Savitribai Phule Pune University, Pune (Formerly, University of Pune)

Four Year (Semester 01 to 08)

B.A./B.Sc. (Honours/Honours with Research) MATHEMATICS

[2024 Pattern]

Syllabus

National Education Policy 2020

To be Implemented From The Academic Year : 2024- 2025

Prepared by : B.O.S. in MATHEMATICS, SPPU

Recommended by: Faculty of Science and Technology

Approved by : Academic Council, SPPU

References:

1. VideG.R.No.NEP 2022/CRNo.09/VISHI
2. University Circular No. 97, Dated 31 May, 2023.
3. Circular Higher Education, Govt. of Maharashtra Dated 13 March, 2024

(For Colleges Affiliated to Savitribai Phule Pune University, Pune.)

Savitribai Phule Pune University (Formerly University of Pune)

Four Year Graduate Degree Programme in Mathematics (Faculty of Science & Technology)

New Syllabi

for

B. A. / B. Sc. - Mathematics-Part-I

(For Colleges Affiliated to Savitribai Phule Pune University, Pune) (As per National Education Policy- 2020)

To be implemented from the Academic Year 2024-2025

Preamble

The board of studies in Mathematics of Savitribai Phule Pune University, made a rigorous attempt to revise the curriculum of degree program B.Sc. to align it with National Education Policy-2020 and UGC quality mandate for Higher Education Institutions-2021. The process of revamping the curriculum started with the series of meetings, workshops, webinars and discussions with sub-committees conducted by the university to orient the teachers about the key features of the National Education Policy, enabling them to revise the curriculum in sync with the policy. Appropriate orientation of the faculty about the vision and provisions of NEP-2020 made it easier for them to appreciate and incorporate the vital aspects of the policy in the revised curriculum focused on creating holistic, thoughtful, creative and well-rounded individuals equipped with the skill sets of 21^{st} century for the development of an enlightened, socially conscious, knowledgeable and skilled citizen of the nation.

With NEP-2020 in background, the revised curriculum will articulate the spirit of the pol icy by emphasizing upon integrated approach to learning, innovative pedagogies and assess ment strategies, multidisciplinary and interdisciplinary education, creative and critical thinking, student-centric participatory learning, imaginative abilities and flexible curricular structures to enable creative combination of disciplines for the study. The credit structure is followed by university as it is as per the guidelines of state government to design the Degree Program. The curriculum is further modified as per the needs specified in NEP. The curriculum is developed to trigger the inquisitiveness, discussion, analytical ability and quest for discovery among learners.

Mathematics is a powerful tool for understanding and communicate globally that organizes our lives and prevents chaos, which helps us to understand the world and provides an effec tive way of building mental discipline. Along with mathematical skills, it is also expected that students will learn life skills like argumentation, communication and general social values which are necessary to life rich, productive and meaningful life. Additionally, the knowledge of mathematical modelling and computational training which the students acquire during the Pro gram makes them highly sought after. In keeping with the demands of industry and academia, the syllabus is updated regularly, with inputs taken from various stakeholders including stu dents, alumni and parents at different stages of the modification/addition of the syllabus. The new curriculum provides a synoptic overview of possible career paths mapped by a degree in mathematics teaching, research, engineering, computer programming, statistician, competitive examinations and many more.

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Four Year Degree Program in Mathematics
under the Faculty of
Science and Technology

B.A./B.Sc. (Honours/ Honours with Research)

ABOUT THE PROGRAM:

This B.Sc. Program is uniquely designed to impart essential knowledge in all major areas of pure or applied mathematics. This Program offers an exciting opportunity for specialization in constructing mathematical models for real-life problems and solve them. The program consists of total 08 semesters which are carefully selected blend of theory and practical. It provides feast of mathematical concepts and advanced knowledge in mathematics which are useful to students for specialist professional employment, research in academia and various industries for broader applications. Learner centric curriculum is designed in adherence to the principles of Na tional Education Policy (NEP 2020) to acquire knowledge and skills with valuable experiences through VSC, SEC, AEC, VEC, IKS, hands-on activities, projects, internships and much more.

OBJECTIVES OF THE PROGRAM:

To prepare the learners, who will understand and apply the basic as well as advanced principles of mathematics for solving problems from science with an emphasis on appli

cations.

To produce the learners who are well-grounded in the fundamentals of mathematics with the acquisition of the necessary skills, tools, and techniques required in many applications areas.

To develop an ability to study the conceptual problem and critically analyze and also promote the use of mathematics in industry and applied sciences.

To provide exposure and motivate students for research in current trends of mathematics.

