AS PER NEP 2020

S. R. D. S. P. Mandal's

Shri Pancham Khemraj Mahavidyalaya,

Sawantwadi-416510

(Autonomous)

Affiliated to University of Mumbai

Title of the program

B. Sc. (Mathematics)

1. F.Y. B. Sc. 2023-2024

2. S.Y. B. Sc. 2024-2025

Syllabus for

Semester I & Semester II

Reference: GR dated 16th May 2023 for Credit structure

University of Mumbai

S. R. D. S. P. Mandal's
SHRI PANCHAM KHEMRAJ MAHAVIDYALAYA
SAWANTWADI
(An Autonomous College)
DIST: SINDHUDURG- 416 510, MAHARASHTRA
DEPARTMENT OF MATHEMATICS
Syllabus

Sr. No.	Heading	Particulars
1.	Title of the Course	F. Y. B. Sc. MATHEMATICS (MINOR COURSE)
2.	Eligibility for Admission	H. S. C. with Science Stream
3.	Passing Marks	40%
4.	Ordinance/Regulations (if any)	-
5.	No. of Years/Semesters	Two Semesters
6	Level	UG
7	Pattern	Semester (60:40)
8	Status	Revised
9	To be implemented from Academic Year	4.5 Certificate 2023-2024 5.0 Diploma 2024-2025

Date: 21/12/2023

HoD,
Dept. of Mathematics

S. R. D. S. P. Mandal's

Shri Pancham Khemraj Mahavidyalaya, Sawantwadi (Autonomous)

Sr. No.	Name of the Faculty	Category	Designation	Signature
01	Dr. Vishwas Pandurang Sonalkar	12.5 (1)	HoD/ Chairman	
02	Miss. Tanvi Dilip Shinde	12.5 (2)	Member	
03	Miss. Gayatri Rajesh Awate		Member	
04	Dr. Kishor D. Kucche	12.5 (3)	Member	
05	Dr. Jervin Zen Lobo		Member	
06	Dr. Shridhar Krishna Pawar	12.5 (4)	Member	
07	Asst. Prof. Sagar Balavant Patil	12.5 (5)	Member	
08	Miss. Shreya Shripad Bhagwat	12.5 (6)	Member	
09	Dr. Subhash Ishwar Unhale	12.5 (7)	Member	

Preamble

1. Introduction:

Shri Pancham Khemraj Mahavidyalaya, Sawantwadi (Autonomous) believes in implementing several measures to bringequity, efficiency and excellence in higher education system in conformity to the guidelines laid down by the University Grants Commission (UGC). In order to achieve these goals, all efforts are made to ensure high standards of education by implementing several steps to enhance the teaching- learning process, examination and evaluation techniques and ensuring the all-round development oflearners.

The institute has brought into force the revised syllabi as per the Choice Based Credit System (CBCS) for the First year B. Sc. in Mathematics from the academic year 2023-2024. Mathematics has been fundamental to the development of science and technology. In recent decades, the extent of application of Mathematic s to real world problems has increased by leaps and bounds. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects like Physics, Statistics and Computer Sciences, the board of studies in Mathematics with concern of teachers of Mathematics from different colleges affiliated to University of Mumbai has prepared the syllabus of F.Y.B. Sc. Mathematics. The present syllabi of F. Y. B. Sc. for Semester I and Semester II has been designed as per U. G. C. Model curriculum so that the students learn Mathematics needed for these branches, learn basic concepts of Mathematics and are exposed to rigorous methods gently and slowly. The syllabi of F. Y. B. Sc. Mathematics would consist of two semesters and each semester would comprise of two courses. Course I is 'Calculus I and Calculus II'. Calculus is applied and needed in every conceivable branch of science. Course II, 'Algebra I and Discrete Mathematics' develops mathematical reasoning and logical thinking and has applications in science and technology. The practical course has been designed to help the student have a firm grip on the theoretical concepts through relevant experiments in each course.

2. Aims and Objectives:

- To provide learners sufficient knowledge of fundamental principles, methods and a clear perception of boundless power of mathematical ideas and tools and knowing how to use them by analysing, modelling, solving and interpreting.
- Reflecting on the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.

- Enhancing learners overall development and to equip them with mathematical modelling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment.
- To enhance knowledge of Mathematics through practicals.

3. Program Outcome:

After successful completion of this programme learners will be able to

- Develop the knowledge of basic concepts of different branches of science.
- Basic tricks in Mathematics can be helpful to learners in Competitive Examinations.
- Prepare Learners for prominent career in Industry, Banks and for further Academic study.
- Learners can set up mathematical models of real-world problems and obtain solutions for the same.

4. Program Specific Outcome:

After successful completion of this programme learners are able to

- Develop the knowledge of basic concepts of Mathematics.
- Know the Basic tricks in Mathematics which can be helpful to learners in Competitive Examinations.
- Set up mathematical models of real-world problems and obtain solutions for the same.

Credit Structure of the Programme (Sem I & II) (Table with sign of HoD and BOS)

Semester	Course Code	Title of the Course	Category of Course	Number of Credits
I (Level 4.5)	**S101 MTT (Minor)**	Calculus – I	**Minor**	**2**
	S102 MTT (Minor)	Algebra – I	**Minor**	**2**
	MTOE-101 (GE/OE)	Mathematics for Competitive Exams – I	**Open Elective**	**2**
	MTVS - 101(VSC)	Practicals of Mathematics	**VSC**	**2**
	MTSE – 101 (SEC)	Statistics tools using R programming – I	**Skill Enhan.**	**2**
II (Level 4.5)	**S103 MTT (Minor)**	Calculus – II	**Minor**	**2**
	S104 MTT (Minor)	Discrete Mathematics	**Minor**	**2**
	S105 MTP (Minor)	Practicals of Mathematics	**Minor**	**2**
	MTOE-102 (GE/OE)	Mathematics for Competitive Exams – II	**Open Elective**	**2**
	MTOE-103 (GE/OE)	Vedic Mathematics	**Open Elective**	**2**
	MTSE - 102 (SEC)	Statistics tools using R programming – II	**Skill Enhan.**	**2**

