
HSNC
UNIVERSITY
MUMBAI

HSNC University Mumbai

(2020-2021)

Ordinances and Regulations

With Respect to

Choice Based Credit System

(CBCS)

For the Programmes Under

The Faculty of Science and Technology

For the Course

Mathematics

Curriculum – First Year Undergraduate Programmes

Semester-I and Semester -II

2020-2021

Section D

Mathematics

Part 1- Preamble

The subject of Pure Mathematics is one of the most original creation of the human mind. It is a contemporary subject whose concepts and methodologies are being used by Physicists, Statisticians, Computer Scientists, Chemists, Biologists, Economists and financial advisors to name a few.

This proposed curriculum is drafted with a view to create an option for B.Sc. in both Pure and Applied Mathematics.

There are two courses of Mathematics for Science students at the F.Y.B.Sc. level in Semesters I as well as II.

The assignments, projects which will be part of internal assessment aims to improve the problem solving ability of the learners and also their ability to do teamwork. It will help the learner to get an in depth understanding of the topic. The presentations which will be part of the internal assessment will improve presentation and interpersonal communication skills.

In addition to traditional problem-solving sessions, there will be few hands-on training sessions using Computer Algebra System (CAS)like SageMath.

1. Course Objectives:

Imparting knowledge to the students on very important basic concepts of Pure Mathematics in Calculus and Discrete Mathematics which are applied and needed in various branches of science and humanities.

Giving a broad overview and introduction to the nature of the subject and develop Mathematical tools for continuing further study in various other disciplines.

2. Process adopted for curriculum Designing:

After several rounds of discussion, at the departmental level, the members of the Department of Mathematics drafted the syllabus. The draft syllabus was shown to Industry Partners, Academic Partners and Research Institute Partners, through meetings and mails They suggested some changes. These changes were incorporated.

3. Salient features, how it has been made more relevant.

The subject of Mathematics is the blend of Pure Mathematics and applied mathematics. Apart from the theorems and proofs which gives them better understanding of the basic concepts in mathematics, we have added practical sessions with CAS like SageMath, which will teach them how to use mathematics as a tool in real life problems without doing rigorous theory and tedious calculations.

The course would give the learners option to develop skills in areas which have direct relevance to employability in industry, finance, banking and computer software designing apart from research in mathematics and teaching profession.

4. Learning Outcomes:

The learner's understanding and problem-solving skills on the basic mathematical concepts of Calculus and Discrete Mathematics will get enhanced and they will start developing affinity for the subject of Mathematics.

The learner's mathematical abilities will be enhanced due to in depth study of Logic and they will gradually be able to use appropriate mathematical language: notations, symbols, terminology, in both oral and written explanations.

Since the theory of Mathematics has been applied using CAS techniques and numerical methods, the Learner's ability to synthesize the acquired knowledge, understanding and experience for a better and improved comprehension of the real-life problems will enhance.

The learner will be able to mathematically formulate problems arising in the other subjects like Physics, Statistics, Operations Research, Law, Economics and also will be able to solve these problems applying the mathematical tools learnt.

The introduction of the self learning of certain topics will enhance the learners' ability to understand, apply and experiment ,which can give them the ability to think differently

The learner will be ready with the knowledge of computer software which will enhance the job opportunities.

5. Input from stakeholders:

As per the suggestions given by the stake holders following changes were made in the draft syllabus.

The Unit I: Differential Equations in Semester II (Calculus II) in the draft syllabus has been shifted to Semester I (Calculus I) and Limits and Continuity has been shifted to Semester II (Calculus II).

Existence of square root of a non-square positive integer in Unit II SEM I has been added.

In Semester I (Discrete Mathematics I) the concept of Family of set has been added.

The Semester II, Course II (Linear Algebra I) has been replaced by a Course on Discrete Mathematics (Discrete Mathematics II).