SCOPE OF THE PROGRAM:

After successful completion of the B.Sc. Program, the learner has ample opportunities to use their mathematical knowledge in different areas:

Career opportunities in government organizations like Defense Research and Development Or ganization (DRDO), Indian Space Research Organization (ISRO), research laboratories like Council of Scientific and Industrial Research or government owned scientific organizations.

Job positions like Mathematics specialist, Quantitative risk analyst, Treasury management spe cialist, Public sector banking, Financial institutions, Engineering or Insurance sectors, etc.

Job opportunities in the teaching profession at science and engineering colleges and universities.

Scope for Higher Studies and find lucrative opportunities in the field of research.

PROGRAM OUTCOMES(PO's):

After successful completion of this program, students will be able to

1. enhance their logical thinking and apply advanced mathematical concepts to solve com plex problems.
2. formulate research questions, design experiments or investigations, collect and analyze data and present their findings in a clear and coherent manner.
3. apply advanced mathematical techniques or tools to analyze and solve challenging prob lems encountered in mathematics and related fields.
4. formulate mathematical models that represent real-world phenomena, analyze the models using mathematical methods and interpret the results to make informed decisions or predictions.
5. develop proficiency in utilizing computational tools, software and programming languages to aid in mathematical analysis, numerical simulations and data visualization.
6. present complex mathematical concepts, proofs and research findings to both technical and non-technical audiences.
7. develop a strong foundation for professional growth and lifelong learning in Mathematics.
8. acquire lifelong learning skills which will lead important to better opportunities and im prove quality of life.
9. gain knowledge with the holistic and multidisciplinary approach across the fields. 10.

analyzing the results critically and applying acquired knowledge to solve the problems. 11.

be independent innovations and published it though research papers and projects.

PROGRAM SPECIFIC OUTCOMES (PSO's):

The student will

1. have a strong foundation for being research in mathematics.
2. be able to apply mathematical skills for solving problems.

3. at least basic knowledge of programming and computational techniques as required for employment.

4. capable to analyze the results critically and apply acquired knowledge to solve the prob lems.

5. have at least four different skills and capable to think and communicate in three different languages.

6. be able prepare the models for real life problems.

BASIC INFORMATION:

1. Title of the Program: B.A./B. Sc. (Mathematics)

2. Minimum Duration:

   i) 3 years for B.Sc. Degree- Major in Mathematics.

   ii) 4 years for B.Sc. Honours with Major in Mathematics.

3. Maximum Program Duration: 7 years from the date of admission to the program, also referred as valid registration period.

4. Medium of Instruction: English

5. Attendance: Minimum 75% attendance for all type of courses.

6. Teaching-Learning: 15 weeks per semester

7. Total Credits: 132 credits for 3 years under graduate degree and 176 credits for 4 years under graduate (Honours) degree. As per UGC norms one credit means 30 hours for practical/lab sessions and 15 hours for theory.

8. Semester Credits: 22 credits in each semester.

9. Continuous Assessment: Continuous Assessment(CA) will be conducted for contin uous evaluation during teaching-learning. 30% weightage may be considered for one or more of the following.

   i) Home assignment(s)

   ii) Seminar/Presentation (individual / group)

   iii) Laboratory Assignment

   iv) Group discussions / Oral

   v) Research paper review

   vi) Technology demonstration using ICT

10. End Exam: End Examination (EE) will be conducted for summative evaluation of the student for 70% weightage.

11. Passing of course: Min. 40% in CA and EE each.

12. Eligibility:

Admission eligibility for the Program	Degree Certification Eligibility
HSC/ (10+2) or equivalent from a recognized board OR 10+3 Diploma (any stream) awarded by any state board of technical education	Min 40% marks out of total 132 credits at Semesters 01 to 06 for B.A./B.Sc. Mathe matics degree OR Min 40% marks out of total 176 credits at semesters I to VIII B.A./B.Sc. Mathematics Honours degree.

13. Rules for A.T.K.T.: A student who wishes to take admission to the second year (to register for third or fourth semester) of B. A. /B. Sc. (Mathematics) program has to earn at least 22 credits from the total credits of two semesters of the first year of B. A./B.Sc. (Mathematics).

