AC – 20/04/2024
Item No. – 6.7 Sem. II (1a)

As Per NEP 2020

University of Mumbai

Syllabus for Basket of Minor	
Board of Studies in Mathematics	
UG First Year Programme	
Semester	**II**
Title of Paper	**Credits 2/ 4**
I) Calculus-I (Minor I)	
II)	
III)	
From the Academic Year	**2024-25**

Name of the Course: Calculus-I (Minor I)
(Sem II)

Sr. No.	Heading	Particulars
1	**Description the course:** **Including but not limited to:**	This course covers fundamental concepts in calculus and number theory. It includes a review of the real number system, graphing various functions, understanding limits, continuity, and exploring bijective functions. Additionally, the course delves into integers, divisibility, functions, and basic principles of induction, with applications to number theory, congruence, and theorems like Euler's and Fermat's.
2	**Vertical:**	Minor
3	**Type:**	Theory
4	**Credits:**	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives (CO):** (List the course objectives) This course gives introduction to basic concepts of Analysis with rigor and prepares students to study further courses in Analysis. In this course, importance is given to formal proofs which also enhances understanding of the subject of Mathematics as a whole. CO1. To give sufficient knowledge of fundamental principles, methods, and a clear perception of numerous powers of mathematical ideas and tools and the skills to use them by modelling, solving and interpreting. CO2. To reflect the broad nature of the subject and develop mathematical tools for continuing further study in various fields of sciences. CO3. To enhance students' overall development, problem solving skills, creative talent and power of communication are necessary for various kinds of employment. CO4. To give adequate exposure to global and local concerns that would help learners explore many aspects of Mathematical Sciences.	
8	**Course Outcomes (OC):** (List the course outcomes) After completion of the course, students will be able to OC1: learn graphical representation of functions and understand the concepts of limits and continuity of functions. OC2: explain the concept of limit and continuity of real valued functions and order, degree of differential equation. OC3: apply differential equations to solve real life problems.	

	OC4: verify existence of limit, continuity of a functions and solutions of differential equations. OC5: find the limits of various functions and integrating factors along with general solutions of differential equations. OC6: construct counter examples related to continuous and discontinuous functions etc.
9	**Modules** **Module 1: Graphs of Functions, Limits and Continuity of Real Valued Functions (15 Hours)**
	(1) Review of real number system, intervals, graphs of functions such that $\|x\|$, $\frac{1}{x}$, ax^2+bx+c, $\lfloor x \rfloor$ (flooring functions), $\lceil x \rceil$ (ceiling function), x^3, $sinx$, $cosx$, $tanx$, $\sin\left(\frac{1}{x}\right)$, $xsin\left(\frac{1}{x}\right)$ over suitable intervals. (2) Graphs of bijective function and its inverse. Examples such as x^2 and $x^{\frac{1}{2}}$, x^3 and $x^{\frac{1}{3}}$, $ax+b$ $(a \neq 0)$ and $\frac{1}{a}x-\frac{b}{a}$ over suitable domains. (3) (i) Idea of limits, algebra of limits. (ii) Sandwich theorem of limits (without proof). (iii) Limits at infinity and infinite limits. (4) (i) Continuity of a real valued function at a point in terms of limits, two sided limits, graphical representation of continuity, standard continuous functions like exponential, logarithmic, trigonometric, polynomial and rational functions. (ii) Continuity of a real valued function at end points of the domain. (iii) Discontinuity and its types. (iv) Algebra of continuous functions (without proof). (v) Intermediate value property (without proof).
	Module 2: First Order First Degree Differential Equations (15 Hours)
	Review of Definition of a differential equation, order, degree, ordinary differential equation, linear and non-linear ODE. Solution of homogeneous and non-homogeneous differential equations of first order and first degree. Notion of partial derivatives. Exact Equations: General solution of Exact equations of first order and first degree. Necessary and sufficient condition for $Mdx+Ndy=0$ to be exact. Non-exact equations: Rules for nding integrating factors (without proof) for non exact equations, such as: i) $\frac{1}{Mx+Ny}$ is an I.F. if $Mx+Ny \neq 0$ and $Mdx+Ndy=0$ is homogeneous. ii) $\frac{1}{Mx-Ny}$ is an I.F. if $Mx-Ny \neq 0$ and $Mdx+Ndy=0$ is of the form $f_1(x,y)\,y\,dx+f_2(x,y)\,xdy=0$. iii) $e^{\int f(x)dx}$ (resp $e^{\int g(y)dy}$) is an I.F. if $N \neq 0$ (resp $M \neq 0$) and $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ $\left(\frac{1}{M}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)\right)$ is a function of x (resp y) alone, say $f(x)$ (resp $g(y)$). iv) Linear and reducible linear equations of first order, finding solutions of first order differential equations of the type for applications to orthogonal trajectories, population growth, and finding the current at a given time.

10 **Text Books:**

1. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
2. K. G. Binmore, Mathematical Analysis, Cambridge University Press, 1982.
3. R. G. Bartle-D. R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 1994.
4. Sudhir Ghorpade and Balmohan Limaye, A course in Calculus and Real Analysis,Springer International Ltd, 2000.
5. George F. Simmons, Differential Equations with Applications and Historical Notes, Taylor's and Francis, Third Edition, 2017.

11 **Reference Books**

1. T. M. Apostol, Calculus Volume I, Wiley & Sons (Asia) Pte, Ltd.
2. Richard Courant-Fritz John, An Introduction to Calculus and Analysis, Volume I,Springer.
3. Ajit Kumar and S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014.
4. James Stewart, Calculus, Third Edition, Brooks/ cole Publishing Company, 1994.

Scheme of the Examination

The performance of the learners shall be evaluated in two parts.

- Internal Continuous Assessment of 20 marks.
- Semester End Examination of 30 marks.
- A separate head of passing is required for internal and semester-end examinations.

12 **Internal Continuous Assessment: 40%**
Semester End Examination: 60%

13 **Continuous Evaluation through:** Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc.
(at least 3)

Sr. No.	Particulars	Marks
1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10
2	Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.	05
3	Seminar/ group presentation on any one topic related to the syllabus.	05

Paper pattern of the Test (Offline Mode with

	One hour duration): Q1: Definitions/Fill in the blanks/ True or False with Justification. (04 Marks: 4 x 1). Q2: Attempt any 2 from 3 descriptive questions. (06 marks: 2 × 3)	

14 **Format of Question Paper:**

The semester-end examination will be of 30 marks of one hour duration covering the entiresyllabus of the semester. All questions are Compulsory.

Q.No.1	Module 1	A. Attempt any ONE out of TWO.(6 marks) (Theory) (OC1 and OC2) B. Attempt any TWO out of THREE (problems or theory) (4 marks) (OC 3, OC 4, OC 5)	10 Marks
Q.No.2	Module 2	A. Attempt any ONE out of TWO.(6 marks) (Theory) (OC1 and OC2) B. Attempt any TWO out of THREE (problems or theory) (4 marks) (OC 3, OC 4, OC 5)	10 Marks
Q.No.3	Module 1 and 2	Attempt any TWO out of FOUR.(10 marks) (Problems) (OC 5 & OC 6)	10 Marks

Sign of the BOS Chairman
Dr. Bhausaheb S Desale
The Chairman, Board of Studies in Mathematics

Sign of the Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science & Technology

Sign of the Offg. Dean
Prof. Shivram S. Garje
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