Part2. The Scheme of Teaching and Examination

Semester – I

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (Mathematics)			US-FMA-101, US-FMA- 102, US-FMA- 1P1	
2	Elective Course	Discipline Specific Elective (DSE) Course			
		2.1	Interdisciplinary Specific Elective (IDSE) Course		
		2.2	Dissertation/Project		
		2.3	Generic Elective (GE) Course		
3	Ability Enhancement Courses (AEC)				
	Skill Enhancement Courses (SEC)				

First year Semester-I Internal and External Assessment

Detail Scheme:

Sr. No.	Subject Code	Subject Title	Periods Per Week		Seasonal Evaluation Scheme	Total Marks

			Units	S. L.	L	T	P	Credit	S. L. E	CT	TA	SEE	
1	US-FST-101	Calculus I	3	20% *	3	0	0	2	10	20	10	60	100
2	US-FST-102	Discrete Mathematics I	3	20% *	3	0	0	2	10	20	10	60	100
3	US-FST-P-1	Practical Sessions Based US-FMA--101 + Practical Sessions Based US-FMA—102			0	0	6	2				100 (80+20)	100
	Total Hours / Credit							06	Total Marks				300

One to two lectures to be taken for CONTINUOUS self-learning Evaluation.

Semester – I Units – Topics – Teaching Hours

S.N	Subject Code	Subject Unit Title		Hours /Lectures	Total No. of hours/lectures	Credit	Total Marks
1	US-FMA-101	I	Ordinary Differential Equations	15	45 L	2	100 (60+40)
		II	Real Number System	15			
		III	Sequences	15			
2	US-FMA-102	I	Elementary Logic and Naive Set Theory	15	45L	2	100 (60+40)
		II	Integers and Divisibility	15			
		III	Relations and Functions	15			

3	US-FMA-P-1	I	Practical sessions based on US-FMA-101	3	45x2= 90L lectures per batch	2	100 (80+10 +10)
		II	Practical sessions based on US-FMA-102	3			
			TOTAL			6	300

- **Lecture Duration – 45 Minutes = 0 .75 Hours. (45 Lectures equivalent to 33.75 hours)**
- **One Credit =16.87 hours equivalent to 17 Hours**

Part3: Detail Scheme Theory

F.Y.B.SC. MATHEMATICS SYLLABUS

(SEMESTER BASED CREDIT AND GRADING SYSTEM)

TO BE IMPLEMENTED FROM THE ACADEMIC YEAR 2020

Curriculum Topics along with Self-Learning Topics - to be covered, through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT

CourseI: Course Code: US-FMA-101

Title of course: Calculus I Total credits 02

Unit	Content	**No. of Lectures**
1	**1. Ordinary Differential Equations**	

2	1.1 Definition of a differential equation, order, degree, ordinary differential equation and partial differential equation, linear and nonlinear ODE. 1.2 Existence and Uniqueness Theorem for the solution of a second order initial value problem (statement only). 1.3. Methods for solving first order ordinary differential equation. (homogeneous, nonhomogeneous, linear, Bernoulli's equations) 1.4. Exact equation, General Solution of Exact equation of first order and first degree, Necessary and sufficient condition for M dx + N dy = 0 to be exact. Non-exact equations. Rules for finding integrating factors (without proof) for non-exact equations 1.5. Applications of first order ordinary differential equation.	**15**
	2. Real Number System 2.1 The Algebraic and Order properties of $\mathbb{R}$, Absolute value and its properties. 2.2 AM-GM inequality, Cauchy-Schwarz inequality, Intervals and neighborhoods, Hausdorff property. 2.3. Bounded sets, Greatest lower bound (Supremum) and Least upper bound (infimum) of subsets of IR, Maximum and minimum, l.u.b. axiom (Order Completeness axiom) and its consequences, Existence of square root of any nonnegative integer. 2.4 Archimedean property and its applications, The Density Theorem. 2.5 Nested Interval Property.	**15**
3	**3.Sequences**	**15**

3.1 Definition of a sequence and examples, convergence of a sequences, relation between convergent sequence and bounded sequence. Limit of a convergent sequence and uniqueness of limit, Divergent sequences.