Title of the Programme – B.Sc. Mathematics

Letter Grades and Grade Points:

Semester GPA / Programme CGPA Semester/ Programme	**% of Marks**	**Alpha-Sign/ Letter Grade Result**
9.00 - 10.00	90.0 – 100	O (Outstanding)
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)
5.00 - < 5.50	50.0 - < 55.0	C (Average)
4.00 - < 5.00	40.0 - < 50.0	P (Pass)
Below 4.00	Below 40.0	F (Fail)
Ab (Absent)	-	Absent

SYLLABUS

F. Y. B. Sc. MATHEMATICS (MINOR)

SEMESTER - I

STRUCTURE OF THE COURSES

Semester	Course Code	Course title	No of Credits	No of Lectures In Hours
I	**S101 MTT (Minor)**	Calculus – I	**2**	30
	S102 MTT (Minor)	Algebra – I	**2**	30

SEMESTER – I

Course Title: - **CALCULUS – I**

Course Code: **S101 MTT**

Course Objectives: To introduce students to;

- Understand basic concepts of Calculus and Algebra.
- Learn the real number system.
- Learn Exact and non- exact first order first degree differential equations.
- Applications of first order first degree differential equations.
- Understand the sequences of real numbers.

Course Outcomes: After the completion of this course, learners will be able to:

- Understand the basic concepts of Mathematics.
- Develop the Mathematical Logic which is useful for solving mathematical reasoning problems.
- Understand the applications of differential equations in real life.
- Prepare learners to get solutions of many kinds of problems in all subjects in science.

UNIT	Description	Number of Lectures
I) Real Number System	(i) **Introduction to Real number system**, $\mathbb{R}$ and order properties of $\mathbb{R}$, absolute value function and its properties. (ii) AM-GM inequality, Cauchy-Schwartz inequality, Intervals and neighbourhoods, interior point, limit point, Hausdorff property. **(iii)** Bounded sets, statements of l. u. b. axiom and its consequences, supremum and infimum. maximum and minimum.	**10**
II) Sequences in $\mathbb{R}$	(i) Introduction and Definition of a sequence and examples, Types of sequences, Convergent sequence and limit of a Convergent sequence, Uniqueness of limit. Some standard examples like: $\left(\frac{1}{1+na}\right)$, $\forall$	**10**

	a > 0, (b^n), ∀ b, 0 < b < 1, $\left(c^{\frac{1}{n}}\right)$ ∀ c > 0 and $\left(n^{\frac{1}{n}}\right)$. (ii) Convergent sequence is bounded but not conversely. Divergent sequence. Algebra of convergent sequences. (iii) Sandwich theorem with proof and examples. (iv) Monotonic sequence, monotone Convergence theorem and its application as in $\left(\left(1+\frac{1}{n}\right)^n\right)$. Definition of a subsequence, subsequence of a convergent sequence is convergent and converges to the same limit.	
III) First Order First degree differential equations	**Review:** Definition of a differential equation, Order, degree, ordinary differential equation and partial 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. (i) Exact Equations: General solution of exact equations solving exact differential equations of first order and first degree. Necessary and sufficient condition for Mdx + Ndy = 0 to be exact. (ii) Non-exact equations: Rules for finding integrating factor (I.F.) (without proof) for non-exact equations, such as : $(a)\ \frac{1}{M\,x+N\,y}$ is an I. F. if M x + N y ≠ 0 and Mdx + Ndy = 0 is homogeneous. (b) $\frac{1}{M\,x-N\,y}$ is an I. F. if M x - N y ≠ 0 and Mdx + Ndy = 0 is of the form	**10**

	$f_1(x,y)y\,dx + f_2(x,y)x\,dy = 0.$ (c) $e^{\int f(x)dx}$ (resp $e^{\int g(y)dy}$) is an I. F. if N $\neq$ 0 (resp M $\neq$ 0) and $\frac{1}{N}\left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right)$ (resp $\frac{1}{M}\left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right)$) is a function of x (resp y) alone, say f(x) (resp g(y)). (d) Linear differential equation, 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.	

Recommended Books:

1. R. G. Bartle- D. R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 1994.
2. E. A. Coddington, An introduction to ordinary differential equations, Dover Books.

Reference Books

1. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
2. K. G. Binmore, Mathematical Analysis, Cambridge University Press, 1982.
3. Sudhir Ghorpade and Balmohan Limaye, A course in Calculus and Real Analysis, SpringerInternational Ltd, 2000.
4. Daniel, First order First degree ODE and Applications, 2009.
5. G. F. Simmons, Differential equations with applications and historical notes, McGraw Hill.
6. T. M. Apostol, Calculus Volume **I,** Wiley & Sons (Asia) Pte, Ltd.
7. Richard Courant-Fritz John, A Introduction to Calculus and Analysis, Volume I, Springer.
8. Ajit kumar and S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2014.

9. James Stewart, Calculus, Third Edition, Brooks/cole Publishing Company, 1994.
10. D. A. Murray, Introductory Course in Differential Equations, Longmans, Green and Co., 1897.
11. A. **R.** Forsyth, A Treatise on Differential Equations, MacMillan and Co.,1956.

Course Title: **ALGEBRA – I**

Course Code: **S102 MTT**

Course Objectives: To introduce students to;

- Understand basic concepts of Algebra.
- Learn the concept of Integers and Divisibility.
- Learn Functions, Relations and Binary Operations.
- Applications of first order first degree differential equations.
- Understand the concept of Polynomials.

