JAI HIND COLLEGE
BASANTSING INSTITUTE OF SCIENCE
&
J.T.LALVANI COLLEGE OF COMMERCE
(AUTONOMOUS)

"A" Road, Churchgate,Mumbai - 400 020, India.

Affiliated to
University of Mumbai

Program : B.Sc. Mathematics

Course: Calculus I

Semester I

Credit Based Semester and Grading System (CBSGS) with effect from the academic year 2021-22

F.Y. B.Sc. Mathematics Syllabus

Semester I			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SMAT 101	CALCULUS I	02	03

Semester I – Theory

SMAT 101	Calculus-I (Credits: 02 Lectures/Week:03)	Total lectures = 45
	Course Objectives: **1.** To introduce real numbers and subsets of reals such as set of rational numbers, set of irrational numbers. **2.** To understand the applications of differential equations **3.** To acquaint with properties of real numbers such as Density of rational numbers and irrational number, Hausdorff property, fundamental theorems in real analysis like Archimedean property, Bolzano-Weierstrass theorem **4.** To introduce the concept of sequence of real numbers and the notion of convergent sequences **Course Outcomes:** **1.** To enhance the analytical skills and bolster confidence and interest in pure mathematics. **2.** To enable students to formulate and solve problems from a mathematical perspective. **3.** To analyse and solve real-world problems using the concept of differential equations, fundamental theorems in real analysis,	
Unit I	**Differential Equations:** **1.** Solutions of homogeneous and non-homogeneous differential equations of first order and first degree, Notion of partial derivative, solving exact differential equations. **2.** Rules for finding integrating factor (I.F) (without proof) for non-exact equations such as: **3.** $(i)\frac{1}{Mx+Ny}$ is an I.F if $Mx + Ny \neq 0$ and $M\,dx + N\,dy$ is homogeneous **a.** $(ii)\frac{1}{Mx-Ny}$ is an I.F if $Mx - Ny \neq 0$ and $M\,dx + N\,dy$ **b.** is of the type $f_1(xy)y\,dx + f_2(xy)x\,dy$ **c.** $(iii)e^{\int f(x)\,dx}$ is an I.F if $N \neq 0$ and $\frac{1}{N}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right)$ is a **d.** function of x alone say $f(x)$. **e.** $(iv)e^{\int f(y)\,dy}$ is an I.F if $M \neq 0$ and $\frac{1}{M}\left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right)$ is a **f.** function of y alone say $f(y)$. **4.** Finding solutions of first order differential equations of the type $\frac{dy}{dx} + P(x)y = Q(x)y^n$ for $n \geq 0$. Applications to orthogonal trajectories, population growth, and finding the current at a given time.	**15L**
Unit II	**Real Numbers:** 1. Real number system $\mathbb{R}$ and order properties of $\mathbb{R}$, Elementary consequences of these properties including AM-GM inequality. 2. Absolute value function (modulus) on $\mathbb{R}$, Examples and basic properties. 3. Triangle inequality, Intervals and neighbour hoods. 4. Bounded sets of real numbers, Supremum (l.u.b) and Infimum (g.l.b), l.u.b and g.l.b property and its applications 5. Archimedean property and its applications like Density theorem, nested interval theorem, existence of square root of 2	**15L**
Unit III	**Sequences** **1.** Definition of a sequence and examples, Convergence and divergence of sequences, Convergent sequence is bounded, Uniqueness of limit if it exists.	**15L**

	Examples on convergence of a sequence using ϵ-n_0 definition. **2.** Sandwich theorem, Algebra of convergent sequences, Examples. **3.** Bounded sequences, Monotone sequences and their convergence. **4.** Standard examples such as $a^n, \frac{a^n}{n!}, \left(1+\frac{1}{n}\right)^n, 1+\frac{1}{1!}+\frac{1}{2!}+\cdots+\frac{1}{n!}, a^{\frac{1}{n}}(a>0), n^{\frac{1}{n}}$ **5.** Cauchy sequences and their convergence, sub sequences and their convergence, Bolzano-Weierstrass theorem.	

References:

1. Dennis Zill, A first course in differential equations with modelling applications, Brooks/Cole ninth edition, 2012.
2. R.G.BartleandD.R.Sherbert,Introductiontorealanalysis,JohnWileyandSons, third edition, 2010
3. Ajit Kumar and S.Kumaresan, A basic course in real analysis, CRC press 2014.

Additional References:

1. G.F. Simmons, Differential equations with applications and historical notes, McGraw Hill, 1972.
2. R.R. Gold berg , Method of real analysis, Oxford and IBH,1984.
3. T.M. Apostol, Calculus Volume I, second edition, Wiley and Sons (Asia), 1967.
4. K.G. Binmore, Mathematical Analysis, Cambridge university press, 1984.