3.2 Convergence of standard sequences like $\left(\frac{1}{1+na}\right) \forall\ a > 0$, (b^n) $\forall$ $0 < b < 1$, $\left(c^{\frac{1}{n}}\right) \forall\ c > 0$ &$\left(n^{\frac{1}{n}}\right)$. Algebra of convergent sequences, Sandwich (Squeeze) theorem,

3.3 monotone sequences, monotone convergence theorem and consequences such as convergence of $\left(\left(1+\frac{1}{n}\right)^n\right)$.

3.4Subsequences, subsequence of a convergent sequence is convergent and converges to the same limit

3.5Cauchy sequences. Every convergent sequence is a Cauchy sequence and converse.

3.6 Bolzano–Weierstrass' Theorem.

Self-Learning topics (Unit wise)

Unit	**Topics**
1	1.1 Definition of a differential equation, order, degree, ordinary differential equation and partial differential equation.
1	1.4. Exact: General Solution of Exact equations of first order and first degree, Necessary and sufficient condition for M dx + N dy = 0 to be exact. Non-exact equations. Rules for finding integrating factors (without proof) for non-exact equations
2	2.3Bounded sets, Greatest lower bound(Supremum) and Least upper bound(infimum)of subsets of IR, l.u.b. axiom (Order Completeness axiom)

3	3.1. Definition of a sequence and examples, Convergence of sequences, every convergent sequence is bounded. Limit of a convergent sequence and uniqueness of limit, Divergent sequences.
3	3.5Cauchy sequences. Every convergent sequence is a Cauchy sequence and converse.

Online Resources

1."Differential Equation for engineers "by Prof. Srinivasa Manam, https://nptel.ac.in/courses/111/106/111106100/ lecture 1,2,3,4,7

1)Basic Real Analysis' **by Prof. I K Rana , IIT Mumbai**

https://nptel.ac.in/courses/111/101/111101134/ lectures ,3,4,5,6

Subject to change if any new relevant course is available .

Reference Books

1. Differential equations with applications and historical notes, by G. F. Simmons,

McGraw Hill (unit1)

2.Introduction to Real Analysis -R. G. Bartle- D. R. Sherbert,, John Wilely & Sons, 1994,Chapter2., 3.1,3.2,3.3,3.4,3.5,3.6,(Unit2,3)

3.Numerical methods by E Balaguruswamy

4. A Basic Course in Real Analysis, Ajit kumar, S. Kumaresan, CRC Press, 2014.

5. Calculus and Analytic Geometry, Thomas and Finny ,9th edition

6. Calculus ,T.M. Apostol, Volume I, Wiley & Sons (Asia) Pte, Ltd.

7. Calculus ,James Stewart, , Third Edition, Brooks/ cole Publishing Company, 1994

8. An introduction to ordinary differential equations E. A. Coddington,

CourseII : Course Code: US-FMA-102

Title of course: Discrete Mathematics I Total credits: 02

Unit	Content	**No. of Lectures**
1	**1**: **Elementary Logic and Naive Set Theory (15 Lectures)**	
	1.1. Propositions and Logical Connectives (Negation, Conjunction, Disjunction, Conditional, Biconditional), Types of Propositions, Truth values and Truth Tables, Tautology and Contradiction, Logical equivalence (Inverse, Converse and Contrapositive), Quantifiers (Universal and Existential), Negation of Quantifiers.	15
	1.2. Sets, the universal set and the empty set, describing sets (Roaster and Set Builder notations), Subsets, Union, intersection and Cartesian Product of Sets. Some standard sets ($\mathbb{N}$, $\mathbb{Z}$, $\mathbb{W}$, $\mathbb{Z}^+$, $\mathbb{R}$, Q, Q', $\mathbb{C}$). Finite, Infinite, Denumerable, Countable and Uncountable sets (definitions and examples only). Family of sets.	
2	**Unit II**: **Integers and Divisibility (15 Lectures)**	
	2.1. Well Ordering Property (W.O.P) for N / W. Mathematical Induction: First and second principles of Induction with examples.	**15**
	2.2 Divisibility in Z: Definition and elementary properties. Division Algorithm, G.C.D. and L.C.M of two integers. Basic properties of G.C.D. including G.C.D. for any two integers a and b if it exists, is unique, and can be expressed as ua+vb. Euclidean Algorithm.	