14. Multiple Entry and Multiple Exit:

Level of the Program	Entry Option (with criteria)	Exit Option (with criteria)
Certificate Level	HSC (10+2) OR equivalent from the recognized Board OR 10+3 Diploma (any stream) awarded by any state board of technical education	Award of UG certificate in Mathematics as Major with 44 credits and an additional 4 credits core NSQF course/ Internship.
Diploma Level	UG Certificate in Mathematics as Major with 40-44 credits	Award of UG Diploma in Mathematics as Major with 88 credits and an additional 4 credits core NSQF course/Intern ship
Degree Level	UG Diploma in Mathematics as with 80-88 credits	Award of UG Degree in Mathematics as Major with 132 credits

15. Abbreviation:

VSC : Vocational Skill Course
IKS : Indian Knowledge System
FP : Field Project
OJT : On Job Training
CEP : Community Engagement and Service
GE/OE : Generic Elective / Open Elective
SEC : Skill Enhancement Course
AEC : Ability Enhancement Course
VEC : Value Education Course
CC : Co-curricular Courses
RP : Research Project
RM : Research Methodology
T : Theory
P : Practical

16. Note:

i) VSC, IKS, FP/OJT/CEP should be related to the Major subject.

ii) The Minor subject may be from the different disciplines of the same faculty of Major (Core) or they can be from different faculty altogether.

iii) OE is to be chosen compulsorily from faculty other than that of the Major. iv) SEC Prepared by BOS or to be selected from the basket approved by university. v) Wherever require the BOS can choose theory or practical course as per the need and within the given structure.

17. EXAMINATION RULES:

(a) A student cannot appear for semester end examination unless he/she has maintained 75% attendance during the teaching period of that course. If a student fails to main

tain 75% attendance at the time of filling of examination forms, an undertaking from the student should be taken stating that he/she will be allowed to appear for ex amination subject to fulfilment of required attendance criteria during the remaining period of teaching of the course.

(b) Each credit will be evaluated for 25 marks Including End Examination (EE) and Continuous Assessment (CA).

(c) Each course of 04 Credits will have semester End Examination (EE) of 70 Marks and Continues Assessment (CA) of 30 Marks while each course of 02 Credit will have semester-end examination of 35 Marks and Continues Assessment of 15 Marks.

(d) To pass a course, the student has to obtain 40% marks for Continuous assessment (CA) and Semester-End Examination (EE) each of these separately.

(e) If any student is not able to appear for internal assessment examination, he/she may be allowed to appear for examination by the permission of higher authorities based on the verification of reason.

(f) Students who fail to score passing marks in semester-end exam/Continues Assess ment may appear for the semester-end exam/ Continuous Assessment in the subse quent period but within allotted period for Program. The allotted period for two, three and four year degree programs is four, five and seven years respectively.

(g) A student cannot register for the subsequent year unless he/she achieves 50% credits of the total credits expected to be ordinarily completed for that particular year. The student can seek admission to third year only after achieving 100% Credits of the first year as well the student seeking admission to fourth year should achieve 100% Credits of second year.

(h) There shall be revaluation of the answer scripts of semester-end examination but not of internal assessment and Practical Examination.

(i) Even though the marks will be given for all examinations, they will be converted into grades. The semester end and final mark sheets and transcripts will have only grades and grade points average.

(j) Continuous Assessment of each Course will have weightage of 30% of marks and a teacher must select at least three components for the examination from the following

i) Written Test / Mid Term Test/ An Open Book Test
ii) Seminar/ Group discussion.
iii) Journal/Lecture/Library notes.
iv) PPT or poster Presentation.
v) Short Quizzes.
vi) Assignments
vii) Mini Research Project
viii) Field visit/ Industrial visit

(k) Evaluation of OJT/FP/RP/RM will be done during practical Examination through external examiners by dissertation, Presentation, Oral, Field work project report, etc.

Board of Studies in Mathematics, Savitribai Phule Pune University, Pune							
Proposed Credit Structure for Level 4.5-8 as per Govt. of Maharashtra through GR- **शासन ननर्णय क्रमांक३ नशका**							
Year/ Level	**Sem .**	**Subject- I**			**Subject- II**	**Subject- III**	**V-**
							OE