Course Outcomes: After the completion of this course, learners will be able to:

- Understand the basic concepts of Mathematics.
- Develop the Mathematical Logic which is useful for solving mathematical reasoning problems.
- Understand the applications of Relations and Binary Operations.
- Prepare learners to get solutions of many kinds of problems in all subjects in science.

UNIT	Description	Number of Lectures
I) Integers and Divisibility	(i) Introduction & properties of $\mathbb{N}$, Well ordering Property, Principles of finite Induction (First and second) with examples. (ii) Divisibility in integers, trivial divisors, Division Algorithm. (iii) Greatest common divisor (g. c. d.) & least common multiple (l. c. m.) of two non-zero integers, Properties of g. c. d. such as existence and uniqueness of g. c. d. of two non- zero integers a and b and that the g. c. d. can be expressed as ma + nb for some m, n $\in Z$, Euclidean Algorithm & Applications. (iv) Euclid's lemma, Primes & results, Fundamental theorem of Arithmetic. The set of primes is infinite, there are arbitrarily large gaps between	**10**

	primes, there exists infinitely many primes of the form 4n -1.	
II) Functions, Relations and Binary Operations	(i) Definition of functions and examples, types of functions: injective, surjective and bijective functions. Projection function. Direct image f(A) and inverse image $f^{-1}(B)$ for a function f. Invertible functions and the inverse of a function, properties such as bijective functions are invertible and conversely, Composition of functions and related properties. (ii) Cartesian product of two sets, definition of Binary relation and examples, reflexive, symmetric and transitive relations. Equivalence relation, Equivalence classes and its properties such as two equivalence classes are either identical or disjoint. (iii) Partition of a set, every partition gives an equivalence relation and vice versa. Binary operations, properties and examples.	**10**
III) Polynomials	(i) Definition of a polynomial, polynomials over the field F[x] where F = Q, R or C, Algebra of polynomials, degree of a polynomial, basic properties. (ii) Division algorithm for polynomials over R[x] (without proof), g. c. d. of two polynomials and its basic properties, Euclidean algorithm and its applications. (iii) Roots of a polynomial, relation between roots and coefficients, multiplicity of a root, remainder theorem, factor theorem. A polynomial of degree n has at most n roots,	**10**

		Complex roots of a polynomial in R[X] occur in conjugate pairs.	
	(iv)	Statement of Fundamental theorem of algebra. Rational root theorem. Corollary for monic polynomials viz a rational root of monic polynomial with integer coefficients is necessarily an integer. Simple consequences such as $\sqrt{p}$ is an irrational number when p is a prime number.	

Reference Books:

1. David M. Burton, Elementary Number Theory, Seventh Edition, McGraw Hill Education (India) Private Ltd.
2. Norman L. Biggs, Discrete Mathematics, Revised Edition, Clarendon Press, Oxford 1989.

Additional Reference Books

1. I. Niven and S. Zuckerman, Introduction to the theory of numbers, Third Edition, Wiley Eastern, New Delhi, 1972.
2. G. Birkoff and S. Maclane, A Survey of Modern Algebra, Third Edition, Mac Millan, New York, 1965.
3. N. S. Gopalkrishnan, University Algebra, Ne Age International Ltd, Reprint 2013.
4. I. N. Berstein, Topics in Algebra, John Wiley, 2006.
5. P. B. Bhattacharya S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra, New Age International, 1994.
6. Kenneth Rosen, Discrete Mathematics and its applications, Mc-Graw Hill, International Edition, Mathematics Series.

EXAMINATION PATTERN FOR MINOR SUBJECTS

Scheme of Examination for Each Semester:

Continuous Internal Evaluation (CIE): 40 Marks

Sr. No.	Particulars	Marks
01	One Unit Test	20 Marks
02	Home Assignment/ Book Review/ Presentation/Poster/Chart /Model Making	10 Marks
03	Attendance	05 Marks
04	Classroom manners, Etiquette/Subject related activities.	05 Marks
	Total	**40 Marks**

Semester End Examination (SEE): 60 Marks

Duration: 2 hours			**Marks: 60**
	N. B. 1. All questions are compulsory. **2.** Use of simple Calculator is allowed.		
Q. 1 A)	MCQ/Fill in the blanks	Unit – I, Unit – II & Unit – III	06 Marks
Q. 2 A)	Theory Question (Any One out of Two)	Unit - I	08 Marks
Q. 2 B)	Theory/ Examples (Any Two out of Three)		10 Marks
Q. 3 A)	Theory Question (Any One out of Two)	Unit - II	08 Marks
Q. 3 B)	Theory/ Examples (Any Two out of Three)		10 Marks
Q. 4 A)	Theory Question (Any One out of Two)	Unit - III	08 Marks
Q. 4 B)	Theory/ Examples (Any Two out of Three)		10 Marks
	Total		**60 Marks**

SYLLABUS FOR VOCATIONAL SKILL COURSE

CREDIT STRUCTURE

Semester	Course Code	Title of the Course	Category of Course	Credits/ Hr
I (Level 4.5)	**MTVS - 101**	**Practicals of Mathematics**	**Practical**	**02/60**

Course Objectives:

To introduce students to;

- Learn the properties of real numbers.
- Understand the applications of differential equation in real life.
- Use of the properties of sets, functions and Binary relations in real life.
- Understand the sequences in real numbers.

Learning Outcomes:

After completing the Course, student will be able to

- Explain the properties of real numbers.
- Understand the sequences in real numbers.
- Crack the first order first degree differential equation.
- Examine the properties of sets, functions and Binary relations.
- Understand the different properties of Polynomials.