2.3. Primes. Euclid's Lemma, Unique Factorization Theorem. Examples.

2. 4. Congruences: Definition and elementary properties. Examples.

3 **Unit III: Relations and Functions (15 Lectures)**

3.1. Definition of a Relation with examples. Definition of function as a Relation.
Domain, co domain and the range of a function. Direct and inverse images.
Injective, surjective and bijective functions. Composite and inverse functions.

15

3.2. Equivalence relations, Equivalence classes, properties such as two equivalences classes are either identical or disjoint, Definition of a partition, every partition gives an equivalence relation and vice versa.

3.3 Congruence relation as an equivalence relation on Z. The set Zn, of residue classes modulo n under addition and multiplication modulo n. Addition and multiplication and inverse in Zn.

Self-Learning topics (Unit wise)

Unit	Topics
1	1. 1 Propositions and Logical Connectives (Negation, Conjunction, Disjunction, Conditional, Biconditional), Types of Propositions, Truth values and Truth Tables, Tautology and Contradiction, Logical equivalence (Inverse, Converse and Contrapositive), Quantifiers (Universal and Existential), Negation of Quantifiers.

1	1.2 Sets, the universal set and the empty set, describing sets (Roaster and Set Builder notations), Subsets, Union, intersection and Cartesian Product of Sets.

Online Resources

1. 'Discrete Mathematics', by Prof. Sourav from Chennai Mathematical Institute, available on Swayam-NPTEL portal https://nptel.ac.in/courses/111/106/111106086/

*Subject to change if any new relevant course is available.

Reference Books:

1. Elementary Number Theory: David Burton; Tata McGraw Hill

2. Discrete Mathematics: Norman L. Biggs, second Edition, Oxford University Press

3. A Foundation Course in Mathematics: Ajit Kumar, S. Kumaresan, Bhabha Kumar Sarma

Course -I- Practical Total Credit: 01

Title of Paper: **Calculus– I**

Course Code:US-FMA-P101			
Unit	Content	No. of Lectures	Reference Books
I	1. Solving differential equations of first order, first degree. 2. Solving exact differential equations, finding integrating factor and solving non-exact differential equations of first order, first degree. 3. Applications of first order ordinary differential equations.	03 Lectures per Practical per Batch	Reference No. 1, 2,3

II	4, Order axioms, intervals, neighborhood. Consequences of l.u.b axiom, infimum and supremum of set. 5. Application based examples of Archimedean property, Decimal representation using Nested Interval Theorem .		
III	3. Calculating limits of sequences, Cauchy sequences, 4. Monotone sequences, subsequences		

Course -II-Practical Total Credit: 01

Title of Paper: **Discrete Mathematics** I

Course Code:US-FST-P102			
Unit	Content	No. of Lectures	Reference Books
I	1. 1. Examples based on Elementary Logic 2. Examples based on Set Theory	03 Lectures per Practical per Batch	Reference No. 1, 2,3
II	3. Examples based on Mathematical Induction, Euclidean algorithm to find G.C.D. of integers, L.C.M. of integers. 4. Examples based on Primes and the Unique Factorization Theorem, Examples based on Congruence modulo n.		

III	5. Examples on Relations and Functions including finding direct image and inverse image of functions, injective, surjective, bijective functions, finding inverses of bijective functions. 6. Examples based on equivalence relations and partitions including examples on congruence relation modulo n.		