1 Yr./4.5	**I**	2(T)+2(T/P)=4 **MTS-101-T :**Algebra and Calculus-I (2T) **MTS-102-P:** Practical Based on MTS-101(2P)	--	_	_	2(T)+2(T/P)=4	2(T)+2(T/P)=4	2(O 10 M (c er Fa ty
	II	2(T)+2(T/P) =4 **MTS-151-T :**Algebra and Calculus-II (2T) **MTS-152-P :**Practical Based on MTS-151(2P)		_	_	2(T)+2(T/P)=4 2		2(O 15 M (c er Fa ty
Students will Select One Subject Among the (Subject 1, Subject 2, Subject 3) as Major								
		Major	**Elective**	**VSC**	**OJT/ FP /CEP**	**Minor**	**-**	**OE**
		V-1		**V-4**	**V-6**	**V-2**		**V-**
2 Yr./5.0	**III**	4(T)+2(P)=6 **MTS-201MJ:** Calculus of Several Variables(T) **MTS-202MJ:** Laplace Transforms (T) **MTS-203 MJP:** Practical Based on MTS201&M TS2 02 (P)	--	2 **MTS-221VSC** Foundatio n Mathemati cs (T)	2 MTS 231 FP	2(T)+2(P)=4 MTS 241 MN &MTS 242 MN	-	2 O 20 M (c er Fa ty
	IV	4(T)+2(P)=6 **MTS-251MJ:** Linear Algebra(T) **MTS-252 MJ:** Vector Calculus (T) **MTS-254 MJP :** Practical Based on MTS251&MTS2 52 (P)	--	2 **MTS-271VSC** R Programmi ng (P)	2 MTS 281 CEP	2(T)+2(P)= 4M TS 291 MN &MTS 292 MN	-	2(O 25 M (c er Fa ty

3 Yr./5.5	**V**	8(T)+4(P)=12 **MTS-301 MJ :** Abstract Algebra **MTS-302MJ :** Set Theory and Logic **MTS-303 MJ :** Real Analysis **MTS-304 MJ :** Graph Theory (T) **MTS-305 MJP :** Practical Based on MTS-301 and 302 **MTS-306 MJP** : Practical Based on MTS-303 and 304	2(T)+2(T/P) =4 **MTS-310 MJ:** A) Numerical Analysis(T) OR B) LPP and Game Theory(T) **MTS-311 MJP:** Practical based on MTS-310 (A / B)	2 **MTS-321 VSC:** Mathema tic al Statistics (P)	2 MTS 331 FP/CE P	2(T/P) MTS 341 MN	-	
	VI	8(T)+4(P)=12 **MTS-351 MJ**: Metric Spaces **MTS-352 MJ** : Differential Equations **MTS-353 MJ:** Complex Analysis **MTS-354 MJ:** Numerical Methods (T) **MTS-355 MJP**: Practical Based on MTS-351 &352 **MTS-356 MJP**: Practical Based on MTS-353 & 354	2(T)+2(T/P) =4 **MTS-360 MJ**: A) Operation Research (T) OR B) Analytical Geometry(T) **MTS-361 MJP:** Practical based on MTS-360 (A / B)	2 **MTS:371 VSC** Data Science (P)	4 MTS-381 OJT:	-	-	
Total		**44**	**8**	**8**	**10**	**18**	**8**	**8**

4 Yr./6.0	**VII**	6(T)+4(P)=10 **MTS -401 MJ:** Linear Algebra(T) **MTS-402 MJP:** Practical Based on MTS-401 (P) **MTS -403 MJ:** Group Theory **MTS -404 MJ:** Ordinary differential Equations **MTS -405 MJP:** Programming with Python(P)	2T)+2(T/P)=4 **MTS-410MJ :** A)Advanced Numerical Analysis OR B)Number Theory OR C) Combinatorics OR D)Lattice Theory **MTS-411 MJP:** Practical based on (A /B/C/D)			**4 RM**		

Hon. With Research	**VIII**	6(T)+4(P)=10 **MTS- 451 MJ:** Topology (T) **MTS- 452 MJ:** Practical Based on MTS-451 (P) **MTS- 453 MJ:** Ring Theory(T) **MTS- 454 MJ:** Advanced Calculus(T) **MTS- 455 MJ:** Data Science(P)	2T)+2(T/P)=4 **MTS-460 MJ** A)Graph Theory OR B)Dynamical Systems OR C) Coding Theory OR D)Operation Research **MTS-461 MJP:** Practical based on MTS 460 (A/B/C/D)					
Total		**64**	**16**	**8**	**10**	**22**	**8**	**8**

Syllabus for F.Y.B.Sc. as per NEP-2020
Subject: Mathematics

Semester - I

MTS 101-Algebra and Calculus I

Course type: Theory No. of Credits: 02

Course Objectives: This course aims

1. To provide a first approach to Algebra, a basic pillars of mathematics.
2. To cover the basic knowledge of integers and polynomials.

3. To study the theory of integers and polynomials.

4. To establish the fundamental theorem and applications of single variable functions.

5. To understand real numbers and its properties.

6. To understand the concept of limiting process, and continuity in terms of limit. 7.

To develop mathematical thinking and skills.

Course Outcomes: The student will able

1. To know the concept of divisibility in integers.

2. To find Greatest Common Divisor of integers using the Euclidean algorithm.

3. To understand the concept of Fermat?s theorem and Euler?s phi function.

4. To understand the method of finding roots of polynomials and relationship between roots and coefficients of a polynomial.