LIST OF PRACTICALS

1.	Algebraic and Order properties of Real numbers.
2.	Hausdorff property. Interior point and limit point.
3.	l. u. b. axiom and its consequences, supremum and infimum. maximum and minimum.
4.	Problems on Convergent sequence. Limit of a Convergent sequence.
5.	Problems on Divergent sequence. Algebra of convergent sequences.
6.	Problems on Monotone convergence theorem and its applications.
7.	Problems on Sandwich theorem for sequences.
8.	Solving exact and non-exact differential equations of first order and first degree.
9.	Solutions of first order differential equations of the type $\frac{dy}{dx} + P(x)y = Q(x)y^n$ for n $\geq$ 0,
10.	Applications to orthogonal trajectories.
11.	Well ordering Property, Principles of finite Induction (First and second) with examples.
12.	G. c. d. & l. c. m. of two non-zero integers, Properties of g. c. d. such as existence and uniqueness of g. c. d. of two non- zero integers a and b and that the g. c. d. can be expressed as ma + nb for some m, n $\in Z$. Examples.
13.	Euclidean Algorithm & Applications.
14.	Euclid's lemma, Primes, Fundamental theorem of Arithmetic. The set of primes is infinite.
15.	Types of functions, Invertible functions and the inverse of a function, properties such as bijective functions are invertible and conversely.
16.	Reflexive, symmetric and transitive relations. Equivalence relation. Examples.
17.	Binary operations, properties and examples.
18.	Algebra of polynomials, degree of a polynomial, basic properties.
19.	Division algorithm for polynomials over R[x], g. c. d. of two polynomials and its basic properties, Euclidean algorithm.
20.	Roots of a polynomial, relation between roots and coefficients, Multiplicity of a root, Remainder theorem, Factor theorem, examples.

Recommended Book:

1. A Foundation Course in Mathematics, Ajit Kumar, S. Kumaresan and Baba Kumar Sarma, Narosa Publishing House, New Delhi, 2018.

Reference Books:

1. David M. Burton, Elementary Number Theory, Seventh Edition, McGraw Hill Education (India) Private Ltd.
2. Norman L. Biggs, Discrete Mathematics, Revised Edition, Clarendon Press, Oxford 1989.
3. I. Niven and S. Zuckerman, Introduction to the theory of numbers, Third Edition, Wiley Eastern, New Delhi, 1972.
4. G. Birkoff and S. Maclane, A Survey of Modern Algebra, Third Edition, Mac Millan, New York, 1965.
5. N. S. Gopalkrishnan, University Algebra, Ne Age International Ltd, Reprint 2013.
6. I. N. Berstein, Topics in Algebra, John Wiley, 2006.
7. P. B. Bhattacharya S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra, New Age International, 1994.
8. Kenneth Rosen, Discrete Mathematics and its applications, Mc-Graw Hill, International Edition, Mathematics Series.

EXAMINATION PATTERN FOR VSC (Practicals of Mathematics)

Scheme of Examination for Each Semester:

Continuous Internal Evaluation (CIE): 20 Marks

Sr. No.	Particulars	Marks
01	Journal	10 Marks
02	Viva	05 Marks
03	Systematic Work and Attendance	05 Marks
	Total	**20 Marks**

Semester End Examination: 30 Marks

Duration: 1 hour **Marks: 30**		
	N. B. 1. All questions are compulsory. **2. Use of simple Calculator is allowed.** **3. Questions 1 and 2 are on Course – I and Questions 3 and 4 are on Course – II.**	
Q. 1 A)	MCQ/Fill in the blanks	05 Marks
Q. 2 A)	Answer Any Two out of Three (Theory/ Examples)	10 Marks
Q. 3 A)	MCQ/Fill in the blanks	05 Marks
Q. 4 A)	Answer Any Two out of Three (Theory/ Examples)	10 Marks
	Total	**30 Marks**

SYLLABUS FOR OPEN ELECTIVE COURSE

TITLE OF THE COURSE: MATHEMATICS FOR COMPETITIVE EXAMS - I

CREDIT STRUCTURE

Semester	Course Code	Title of the Course	Type	Credits
I (Level 4.5)	MTSE – 101	MATHEMATICS FOR COMPETITIVE EXAMS - I	Theory	02

Aims and Objectives: After the successful completion of the course, the learner will be able to:

- Understand the Basic concepts in Mathematics.
- Use different tricks to solve the problems of Mathematics in Competitive Examinations.
- To strengthen the ability to draw logical conclusions.

Learning Outcomes:

- Provide a platform to the learners for building the fundamentals of basic mathematics for competitive examinations preparation strategy.
- Establish a framework to help learners acquire knowledge and expertise necessary to secure employment opportunities in the Government sector.

UNIT	Description	Number of Lectures
UNIT 1) ARITHMETIC	Percentages, Interest, Profit and Loss. Mixtures and Allegation, Ratio and Proportion, Relation between Fraction and percentage, Time, Speed and Distance. Races and Clocks, Time and Work. Related Examples.	**10**
UNIT 2) NUMBER SYSTEM	Types of Number, Prime number, composite numbers, Factorial, Absolute value of a real number. Laws of Indices, Last digit of a^n, HCF and LCM For two numbers, relatively Prime numbers, related examples.	**10**
UNIT 3) MEASURES OF CENTRAL TENDENCIES	Definition of Average, Types of Averages: Arithmetic Mean, Median, and Mode for grouped as well as ungrouped data. Using Histogram locate mode and using Ogive locate median.	**10**

References Books:

1) Basis Abstract Algebra, P. B. Bhattacharya, S. K. Jain, S. R. Nagpaul, second Edition, Cambridge University press, 1995.
2) Quantitative Aptitude for Competitive Examinations, Dinesh Khattar, 4th Edition.
3) Text Book of Quickest Mathematics: Quantitative Aptitude and Numerical ability useful for All Competitive Exams, Kiran Prakashan, 5th Revised Edition, 2014.
4) Fundamentals of Mathematical Statistics, Gupta S. C., Kapoor V. K., Sultan Chand & Sons 12th Edition, 2020.
5) Mathematical Statistical Techniques (F. Y. B. Com.), R. J. Shah, Sheth publishers Pvt. Ltd. Mumbai, 3rd Edition, 2009.
6) Quantitative Methods – I (BBI First year: First Semester), A. V. Deshpande, A. P. Kumtha, Vipul Prakashan, Mumbai, 1st Edition 2016.
7) Quantitative Methods – II (BBI First year: Second Semester), A. P. Kumtha, Vipul Prakashan, Mumbai, 1st Edition 2016.