Online Reference (For Practical)
https://ajitmathsoft.wordpress.com/sagemath/

Part 5

First Year Semester – II

Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (Mathematics)			US-FMA-201, US-FMA-202, US-FMA-P-2	
2	Elective Course	Discipline Specific Elective (DSE) Course			
		2.1	Interdisciplinary Specific Elective (IDSE) Course		
		2.2	Dissertation/Project		
		2.3	Generic Elective (GE) Course		
3	Ability Enhancement Courses (AEC)				
	Skill Enhancement Courses (SEC)				

First year Semester-II Internal and External Assessment

Detail Scheme

Sr. No.	Subject Code	Subject Title	Periods Per Week						Seasonal Evaluation Scheme				Tot al Marks
			Unit s	S. L.	L	T	P	Credit	S. L. E	CT	TA	SEE	
1	US-FMA-201	Calculus-II	3	20% *	3	0	0	2	10	20	10	60	100
2	US-FMA-202	Discrete Mathematics-II	3	20% *	3	0	0	2	10	20	10	60	100
3	US-FMA-P-2	Practicals Based US-FMA--201 + Practicals Based US-FMA—202			0	0	6	2				100 (80 +20)	100
	Total Hours / Credit							06	Total Marks				300

***One to two lectures to be taken for self -learning Evaluation.**

First Year Semester – II Units – Topics – Teaching Hours

S.N	Subject Code	Subject Unit Title	Hours /Lectures	Total No. of hours/lectures	Credit	Tot al Marks

1	US-FMA-201	I	Continuity and Limits	15	45	2	100 (60+40)
		II	Differentiation of real valued function of one variable:	15			
		III	Applications of differentiation	15			
2	US-FMA-202	I	Preliminary Counting	15	45	2	100 (60+40)
		II	Advanced Counting	15			
		III	Introduction to Graph Theory	15			
3	US-FMA-P-2	I	Practicals based on US-FMA-201	3	45x2= 90 lectures per batch	2	100 (80+10 +10)
		II	Practicals based on US-FMA-202	3			
			TOTAL			6	300

Part6: Detail Scheme Theory

Curriculum Topics along with Self-Learning topics - to be covered, through self-learning mode along with the respective Unit. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT

CourseI: Course Code: US-FMA-201

Title of course: Calculus II Total credits 02

Unit	Content	**No. of Lectures**
1	**1.Continuity and Limits**	15

1.1Graphs of some standard functions such as absolute value function,

x^2,$ax^2 + bx + c$,$\frac{1}{x}$, tan x, sin x,cosx,$\sin^{-1}x$, x sin$\frac{1}{x}$, $x^2 \sin\frac{1}{x}$ over suitable intervals of $\mathbb{R}$.

1.2. Definition of Limit of a function, evaluation of limit of simple functions using the $\varepsilon-\delta$ definition, uniqueness of limit if it exists, algebra of limits, sandwich theorem, left-hand limit, right-hand limit, non-existence of limit.

1.3 Continuous functions: 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, Sequential continuity, limits of a composite function, Algebra of continuous functions, discontinuous functions, examples of removable and essential discontinuity.

1.4. Properties of continuous Function:

1.4.1. Boundedness theorem, Minimax Theorem

1.4.2. Intermediate value theorem

1.4.3 Applications of Intermediate Value Theorem, including Bisection
method to find approximate root of equation f(x)=0.

2 **Differentiation of real valued function of one variable:**

2.1 Review of limit definition of differentiation of real valued function
of one variable: Definition of differentiation at a point of an open interval using $\varepsilon - \delta$, one sided derivative.

2.2 Examples of differentiable and non-differentiable functions, differentiable functions are continuous but not conversely, chain rule. 15

2.3 Higher order derivatives, Leibnitz rule, Derivative of inverse functions.

4. Implicit differentiation (only examples)

3 **Applications of differentiation**

3.1 Definition of local maximum and local minimum, Absolute maximum, Absolute minimum, stationary(critical) points, second derivative test, examples, graphing of functions using first and second derivatives, convex, concave functions, points of inflection.