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Program : B.Sc. Mathematics

Course: Algebra I

Semester I

Credit Based Semester and Grading System (CBSGS) with effect from the academic year 2021-22

F.Y. B.Sc. Mathematics Syllabus

Semester I			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SMAT 102	ALGEBRA I	02	03

Semester I

SMAT 102	**Algebra I** **(Credits: 02 Lectures/Week:03)**	**Total no. of Lectures = 45**
	Course Objectives: **1.** To introduce the concepts of sets, functions and relation, bijective functions and to get an idea of graph of a function. **2.** To understand the concept of divisibility in integers and the principle of mathematical induction. **3.** Toacquire the knowledge of theory of congruences and its applications like Euler's theorem, Fermat's little theorem, Wilson's theorem **Course Outcomes:** **Students will be able to:** **1.** Explain the basic concepts like sets, functions, relations, equivalence relations etc. **2.** Apply different techniques of proving theorems, lemmas using induction, proof by contradiction etc. **3.** To solve divisibility in integers, divisional gorithm, Euclidean algorithm and Linear Diophantine equation. **4.** To assess the parameters of equivalence relation, equivalent classes, definition of partition, Euler's function, Chinese remainder theorem and its applications.	
Unit I	**Sets and Functions:** **1.** Negation of a statement, use of quantifiers, sets, union and intersection of sets, complement of a set, De Morgan's law, Cartesian product of sets. **2.** Definition of a function; domain, co-domain and range of a function, composite functions, examples, Graph of a function, Injective, surjective, bijective functions; composite of injective, surjective, bijective functions when defined. **3.** Invertible functions, bijective functions are invertible and conversely. Examples of functions including constant, identity, projection, inclusion. **4.** Image and inverse image of a set under f interrelated with union, intersection and complement. Finite and infinite sets. Countable set and its examples such as $\mathbb{Z}$, $\mathbb{Q}$ .Uncountable set and its examples.	**15L**
Unit II	**Integers and Divisibility:** **1.** Well-ordering property, First and second principle of mathematical induction as a con-sequence of well-ordering property **2.** Divisibility in integers, division algorithm, existence uniqueness of greatest common divisor (g.c.d.) and least common multiple (l.c.m.) and their basic properties. Bezout's identity and its applications. **3.** Euclidean algorithm, Primes, Euclid's lemma, Fundamental theorem of arithmetic, the set of primes is infinite. **4.** The necessary and sufficient condition to have a solution for the linear Diophantine equation$ax + by = c$. Solving of linear Diophantine equations with examples.	**15L**
Unit III	**Theory of Congruences:** **1.** Equivalence relation, equivalence classes and properties, Definition of a partition, everypartitiongivesanequivalencerelationandviceversa.Congruences,definitionandelementary properties, Congruence is an equivalence relation on $\mathbb{Z}$, residue classes and partition of $\mathbb{Z}$,addition modulo$n$, multiplication modulo$n$, examples **2.** Linear congruences. Chinese remainder theorem and its applications **3.** Euler's φfunction, Euler's theorem, Fermat's little theorem, Wilson's theorem and their applications.	**15L**

References:

1. S. Kumaresan, Ajit Kumar and Bhaba Kumar Sarma, A foundation course in Mathematics, first edition, Narosa publication house, 2018.
2. David M. Burton, Elementary number theory, seventh edition, Tata McGraw-Hill edition, 2011

Additional References:

1. Ivan Niven, Herbert S. Zuckerman, Introduction to the theory of numbers, fifth edition, Wiley eastern limited, 2008
2. R.G. Bartle and D.R. Sher bert, Introduction to real analysis, third edition, John Wiley and Sons, 2010
3. Jones and Jones, Elementary number theory, second edition, Springer, 2011
4. I.S. Luthar, Sets, functions and numbers, Narosa publishing house, 2005
5. Thomas Koshy, Elementary number theory with applications, Academic press, 2007

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Course: Practical I

Semester I

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F.Y. B.Sc. Mathematics Syllabus

Semester I			
Course Code	**Course Title**	**Credits**	**Lectures /Week**
SMAT1 PR1	PRACTICAL-I	02	02

Semester I – Practical

Course Code: SMAT1 PR1	Course Title: PRACTICAL-I	Credits: 2

Course Objectives:

- To acquire the knowledge of applications of Euler's theorem, Fermat's little theorem, Wilson's theorem
- To acquaint with Density of rational numbers and irrational number, Hausdorff property, fundamental theorems in real analysis like Archimedean property, Bolzano-Weierstrass theorem

Course Outcomes

- To assess the parameters of equivalence relation, equivalent classes, definition of partition, Euler's function, Chinese remainder theorem
- To solve real-world problems using the concept of differential equations, fundamental theorems in real analysis,

Practical for Calculus I

1) Problems based on absolute value and properties of $\mathbb{R}$.
2) Problems on bounded sets and Archimedean property.
3) Problems on convergent sequences.
4) Problems based on sub sequences and Cauchy sequences.
5) Solving exact and non-exact differential equations.
6) Solving linear differential equations, Bernoulli's differential equations and its applications.

Practical for Algebra I

1) Functions (image and inverse image), injective, surjective, bijective functions, finding inverses of bijective functions.
2) Problems on countability.
3) Problems on mathematical induction, Euclidean algorithm in $\mathbb{Z}$.
4) Problems on fundamental theorem of arithmetic and solving linear Diophantine equations.
5) Problems on congruences, equivalence relation and Chinese remainder theorem.
6) Problems on Euler's φ function, Fermat's little theorem, Wilson's theorem.

Evaluation Scheme

I. Continuous Assessment (C.A.) - 40 Marks

C.A.-I : Test (MCQ) – 20 Marks

C.A.-II: Assingnment /Project- 20 Marks

II. Semester End Examination (SEE) - 60 Marks