SEMESTER – I

SYLLABUS FOR SKILL ENHANCEMENT COURSE (SEC))

COURSE TITLE: STATISTICAL TOOLS USING R PROGRAMMING – I

CREDIT STRUCTURE

Semester	Course Code	Title of the Course	No. of Credits	No. of Lectures (practicals)
I (Level 4.5)	MTSE – 101	STATISTICS TOOLS USING R PROGRAMMING - I	02	60

Aims and Objectives:

To introduce students to;

- Learn the basics of statistical computing.
- Understand R programing.
- Exercise the fundamentals of statistical analysis in R environment.
- Analyze the data for the different purposes using R Programming.

Learning Outcomes:

After completing the Course, student will be able to

- Understand the Basic concepts related to Statistics.
- familiar about R and its basic operations-creating a vector, importing data, saving output and graphics using R.
- Represent the data diagrammatically and graphically.
- Analyze the data for the different purposes using R Programming.

LIST OF PRACTICALS

1.	Examples on Attribute, Variable.
2.	Discrete and Continuous variable.
3.	Examples on Univariate and Bivariate distribution.
4.	Types of Characteristics.
5.	Different types of scales: Nominal, Ordinal, Interval and Ratio.
6.	Frequency distribution, Histogram, Ogive curves.
7.	Data input, Arithmetic Operators.
8.	Vector Operations. Matrix Operations.
9.	Data Frames, Built-in Functions.
10.	Frequency Distribution, Grouped Frequency Distribution.
11.	Diagrams and Graphs.
12.	Summary statistics for raw data and grouped frequency distribution.
13.	Examples on Average/Central tendency.
14.	Characteristics of good measure of central tendency.
15.	Examples on Arithmetic Mean (A.M.), Median and Mode for ungrouped data.
16.	Examples on Arithmetic Mean (A.M.), Median and Mode for grouped data.
17.	Effect of shift of origin and change of scale.
18.	Merits and demerits of Arithmetic Mean, Median and Mode.
19.	Combined arithmetic mean.
20.	Quartiles, Deciles and Percentiles - examples for ungrouped data.

Reference Books:

1) Fundamentals of Mathematical Statistics, Gupta S. C., Kapoor V. K., Sultan Chand & Sons 12th Edition, 2020.
2) Fundamentals of Statistics, Goon A. M., Gupta M. K. and Dasgupta B., The World press Pvt. Ltd. Calcutta, Vol. 1, 6th Revised Edition, 1983.
3) Statistics made it simple: Do it yourself on PC, Sarma, K. V. S. Prentce Hall of India, New Delhi, 2001.
4) Programmed Statistics, Agarwal B. L., New Age International Publisher, 2nd Edition, New Delhi, 2003.
5) Statistics using R, Purohit S. G., Gore S. D., Deshmukh S. R., Narosa Publishing House, New Delhi, 2008.

EXAMINATION PATTERN FOR SKILL ENHANCEMENT COURSE

Scheme of Examination for Each Semester:

Continuous Internal Evaluation (CIE): 20 Marks

Sr. No.	Particulars	Marks
01	Assignment	10 Marks
02	Attendance / Classroom manners / Subject related activities.	10 Marks
	Total	**20 Marks**

Semester End Examination: 30 Marks

Duration: 1 hour		**Marks: 30**
	N. B. 1. All questions are compulsory. 2. Use of simple Calculator is allowed.	
Q. 1 A)	Answer Any Two out of Three (On Unit – I)	10 Marks
Q. 2 A)	Answer Any Two out of Three (On Unit – II)	10 Marks
Q. 3 A)	Answer Any Two out of Three (On Unit – I and Unit – II)	10 Marks
	Total	**30 Marks**

SYLLABUS

F. Y. B. Sc. MATHEMATICS (MINOR)

SEMESTER - II

STRUCTURE OF THE COURSES

Semester	Course Code	Course title	No of Credits	No of Lectures In Hours
II	**S103 MTT (Minor)**	Calculus – II	**2**	30
	S104 MTT (Minor)	Discrete Mathematics	**2**	30

SEMESTER – II

Course Title: - **CALCULUS – II**

Course Code: **S103 MTT**

Course Objectives: To introduce students to;

- Understand basic concepts of Calculus.
- Learn the Limits and Continuity concept for one variable function.
- Understand differentiability for one variable function.
- Learn the applications of differentiability for one variable function.

Course Outcomes: After the completion of this course, learners will be able to:

- Draw the graphs of standard functions.
- Learn the concept of differentiability for one variable function.
- Understand the applications of differentiability in real life.

