulas or techniques to process the information, and then make the necessary conclusion.
PSO 7	The learner will be able to recognise the relationships between different areas of mathematics and the connections between mathematics and other disciplines.

SEMESTER 1

NAME OF THE COURSE	CALCULUS-1		
CLASS	FYBSC		
COURSE CODE	SMAT111MN		
NUMBER OF CREDITS	3		
NUMBER OF LECTURES PER WEEK	3		
TOTAL NUMBER OF LECTURES PER SEMESTER	45		
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION	TOTAL
TOTAL MARKS	50	50	100
OVERALL PASSING MARKS	-	-	40

COURSE OBJECTIVES:

CO 1.	To enable the learner to become familiar with the fundamental properties of the real number system and its subsets, which form the basis of real analysis.
CO 2.	To enable the learner to have a thorough understanding of functions, a key building block of all sciences, and the ability to assess a function's properties and draw its graph.
CO 3.	To enable the learner to comprehend the ideas of a function's limit and continuity, and to use the results of limits to find solutions to real-world issues.

COURSE LEARNING OUTCOMES:

CLO 1.	The learner will be able to recall the meanings of the terms supremum, infimum, bounded sets, neighbourhoods, interior points, limit points, intervals, and their attributes and compute the values for a subset of IR.
CLO 2.	The learner will be able to understand the various properties of the given function and draw the graph of the functions.
CLO 3.	The learner will be able to define the limit of a function and to gauge if the function is continuous or not.
CLO 4.	The learner will also apply the concepts and applications of the limits and continuous functions.

UNIT 1	Real Number System (15 LECTURES)
1.1	Real number system R and order properties of R, Absolute values and its properties.
1.2	AM-GM inequality, Cauchy-Schwarz inequality, Intervals and neighbourhoods, Hausdorff's property.
1.3	Bounded sets, l.u.b and g.l.b, l.u.b. axiom and its consequences, Archimedean property and its applications, density of rationals and irrationals.
UNIT 2	Functions In Real Number Systems: (15 LECTURES)

2.1	Definitions – Function, Domain and range of a function, direct image and inverse image of a function, injective function, surjective function, bijective function, composite of two functions (when defined), Inverse of a bijective function.
2.2	Graphs of some standard functions such as IxI; e^x; log x; ax^2+bx+c; 1/x, x^n ($n < 4$); sin x; cos x; tan x; x sin(1/x); x^2 sin(1/x), step functions over suitable intervals of R:
2.3.	Definition and examples of limit of a function, left-hand-limit, right-hand-limit, uniqueness of limit if it exists, algebra of limits, limit of composite function, sandwich theorem, non-existence of limits.
UNIT 3	Limits and Continuity: (15 LECTURES)
3.1	Definition and examples of limit of a function, left-hand-limit, right-hand-limit, uniqueness of limit if it exists, algebra of limits, limit of composite function, sandwich theorem, non-existence of limits.
3.2	Continuity of a real valued function on a set in terms of limits, examples, Continuity of a real valued function at end points of domain. Algebra of continuous functions, Discontinuous functions, examples of removable and essential discontinuity.
3.3	Intermediate value theorem and its applications, Bolzano-Weierstrass theorem; Continuity on closed and bounded intervals.

Main Reference:

- T. M. Apostol, Calculus Volume I, Wiley & Sons (Asia) Pte. Ltd.
- James Stewart, Calculus, Third Edition, Brooks/cole Publishing Company, 1994.
- Ajit Kumar-S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014.

Additional Reference Books:

- R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
- K.G. Binmore, Mathematical Analysis, Cambridge University Press, 1982.
- R.G. Bartle- D.R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 1994.
- Richard Courant-Fritz John, A Introduction to Calculus and Analysis, Volume I, Springer.
- Ghorpade, Sudhir R.- Limaye, Balmohan V., A Course in Calculus and Real Analysis, Springer International Ltd, 2000.
- G.B. Thomas and R. L. Finney, Calculus and Analytic Geometry, Ninth Edition, Addison Wesley, 1998.

NAME OF THE COURSE	MATHEMATICS PRACTICALS	
CLASS	FYBSC	
COURSE CODE	SMAT111MNP	
NUMBER OF CREDITS	2	
NUMBER OF LECTURES PER WEEK	2	
TOTAL NUMBER OF LECTURES PER SEMESTER	30	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	-	50
PASSING MARKS	-	20

UNIT 1	Calculus-1 (15 LECTURES)
1.1	Absolute value of real numbers
1.2	Application of Archimedean property, intervals, neighbour-hood.
1.3	Consequences of l.u.b. axiom, infimum and supremum of sets.
1.4	Functions.
1.5	Limits, finding the Left- and Right-hand limit of the function
1.6	Continuous and discontinuous functions.
1.7	Applications of Intermediate Value theorem and Bolzano's theorem.

ASSESSMENT DETAILS:

Internal Assessment (50 marks)

There will be two continuous assessments modes of 25 marks each .