3. 2. Rolle's theorem, Lagrange's and Cauchy's mean value theorems, applications and examples, Monotone increasing and decreasing function, examples,

3.3. L-Hospital rule without proof, examples of intermediate forms, Taylor's theorem and its applications.

3.4. Numerical Solution for ordinary differential equation using Taylor series method, Euler's method, Runge-Kutta method of order second and fourth.

Self-Learning topics (Unit wise)

Unit	Topics
1	1.2. Definition of Limit of a function, evaluation of limit of simple functions using the $\varepsilon-\delta$ definition
1	**1.4.**1. Boundedness theorem, Minimax Theorem 1.4.2. Intermediate value theorem
3	3.4. Numerical Solution for ordinary differential equation using Taylor series method, Euler's method, Runge-Kutta method of order second and fourth .

Online Resources

1)"Calculus of One Real variable" by Prof Joydeep Dutta, IIT Kanpur https://nptel.ac.in/courses/109/104/109104124/Week1 lecture5,week 2 lectures1,2,3,4

2.Numerical Methods by Prof. Ameeya Kumar Nayak, Prof. Sanjeev Kumar by IIT Roorkee https://nptel.ac.in/courses/111/107/111107105/unit8 lecture1,2,3,4

Subject to change if any new relevant course is available.

Reference Books

1.Introduction to Real Analysis, John Wilely & Sons, 1994 by.R. G. Bartle-D. R. Sherbert, Chapter 4,5, (unit1) Chapter6:6.1(unit 2) 6.2,6.3,6.4(unit3)

2. A Basic Course in Real Analysis, Ajit kumar, S. Kumaresan, CRC Press, 2014.

3. Calculus and Analytic Geometry, Thomas and Finny ,9th edition

4. Calculus T.M. Apostol, Volume I, Wiley & Sons (Asia) Pte, Ltd.

5. Calculus James Stewart, , Third Edition, Brooks/ cole Publishing Company, 1994

6. Numerical methods by E Balaguruswamy. (unit1)

Course II: Course Code: US-FMA-202

Title of Course: Discrete Mathematics II Total credits :02

Unit	Content	**No. of Lectures**
1	**Unit I: Preliminary Counting** 1.1. Addition and Multiplication Principles, Counting sets of pairs, Two way counting. 1.2. Stirling numbers of second kind. Simple recursion formulae satisfied by S(n, k) for k = 1, 2, · · · , n − 1, n. 1.3. Pigeonhole principle: Simple, Extended and Strong form with examples, its applications to geometry.	15

1.4. Principle of Inclusion and Exclusion with applications.

2 **Unit II: Advanced Counting**

1.1 Permutation and combination of sets and multi-sets, circular permutations, emphasis on solving problems.

1.2 Binomial and Multinomial Theorem, Pascal's identity.

1.3 Recurrence Relations, definition of homogeneous, non-homogeneous, linear, non-linear recurrence relation, obtaining recurrence relations of Tower of Hanoi, Fibonacci sequence, etc. in counting problems, solving homogeneous as well as non-homogeneous recurrence relations by using iterative methods, solving a homogeneous recurrence relation of second degree using algebraic method proving the necessary result. **15**

1.4 Non-negative integer solutions of equation $x_1 + x_2 + \cdots + x_k = n$.

3 **Unit III: Introduction to Graph Theory**

3.1. Introduction to graphs: Types of graphs: Simple graph, Multigraph, pseudograph, directed graph, directed multigraph.

One example/graph model of each type to be discussed.

3.2. (i) Graph Terminology: Adjacent vertices, degree of a vertex, isolated vertex, pendant vertex in a undirected graph. **15**

(ii) The handshaking Theorem for an undirected graph. An undirected graph has an even number odd vertex.

3.3. Some special simple graphs: Complete graph, cycle, Wheel in a graph, Bipartite graph, Regular graph.

3.4. Representing graphs and graph isomorphism.

(i) Adjacency matrix of a simple graph.

(ii) Incidence matrix of an undirected graph.

(iii) Isomorphism of simple graphs.