UNIT	Description	Number of Lectures
I) Limits and Continuity	(i) Brief Review of a function, Graphs of some standard functions such as |x|, exp(x), log(x), sin(x), cos(x), tan(x), $\sin\left(\frac{1}{x}\right)$, $x^2\sin\left(\frac{1}{x}\right)$, $ax^2 + bx + c$, over suitable intervals of $\mathbb{R}$. (No direct questions to be added.) (ii) $\epsilon - \delta$ definition of limit of a (real valued) function, Uniqueness of limit when it exists, Algebra of limits, limits of composition function, Sandwich theorem, Right hand and Left-hand limits, non-existence of limits, $\lim_{x\to -\infty} f(x)$, $\lim_{x\to \infty} f(x)$ and $\lim_{x\to a} f(x) = \pm\infty$. (iii) Continuous functions: $\epsilon - \delta$ definition of continuity of a (real valued) function, examples, continuity of a real valued function at end points of domain using $\epsilon - \delta$ definition, f is continuous at a iff $\lim_{x\to a} f(x)$ exists and equals to f(a), Sequential continuity. Continuity of constant function, modulus function viz. |x|, etc. Algebra	**10**

	of continuous functions, discontinuous functions, examples of removable and essential discontinuity.	
II) Differentiability of Functions	**(i)** Definition of Differentiation of real valued function of one variable & examples of differentiable and non-differentiable functions, Definition of Differentiability of a function at a point of an open interval, differentiable functions are continuous but not conversely. **(ii)** Algebra of differentiable functions, Chain rule. **(iii)** Higher order derivatives and examples. **(iv)** Implicit differentiation (Only examples).	**10**
III) Applications of Differentiability	(i) Rolle's theorem, Lagrange's and Cauchy's mean value theorems, their applications and examples. Monotone increasing and decreasing functions, examples. (ii) L-Hospital's rule (without proof), Examples of intermediate forms. (iii) Critical point, Definition of local maximum and Local minimum, necessary condition, stationary points, second derivative test, examples, Concave/Convex functions, point of inflection. (iv) Graphing of functions using first and second derivatives.	**10**

Recommended books:

1. T. M. Apostol, Calculus, Vol I, Wiley and Sons (Asia) Pvt. Ltd.
2. Sudhir Ghorpade and Balmohan Limaye, A course in Calculus and Real Analysis, Springer International Ltd, 2000.

Reference books:

1. Richard Courant and Fritz John, A Introduction to Calculus and Analysis, Volume-I, Springer.
2. Ajit Kumar and S. Kumaresan, A Basic course in Real Analysis, CRC

Press, 2014.

3. K. G. Binmore, Mathematical Analysis, Cambridge University Press, 1982.
4. Calculus, G. B. Thomas, 12th Edition 2009.
5. Calculus, Spivak Michael, Third Edition, Cambridge University Press, USA, 1994.
6. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
7. James Stewart, Calculus, Third Edition, Brooks/Cole Publishing company, 1994.

Course Title: **DISCRETE MATHEMATICS**

Course Code: **S104 MTT**

Course Objectives: To introduce students to;

- Understand basic concepts of Discrete Mathematics.
- Learn the Preliminary and Advanced Counting.
- Understand the permutations and recurrence relation.
- Learn the use of recurrence relation in counting problems.

Course Outcomes: After the completion of this course, learners will be able to:

- Understand the basic concepts of Mathematics.
- Develop the concept of Counting which is useful for solving mathematical reasoning problems.
- Understand the applications of permutations and recurrence relation in real life.
- Use of recurrence relation in counting problems.

UNIT	Description	Number of Lectures
I) Preliminary Counting	(i) Finite and infinite sets, countable and uncountable sets, examples such as $\mathbb{N}$, Z, $\mathbb{N} \times \mathbb{N}$, Q, (0, 1), R. (ii) Addition and multiplication Principle, counting sets of pairs, two ways counting. (iii) Stirling numbers of second kind. Simple recursion formulae satisfied by S(n, k) for $k = 1, 2, \ldots\ldots, n-1, n$. (iv) Pigeonhole principle simple and strong form and examples.	**10**
	(i) Permutation and combination of sets and multi-sets, circular permutations, emphasis on solving problems.	

II) Advanced Counting	(ii) Binomial and Multinomial Theorem, Pascal identity, examples of standard identities such as the following with emphasis on combinatorial proofs. $\sum_{k=0}^{r} \binom{m}{k} \binom{n}{r-k} = \binom{m+n}{r}$ $\sum_{i=r}^{n} \binom{i}{r} = \binom{n+1}{r+1}$ $\sum_{i=0}^{k} \binom{k}{i}^2 = \binom{2k}{k}$, $\sum_{i=0}^{n} \binom{n}{i} = 2^n$. (iii) Non-negative integer solutions of equation $x_1 + x_2 + \cdots\cdots\cdots + x_n = n$. (iv) Principal of inclusion and exclusion, it's Applications.	**10**
III) Permutations and Recurrence Relation	(i) Permutation of objects, S_n, composition of permutations, results such as every permutation is a product of disjoint cycles, every cycle is a product of transpositions, signature of a permutation, even and odd permutations, cardinality of S_n, A_n. (ii) 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.	**10**

Recommended Books:

l. Norman Biggs, Discrete Mathematics, Oxford University Press.

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

References Books:

1. Richard Brualdi, Introductory Combinatorics, John Wiley and sons.
2. V. Krishnamurthy, Combinatorics-Theory and Applications, Affiliated East West Press.
3. Schaum's outline series, Discrete mathematics.
4. Allen Tucker, Applied Combinatorics, John Wiley and Sons.
5. Sharad Sane, Combinatorial Techniques, Springer.

Course Title**: PRACTICALS OF MATHEMATICS**

Course Code: **S105MTP**

Aims and Objectives: After completing the Course, student will be able to

- Learn the Limits and Continuity concept for one variable function.
- Understand differentiability for one variable function.
- Learn the applications of differentiability for one variable function.
- Learn the Preliminary and Advanced Counting.
- Learn the use of recurrence relation in counting problems.

LEARNERS OUTCOMES: After the completion of this course, learners will be able to:

- Draw the graphs of standard functions.
- Learn the concept of differentiability for one variable function.
- Understand the applications of differentiability in real life.
- Understand the basic concepts of Mathematics.
- Develop the concept of Counting which is useful for solving mathematical reasoning problems.
- Understand the applications of permutations and recurrence relation in real life.
- Use of recurrence relation in counting problems.