5. To classify real numbers and recognize various properties of real

numbers. 6. To understand the concept of limit and continuity.

7. To draw the graphs of algebraic and transcendental functions considering limits and continuity.

8. To apply the concept of limit and continuity for advanced study of different mathematics courses, and in physical, chemical and biological sciences.

Course Content

Section I: Algebra

Unit 1: Integers (09 Hours) 1.1 Well Ordering Principle and Principle of Mathematical Induction

(First Principle).

1.2 Divisibility in integers (Z) -Definition and elementary properties, Division algorithm, Greatest Common Divisor (GCD), Least Common Multiple (LCM) of integers, basic properties of GCD, Euclidean Algorithm, relatively prime integers.

1.3 Prime numbers- Definition, fundamental theorem of Arithmetic, Euclid's lemma, Theory of Congruences, basic properties, Fermat's theorem, Euler's phi function, Euler's theorem.

Unit 2: Polynomials (06 Hours)

2.1 Definition of a polynomial, degree of a polynomial, algebra of polynomials, division algo rithm (Statement only) and examples, Greatest Common Divisor (GCD) of two polyno mials (Definition and examples).

2.2 Synthetic division, Remainder theorem, Factor theorem.

2.3 Relation between roots and co-efficient of a polynomial.

Reference Books:

1. Elementary Number Theory, David M. Burton, Tata McGraw Hill, Seventh Edition. Chapter 1: Sec. 1.1, Chapter 2: Sec. 2.2, 2.3,2.4, Chapter 3: Sec. 3.1, Chapter 4:Sec. 4.2, Chapter 5: Sec. 5.2 up to corollary on Theorem 5.1, Chapter 7: Sec. 7.2 only definition, Section 7.3, lemma and Theorem 7.5.

2. Theory of Equations, J. V. Uspensky, McGraw Hill Book Company. Chapter 2, Chapter 3: Sec. 5

3. Textbook of Algebra, S. K. Shah and S. C. Garg, Vikas Publishing House Pvt. Ltd. Edition 2017.

Section II: Calculus

Unit 3: Real Numbers (06 Hours) 3.1 Number system - N,Z,Q,R, Algebraic and Order properties of R.

3.2 Absolute Value of a real number, geometrical meaning, Absolute value properties of R , triangle inequality, examples on absolute value of R.

3.3 Boundedness of R -Neighborhood of a point on real line, Intervals, Lower bound, Upper bound and examples, Well Ordering Principle of N, Supremum and Infimum of a subset of R and examples, Completeness property of R.

Unit 4: Limits and Countinuity (09 Hours) 4.1 Limit of Real valued function-Definitions and examples, Algebra of limits and examples.

4.2 Limit theorems- Squeeze theorem and some results, one sided limits and limits at infinity and examples.

4.3 Continuity - Definition of deleted neighborhood of a point, Continuity of a function at a point - Definitions and examples, Algebra of continuous functions, properties, Con tinuity on an interval - Definition and examples, Bounded function, Boundedness the orem (Statement only), Absolute maximum and minimum of a function - definition, Maximum-Minimum theorem (statement only), Location of roots theorem statement only), Bolzano?s theorem (statement only) the intermediate value theorem

Text Books:

1. Calculus, Vol. I: One Variable Calculus with an Introduction to Linear Algebra- Tom M. Apostol, Second Edition, Reprint 2011, Wiley Students Edition, John Wiley and Sons Inc., U.K
   (a) Introduction Part 3: 1.3.1, 1.3.2, 1.3.4, 1.3.7, 1.3.8, 1.3.13 (without Theorem 1.3.5), 1.4.3, 1.4.8 (Theorem 1.3.8, Theorem 1.3.9, Theorem 1.4.0)
   (b) Chapter 3: 3.2, 3.3, 3.4, 3.5 - Theorem 3.2, Theorem 3.3, Theorem 3.4, Theorem 3.6, Theorem 3.7, Theorem 3.8, Theorem 3.10, Theorem 3.11 (without proof), Theorem 3.12.

Reference Books:

1. Introduction to Real Analysis - R. G. Bartle and D. R. Sherbert, Third Edition, John Wily and Sons, Inc.
   (a) Chapter 1: Section 1.2 - 1.2.1, 1.2.2, 1.2.3.
   (b) Chapter 2: Section 2.1: 2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6, 2.1.7 Theorem), 2.1.8 (Theorem), 2.1.9 (Statement only), 2.1.10 (Theorem), 2.1.11, 2.1.12, 2.1.13. Section 2.3: 2.3.1, 2.3.2, 2.3.3, 2.3.6, 2.4.3, 2.4.8, 2.4.9.
2. Differential Calculus- Shantinarayan Tenth Revised Edition
3. Introduction to Real Analysis - William F. Trench, Free Edition, 2010. 4.