Summative Assessment (50 marks)

The duration of the paper will be 2 hours.

There shall be four compulsory questions. Pattern of **Theory question** paper at the end of the semester for **each course**. .

Questions	Sub-questions	Maximum marks
Q1	Q1 – Q3 will be based on each unit. Part A: two theory sub-questions each one is of 6 marks and students will attempt any one. Part B: Three sub-questions, each one is of 4 marks and students will attempt any two.	14 each
Q2		
Q3		
Q4	There shall be 3 sub-questions covering all the units of the syllabus of 4 marks and students will attempt any 2.	8

Total marks	50

Practical Assessment

- The duration of the practical exam will be two hours.
- The students are allowed to appear for the practical examination only if
  - (i) the student's attendance in the practical session is minimum 75 percent.
  - (ii) the journal is certified.

Programme Outline: FYBSC (SEMESTER II)

SEMESTER 2

NAME OF THE COURSE	CALCULUS-2		
CLASS	FYBSC		
COURSE CODE	SMAT122MN		
NUMBER OF CREDITS	3		
NUMBER OF LECTURES PER WEEK	3		
TOTAL NUMBER OF LECTURES PER SEMESTER	45		
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION	TOTAL
TOTAL MARKS	50	50	100
OVERALL PASSING MARKS	-	-	40

COURSE OBJECTIVES:

CO 1.	To develop in the learner, an understanding of the concepts of derivative of a function.
CO 2.	To impart knowledge of the methods of finding the higher order derivative of the given function.
CO 3.	To enable the learner understands the applications of the derivative of a function.
CO 4.	To develop an understanding of the concepts and application of Mean Value theorems.

COURSE LEARNING OUTCOMES:

CLO 1.	The learner can find the derivative of a function on the set of real numbers.
CLO 2.	The learner will be able to find the higher order derivatives of the functions.
CLO 3.	The learner will be able to apply the various concepts of differentiation on the functions to find the nature of the function.
CLO 4.	The learner will be able to apply the concepts of Mean Value theorems and find the approximate value of the function at a certain point.

UNIT 1	Differentiation Of Real Valued Function Of One Variable (15 LECTURES)
1.1	Definition of differentiation at a point of an open interval, examples of differentiable and non-differentiable functions, relation between continuity and differentiability.
1.2	Algebra of differentiable functions. Chain rule, Derivative of inverse functions, Implicit differentiation
1.3	Higher order derivatives, Leibnitz rule for higher order derivatives.
UNIT 2	Applications of differentiation: (15 LECTURES)

2.1	Increasing and decreasing functions, definition of local maximum and local minimum, stationary points, first and second derivative test, examples.
2.2	Graph of functions using first and second derivatives, concave functions, points of inflection.
2.3.	Geometric Interpretation of Derivatives- applications such as rate of change in area and volume.
UNIT 3	Mean Value Theorem And Their Applications (15 LECTURES)
3.1	Rolle's theorem, Lagrange's and Cauchy's mean value theorems, applications and examples.
3.2	L'Hospital's Rule (statement only) Examples of finding limits of indeteminate forms.
3.3	Taylor's Mean Value Theorem and the applications.

Main Reference:

1. James Stewart, Calculus, Third Edition, Brooks/cole Publishing Company, 1994.
2. G.B. Thomas and R. L. Finney, Calculus and Analytic Geometry, Ninth Edition, Addison-Wesley.

Additional Reference Books:

1. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
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4. Richard Courant-Fritz John, A Introduction to Calculus and Analysis, Volume I, Springer.
5. AjitKumar-S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014.
6. Ghorpade, Sudhir R.- Limaye, Balmohan V., A Course in Calculus and Real Analysis, Springer International Ltd, 2000.

NAME OF THE COURSE	MATHEMATICS PRACTICALS	
CLASS	FYBSC	
COURSE CODE	SMAT122MNP	
NUMBER OF CREDITS	1	
NUMBER OF LECTURES PER WEEK	2	
TOTAL NUMBER OF LECTURES PER SEMESTER	30	
EVALUATION METHOD	INTERNAL ASSESSMENT	SEMESTER END EXAMINATION
TOTAL MARKS	-	50
PASSING MARKS	-	20

UNIT 1	Calculus-2 (15 LECTURES)
1.1	Differentiability of a function.
1.2	Higher order derivatives, Leibnitz theorem.
1.3	Maxima _ Minima and points of inflections
1.4.	Mean value theorems and its applications.
1.5.	Applications of Taylor's theorem and Taylors polynomials.
1.6.	L'Hospitals Rule.

ASSESSMENT DETAILS:

Internal Assessment (50 marks)
There will be two continuous assessments modes of 25 marks each .
Summative Assessment (50 marks)
The duration of the paper will be 2 hours.
There shall be four compulsory questions. Pattern of **Theory question** paper at the end of the semester for **each course**. .

Questions	Sub-questions	Maximum marks
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Q3		
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Total marks		50

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