LIST OF PRACTICALS

1.	Limit of a function and Sandwich theorem.
2.	Continuous and discontinuous function.
3.	Algebra of continuous functions, Removable and essential discontinuity.
4.	Sequential continuity. Continuity of constant function, modulus function viz. |x|.
5.	Properties of differentiable function.
6.	Algebra of differentiable functions, Chain rule.
7.	Higher order derivatives Leibnitz rule for derivatives.
8.	Rolle's theorem, Lagrange's and Cauchy's mean value theorems, their applications and examples.
9.	Graphing of functions using first and second derivatives.
10.	Miscellaneous Theory questions based on full paper.

11.	Countable and uncountable sets.
12.	Addition and multiplication Principle, counting sets of pairs, two ways counting.
13.	Stirling numbers of second kind. Recursion formulae satisfied by S(n, k) for $k = 1, 2, \ldots\ldots, n-1, n$.
14.	Permutation and combination of sets and multi-sets, circular permutations.
15.	Multinomial Theorem, Pascal identity, examples of standard identities such as the following with emphasis on combinatorial proofs. $$\sum_{k=0}^{r} \binom{m}{k}\binom{n}{r-k} = \binom{m+n}{r}$$ $$\sum_{i=r}^{n} \binom{i}{r} = \binom{n+1}{r+1}$$
16.	Principal of inclusion and exclusion, it's Applications.
17.	Permutation of objects, S_n, composition of permutations, results such as every permutation is a product of disjoint cycles.
18.	Signature of a permutation, even and odd permutations, cardinality of S_n, A_n.
19.	Recurrence Relations.
20.	Miscellaneous Theory questions based on full paper.

Reference books:

1. R. R. Goldberg, Methods of Real Analysis, Oxford and IBH, 1964.
2. James Stewart, Calculus, Third Edition, Brooks/Cole Publishing company, 1994.
3. T. M. Apostol, Calculus, Vol I, Wiley and Sons (Asia) Pvt. Ltd.
4. Sudhir Ghorpade and Balmohan Limaye, A course in Calculus and Real Analysis, Springer International Ltd, 2000.

Additional Reference books:

1. Richard Courant and Fritz John, A Introduction to Calculus and Analysis, Volume-I, Springer.
2. Ajit Kumar and S. Kumaresan, A Basic course in Real Analysis, CRC Press, 2014.
3. G. B. Thomas, Calculus, 12th Edition 2009.
4. Norman Biggs, Discrete Mathematics, Oxford University Press.
5. Richard Brualdi, Introductory Combinatorics, John Wiley and sons.
6. V. Krishnamurthy, Combinatorics-Theory and Applications, Affiliated East West Press.
7. Discrete Mathematics and its Applications, Tata McGraw Hills.
8. Schaum's outline series, Discrete mathematics,
9. Allen Tucker, Applied Combinatorics, John Wiley and Sons.
10. Sharad Sane, Combinatorial Techniques, Springer.

SYLLABUS FOR OPEN ELECTIVE COURSE- II

CREDIT STRUCTURE

Semester	Course Code	Title of the Course	Category of Course	Number of Credits
I (Level 4.5)	**MTOE-102 (GE/OE)**	Mathematics for Competitive Exams – II	**Open Elective Course**	**02**

Course Objectives: After the successful completion of the course, the learner will be able to:

- Understand the Basic concepts in Mathematics.
- Use different tricks to solve the problems of Mathematics in Competitive Examinations.
- To strengthen the ability to draw logical conclusions.

Learning Outcomes:

- Provide a platform to the learners for building the fundamentals of basic mathematics for competitive examinations preparation strategy.
- Establish a framework to help learners acquire knowledge and expertise necessary to secure employment opportunities in the Government sector.

UNIT	Description	Number of Lectures
UNIT 1) INTEREST AND ANNUNITY	Simple Interest, Compound Interest (Nominal & Effective Rate of Interest), Calculations involving upto 4 time periods. Annuity Immediate and its Present value, Future value. Equated Monthly Instalments (EMI) using reducing balance method & amortization of loans. Related Examples	**10**
UNIT 2) PERMUTATION AND COMBINATION	Factorial Notation, Fundamental principle of counting, Permutation as arrangement, Simple examples, combination as selection, Simple examples, Relation between ${}^{n}C_{r}$ and ${}^{n}P_{r}$. Examples on commercial application of permutation and combination.	**10**
UNIT 3) ARITHMETIC	Banker's Discount, Binomial theorem, Boat and Streams, Calendar, Chain rule, clock, Odd Man Out and Series. Problems Trains and Age. Present value, Future value, true discount. Related examples.	**10**

REFERENCES:

1) Mathematics for Economics and Finance Methods and Modelling by Martin Anthony and Norman Biggs, Cambridge University Press, Cambridge low-priced edition, 2000, Chapters 1, 2, 4, 6 to 9 & 10.
2) Business Mathematics by D. C. Sancheti and V. K. Kapoor, Sultan Chand & Sons, 2006, Chapter 1, 5, 7, 9 &10.
3) Fundamentals of Mathematical Statistics, Gupta S. C., Kapoor V. K., Sultan Chand & Sons, 12th Edition, 2020.
4) Statistics - Theory, Method & Applications, D. C. Sancheti & V. K. Kapoor, Sultan Chand and Sons, 2010.
5) Mathematical Statistical Techniques (F. Y. B. Com.), R. J. Shah, Sheth publishers Pvt. Ltd. Mumbai, 3rd Edition, 2009.
6) Quantitative Methods – I (BBI First year: First Semester), A. V. Deshpande, A. P. Kumtha, Vipul Prakashan, Mumbai, 1st Edition 2016.
7) Quantitative Methods – II (BBI First year: Second Semester), A. P. Kumtha, Vipul Prakashan, Mumbai, 1st Edition 2016.
8) https://www.scribd.com/document/479395373/docx

SYLLABUS FOR OPEN ELECTIVE COURSE- III

COURSE TITLE: VEDIC MATHEMATICS

COURSE CODE: MTOE-103

CREDIT STRUCTURE

Semester	Course Code	Title of the Course	Category of Course	Number of Credits
II (Level 4.5)	MTOE-103 (GE/OE)	VEDIC MATHEMATICS	Open Elective Course	02

Course Objectives:

- To reduce the fear of Mathematics and increase the confidence.
- Provide an insight into ancient Indian Mathematics.
- To crack scholarship and entrance exams.