Calculus of single Variable - Ron Larson, Bruce Edwards, Tenth Edition.

5. Elementary analysis: the theory of Calculus - Kenneth A. Ross, Second Edition, Springer Publication.

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MTS 102 - Practicals based on MTS-101 (Algebra and Calculus I) Course type:

Practical No. of Credits: 02

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IKS 101 MTS: Generic IKS

Course type: IKS No. of Credits: 02 ******

SEC-101 MTS: Python-I

Course type: SEC No. of Credits: 02

Course Objectives: This course aims

1. To know about python IDE.
2. To write, test, and debug simple Python programs.
3. To implement Python programs with conditionals and loops statements.
4. To understand the syntax of strings in Python.
5. To understand the concept of function.
6. To understand the concept of list, tuples and its operation.

Course Outcomes: The student will able

1. To write python programs and develop a small application.
2. To develop logic for problem solving.
3. To be familiar about the basic constructs of programming such as data, operations, con ditions, loops, functions etc.
4. To be familiar with string and its operation.
5. To develop basic concepts of function and terminology.
6. To determine the methods to create and develop Python programs by utilizing the data structures like lists and tuples.

Course Content

Unit 1: : Python Basics and IDE (04 Hours) 1.1 Introduction of Python.

1.2 Installing Python

1.3 Running Simple Program.

1.4 Removing Keys.

1.5 Traversing a Dictionary

- Practical 1 based on unit 1.

Unit 2: Basics of Python (08 Hours) 2.1 Data type of Python.

2.2 Variable declaration rule.

2.3 Python Identifier and reserved words.

2.4 Input Output Function.
2.5 Operator of Python.

2.6 Advanced Python operator(Membership and identity).

2.7 Comments in Python.

2.8 Line and Indentation.

- Practical 2, Practical 3 based on unit 2.

Unit 3: Conditional structure (08 Hours) 3.1 if Statements

3.2 if -else and statement

3.3 Nested if

3.4 if-elif-else ladder

- Practical 4 and Practical 5 based on unit 3.

Unit 4: Iteration statement (12 Hours) 4.1 Loop Control Structure.

4.1.1 While loop

4.1.2 For loop

4.2 Nested loop

4.3 Break Statement

4.4 Continue Statement

4.5 Pass Statement

- Practical 6, Practical 7 and Practical 8 based on unit 4.

Unit 5: String and Function (12 Hours) 5.1 String Basics.

5.2 Accessing and updating String.

5.3 Built-in String Methods.

5.4 Function in Python.

5.5 Declaration and Calling function.

5.6 Function Argument

5.7 Anonymous Functions

- Practical 9, Practical 10 and Practical 11 based on unit 5.

Unit 6: List and Tuple (16 Hours) 6.1 Python Lists.

6.2 Accessing and updating List.

6.3 Basic List Operation.

6.4 Built-in List Methods.

6.5 Python Tuple.

6.6 Accessing and updating tuple.

6.7 Basic tuple operation.

6.8 Built-in tuple Method.

- Practical 12 to Practical 15 based on unit 6.

Reference Books:

1. Fundamentals of Python first programs, 2nd Edition, Kenneth A. Lambert. 2.

Beginning Python from Novice to Professional, Third Edition, Magnus Lie Hetland. 3.

Python for Science and Engineering, Hans-Petter Halvorsen.

4. Python Programming: An Introduction to Computer Science, Third Edition, John Zelle.

5. Introduction to Scientific Computing in Python, Continuum Analytics and Robert Jo hansson.

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Semester - II

MTS-151:Algebra and Calculus II

Course type: Theory No. of Credits: 02

Course Objectives:

1. To study matrix properties, algebraic properties, and methods for finding the inverse of a matrix.
2. To explore the solution of systems of linear equations and evaluate determinants by row reduction.
3. To learn the properties of determinants and study the applications of matrices and de terminants.
4. To learn how to find the derivative of a function using limits, and understand the geo metrical and physical significance of derivatives.
5. To explore methods to find the n^{th} derivatives of functions.
6. To generalize the comprehensive study of combined algebra and calculus. Course

Outcomes: The successful completion of these course students will able to:

1. Understand the various types of matrices, their properties, and how to convert matrices to echelon form using elementary row operations.
2. Learn methods to solve systems of linear equations, understand the concept of determi nants, evaluate determinants by different methods, and solve problems using properties of determinants.
3. Apply the concept of matrices and determinant to the problems in chemistry, electronics, cryptography, etc.
4. Understand differentiation and fundamental theorem in differentiation.
5. Apply Mean Value Theorems and it's applications
6. Explore the combined application of algebra and calculus to various mathematical prob lems.