3.5. Connectivity:

(i) Paths, circuit (or cycle) in a graph.

(ii) Connected graphs, connected components in an undirected graph, A strongly connected directed graph, A weakly connected directed graph. A cut vertex.

(iii) Connecting paths between vertices.

(iv) Paths and isomorphisms.

(v) Euler paths and circuits, Hamilton paths and circuits.

Dirac's Theorem, Ore's Theorem (Statement only).

(vi) Shortest path problem, The shortest path algorithm -

Degree sequence and Dijkstra's Algorithm.

Self-Learning topics (Unit wise)

Unit	Topics
3	3.1. Introduction to graphs: Types of graphs: Simple graph, Multigraph, pseudograph, directed graph, directed multigraph. One example/graph model of each type to be discussed.
3	3.2. (i) Graph Terminology: Adjacent vertices, degree of a vertex, isolated vertex, pendant vertex in a undirected graph.
3	3.3. Some special simple graphs: Complete graph, cycle, Wheel in a graph, Bipartite graph, Regular graph.

Online Resources

For Course II (Discrete Mathematics - II)

1. 'A course in Graph theory' available on UGC MOOCs portal

http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/39

Subject to change if any new relevant course is available.

Reference Books

1. Norman Biggs: Discrete Mathematics, Oxford University Press.

2. Richard Brualdi: Introductory Combinatorics, John Wiley and sons.

3. V. Krishnamurthy: Combinatorics-Theory and Applications, Affiliated East West Press.

4. Discrete Mathematics and its Applications, Tata McGraw Hills.

5. Applied Combinatorics: Allen Tucker, John Wiley and Sons.

6. Kenneth H. Rosen: Discrete Mathematics and Its Applications, McGraw Hill Edition.

7. Bernard Kolman, Robert Busby, Sharon Ross: Discrete Mathematical Structures, Prentice-
Hall India.

8. Norman Biggs: Discrete Mathematics, Oxford.

9. Douglas B. West: Introduction to Graph Theory, Pearson.

Course -I- Practical Total Credit: 01

Title of Paper: **Calculus– II**

Course Code:US-FMA-P101			
Unit	Content	No. of Lectures	Reference Books
I	1.Graph of standard functions from IR to IR		

	2.Limits and continuity 3.Intermediate value theorem and its applications including Bisection method.	03 Lectures per Practical per Batch	Reference No. 1, 2,3
II	4. Higher order derivatives, Leibnitz theorem.		
III	5. Applications of differentiation 6. Applications of Taylor's theorem including Newton Raphson method to solve equation f(x)=0. 7. Numerical Solution for ordinary differential equation using Taylor series method, Euler's method, Runge-Kutta method of order second and fourth.		

Course -II-Practical Total Credit: 01

Title of Paper: **Discrete Mathematics** II

Course Code:US-FST-P102			
Unit	Content	No. of Lectures	Reference Books
I	1. Problems based on Addition and multiplication Principle, counting sets of pairs, two ways counting. 2. Problems based on Stirling numbers of second kind. 3. Problems based on Pigeonhole principle. 4. Problems based on Principle of inclusion and exclusion	03 Lectures per Practical per Batch	Reference No. 6, 7, 9
II	1. Problems based on Permutation and combination of sets and multi-sets, circular permutations, emphasis on solving problems.		

	2. Problems based on Binomial and Multinomial Theorem, Pascal identity. 3. Problems based on Problems on Recurrence Relations. 4. Non-negative integer solutions of equation $x_1 + x_2 + \cdots + x_k = n$.		
III	1. Problems based on Types of Graphs and Graph terminology 2. Problems based on Handshaking Lemma and Representation of Graphs 3. Problems based on Isomorphism of Graphs. 4. Problems based on Graph Connectivity. 5. Problems based on Degree sequence and Dijkstra's algorithm 6. Miscellaneous Problems.		

Online Reference (For Practical)

https://ajitmathsoft.wordpress.com/sagemath/