Learning Outcomes:

- Basic tricks in Vedic Maths can be helpful to learners in Competitive Examinations.
- Learners learn the Contribution of ancient Indian Mathematicians to Mathematics.

UNIT	Description	Number of Lectures
UNIT 1) INTRODUCTION OF VEDIC MATHS	Tirthaji and the discovery of Vedic Mathematics. Development of further material. Maharishi School. Calculating Prodigies. The Sutras of Vedic Maths. Origin of Vedas. Authenticity. Nature of the Sutras. Pythagoras and the Cosmology of number.	**10**
UNIT 2) MULTIPLICATION	1. Ekadhikenpurven method (multiplication of two numbers of two digits). 2. Eknunenpurven method (multiplication of two numbers of three digits). 3. Urdhvatiragbhyam method (multiplication of two numbers of three digits). 4. Nikhilam Navtashchramam Dashtaha (multiplication of two numbers of three digits).	**10**
UNIT 3) Division and Divisibility	Part A: Division 1. Nikhilam Navtashchramam Dashtaha (two digits divisor) 2. Paravartya Yojyet method (three digits divisor). Part B: Divisibility 1. Ekadhikenpurven method (two digits divisor) 2. Eknunenpurven method (two digits divisor).	**10**

Reference Books :

1) Sri Bharati Krisna Tirthaji, V. S. Agarwala, Vedic Mathematics or Sixteen Simple Mathematical Formulae from the Vedas, Indological Publishers Delhi, 1981.
2) Gaurav Tekriwal, Maths Sutra: The Art of Vedic Speed Calculation., ISBN 13: 9780143425021, 2015.

3) William Q., Vedic Mathematics Secrets Fun Applications of Vedic Math In Your Everyday Life, 2007.
4) Dhaval Bathia, Vedic Mathematics Made Easy, Jaico Publishing House, 2021.
5) Vedic Mathematics, Motilal Banarsi Das, New Delhi.
6) Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.
7) Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.
8) Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.
9) Leelavati, Chokhambba Vidya Bhavan, Varanasi. 6. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi.

SEMESTER – II

SYLLABUS FOR SKILL ENHANCEMENT COURSE (SEC))

COURSE TITLE: STATISTICAL TOOLS USING R PROGRAMMING – II

CREDIT STRUCTURE

Semester	Course Code	Title of the Course	Category of Course	Number of Credits
II (Level 4.5)	MTSE – 102	STATISTICAL TOOLS USING R PROGRAMMING – II	Skill Enhancement Course	02

Course Objectives: To introduce students to;

- Learn the basics of statistical computing.
- Exercise the fundamentals of statistical analysis in R environment.
- Analyse the data for the different purposes using R Programming.

Learning Outcomes: After completing the Course, student will be able to

- Understand the Basic concepts related to Statistics.
- Workout the fundamentals of statistical analysis in R environment.
- Examine the data for the different purposes using R Programming.

LIST OF PRACTICALS

1.	Examples on dispersion. Absolute and Relative measure of dispersion.
2.	Characteristics of good measure of dispersion.
3.	Range, Semi-interquartile range.
4.	Quartile deviation, Standard deviation.
5.	effect of shift of origin and change of scale, merits and demerits.
6.	Merits and demerits of Range, Semi-interquartile range, Quartile deviation, Standard deviation.
7.	Combined standard deviation, Variance.
8.	Coefficient of range, Coefficient of quartile deviation and Coefficient of variation (C.V.).
9.	Moments are Raw moments.
10.	Central moments, Relation between raw and central moments.
11.	Measures of Skewness and Kurtosis: Concept of Skewness and Kurtosis, measures based on moments, quartiles – I.
12.	Measures of Skewness and Kurtosis: Concept of Skewness and Kurtosis, measures based on moments, quartiles – II.
13.	Correlation.
14.	Types and interpretation
15.	Measure of Correlation: Scatter diagram and interpretation.
16.	Examples on Karl Pearson's coefficient of correlation (r).
17.	Effect of shift of origin and change of scale of Karl Pearson's coefficient of correlation.
18.	Properties of Karl Pearson's coefficient of correlation.
19.	Examples on Spearman's rank correlation coefficient.
20.	Multiple correlation.

References Books:

1) Fundamentals of Mathematical Statistics, Gupta S. C., Kapoor V. K., Sultan Chand & Sons 12^{th} Edition, 2020.
2) Fundamentals of Statistics, Goon A. M., Gupta M. K. and Dasgupta B., The World press Pvt. Ltd. Calcutta, Vol. 1, 6^{th} Revised Edition, 1983.
3) Statistics made it simple: Do it yourself on PC, Sarma, K. V. S. Prentce Hall of India, New

Delhi, 2001.

4) Programmed Statistics, Agarwal B. L., New Age International Publisher, 2nd Edition, New Delhi, 2003.
5) Statistics using R, Purohit S. G., Gore S. D., Deshmukh S. R., Narosa Publishing House, New Delhi, 2008.