Course Content

Unit 1 : Systems of Linear Equations and Matrices: (08 Hours) Section I: Matrix Algebra

1.1 Matrices and Matrix Operations.

1.2 Inverses; Algebraic Properties of Matrices

1.3 Elementary Matrices and a Method for Finding A^{-1}

1.4 Matrix, Matrix Notation and Size of Matrix.
1.5 Diagonal, Triangular, and Symmetric Matrices [Definitions and examples only]

1.6 More on Linear Systems and Invertible Matrices

1.7 Introduction to Systems of Linear Equations

1.8 Gaussian Elimination Method.

Note: Theorems 1.4.1,1.4.3,1.4.8,1.5.3,1.6.1-1.6.4,1.7.1 are without proof. Unit 2:

Determinants (07 Hours) 2.1 Determinants by Cofactor Expansion.

2.2 Evaluating Determinants by Row Reduction.

2.3 Properties of Determinants; Cramer's Rule (Without Proof).

2.4 Applications towards Balancing Chemical Equations.

2.5 Applications in Cryptography.

Note: Theorems 2.1.1, 2.1.2, 2.2.3, 2.2.4, 2.3.1, 2.3.6, 2.3.8 are without proof

Recommended book:

1. Elementary Linear Algebra by Howard Anton, Chris Rorres, 11th Edition [Applications Version] Unit 1: Section 1.1 to 1.7 , Unit 2: Section 2.1 to 2.3, 2.4 [1.10 Balancing Chemical Equations]

Reference Books:

1. Matrix and Linear Algebra by K. B. Datta, Prentice Hall India Pvt., Limited, 2004. 2.

Fundamentals of Matrix Algebra, (3rd Edition) by G. Hartman

3. Linear Algebra and its Applications, David Lay, Third Edition, Pearson Publications.

Section II: Calculus
Unit 3: Differentiation (06 Hours) 3.1 The Derivative as a Function.

3.2 Differentiation Rules

3.3 The Derivative as a Rate of Change

3.4 Derivatives of Trigonometric Functions

3.5 The Chain Rule

3.6 Applications

Unit 4: Mean Value Theorems (09 Hours) 4.1 Extreme Values of Functions.

4.2 The Mean Value Theorem

4.3 L'Hospital's Rule (without proof)
4.4 Cauchy's Mean Value Theorem

Recommended book:

1. Applied Finite Mathematics by R. Sekhon and R. Bloom, Libre Texts. Unit 2 (2.5): Section 2.5

2. Thomas Calculus: EARLY TRANSCENDENTALS (12th Edition), Pearson Education Unit 3: Section 3.2 - 3.6 and 3.10 Unit 4: Section 4.1 - 4.2 and 4.5

Reference Books:

1. Calculus Volume I (Second Edition) Wiley Student Edition, T. M. Apostol, John Wiley, New Delhi.

2. Elements of Real Analysis, Shanti Narayan, M. D. Raisinghaniya (Revised Edition 2012), S. Chand and Company Ltd.

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MTS 152 - Practicals based on MTS-151 (Algebra and Calculus II) Course type:

Practical No. of Credits: 02

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SEC-151 MTS Python-II

Course Objectives:

1. To give students an advanced introduction to Programming.
2. To learn and understand Python programming and paradigm.
3. To implement python program with dictionary and turtle
4. To understand the concept of 2D graphics
5. To understand the concept of files
6. To prepare the program for matrix and operations on it.

Course Outcomes:

1. To write python program and develop maps using dictionary
2. To develop logic for 2D graphics.
3. Demonstrate the use of Python in mathematics such as matrix algebra 4.

To be familiar about basic math built in functions such as sine, cosine, etc. 5.

To be familiar with complex numbers

6. To write Python programs to handle matrices and vectors using NumPy.

Course Content

Unit 1: Dictionaries (08 Hours) 1.1 Dictionary Literals

1.2 Adding Keys and Replacing Values

1.3 Accessing Values

1.4 Removing Keys

1.5 Traversing a Dictionary

-Practical 1 and Practical 2 based on unit 1.

Unit 2: Simple Graphics (12 Hours) 2.1 Overview of Turtle graphics

2.2 Turtle operations

2.3 Setting up a turtle.cfg file and running IDLE.

2.4 Object instantiation and the turtle module

2.5 Drawing two dimensional shapes
2.6 Examining an object's attributes

2.7 Manipulating a Turtle's screen

2.8 Taking a random walk

2.9 Colours and the RGB system

-Practical 3, Practical 4 and Practical 5 based on unit 2.
Unit 3: Complex Numbers in Python (08 Hours) 3.1 Introduction to complex numbers

3.2 Complex numbers with Python

-Practical 6 and Practical 7 based on unit 3.

Unit 4: File Handling (08 Hours) 4.1 Opening Files: File Modes

4.2 The basic file methods

4.2.1 Reading and Writing

4.2.2 Piping output

4.2.3 Reading and writing lines

4.2.4 Closing files

4.2.5 Using the basic files methods

4.3 Iterating over file content

4.3.1 One character at a time

4.3.2 One line at a time

4.3.3 Reading everything

4.3.4 Lazy line iteration with file input

4.3.5 File iterators

-Practical 8 and Practical 9 based on unit 4.

Unit 5: NumPy (12 Hours) 5.1 NumPy basics

5.2 NumPy arrays

5.3 Copying / Sorting

5.4 Array manipulation.

5.5 Mathematics

5.6 Basic Statistics

-Practical 10, Practical 11 and Practical 12 based on unit 5.

Unit 6: Matrix Algebra in Python (12 Hours) 6.1 Vectors

6.2 Matrices

6.3 Linear Algebra

6.4 Matrix addition

6.5 Matrix subtraction

6.6 Matrix multiplication

6.7 Transpose of a matrix.

6.8 Determinant.

6.9 Inverse matrix

- Practical 13 and Practical 14 based on unit 6.
- Practical 15 is based on unit 5 and 6.

Reference Books:

1. Fundamentals of Python first programs, 2nd Edition, Kenneth A. Lambert. 2.

Beginning Python from Novice to Professional, Third Edition, Magnus Lie Hetland. 3.

Python for Science and Engineering, Hans-Petter Halvorsen.

4. Python Programming: An Introduction to Computer Science, Third Edition, John Zelle.

5. Introduction to Scientific Computing in Python, Continuum Analytics and Robert Jo hansson.

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[Open Electives for the Students other than Faculty of Science] OE-101
MTS : Basic Mathematics- I

Course type: OE(T) No. of Credits: 02

Course Objectives:

1. To understand basic concepts of Mathematics.
2. To be able to use the language, symbols, and notation of Mathematics.
3. To develop Mathematical curiosity and acquire skills in problem solving.
4. To develop an appropriate understanding of how to use mathematics in real-world prob lems.
5. To cultivate the right understanding and regain numerical aptitude.
6. To develop a logical approach toward analytical approach data.

Course Outcomes: The student will able

1. To understand the concepts of numbers and integers and able to develop skills in basic operations of integers to cultivate the right understanding and regain numerical aptitude.
2. To understand concepts of H.C.F. and L.C.M. of numbers, square root and cube Root and ability to apply in real-world problems.
3. To understand concepts of ratio, proportion, percentage and be able to cultivate the right understanding regaining numerical aptitude.
4. To understand concepts of average, profit and loss develop a logical approach toward analytical approach to real-world problems
5. To provide a platform for the students to build the fundamentals of Basic Mathematics for competitive examination preparation strategy
6. To establish a framework for the students to help acquire the knowledge and expertise necessary to secure employment opportunities in the government sector

Course Content

Unit 1: Integers (12 Hours) 1.1 Introduction to number system, Basic operations of integers

1.2 Highest Common Factor (H.C.F.) and Least Common Multiple (L.C.M.)

1.3 Square root and cube Root

Unit 2: Ratio, Proportion and Percentage (08 Hours) 2.1 Introduction to ratio and proportion

2.2 Finding ratio and proportion

2.3 Types of ratios

Unit 3: Average (04 Hours) 3.1 Introduction to average

3.2 Finding the average

Unit 4: Profit and Loss (06 Hours) 4.1 Introduction to profit and loss

4.2 Finding profit and loss

Reference Book:

Quantitative Aptitude for Competitive Examination by Dinesh Khattar, Pearson India Educa tion Services Pvt. Ltd., Fourth Edition.

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OE-102 MTS: Applied Mathematics - I

Course type: OE(P) No. of Credits: 02(P)

Course Objectives:

1. To develop a strong understanding of Geometry.
2. To becomes Master of basic operations on numbers in different way.
3. To gain proficiency in working with Profit and loss.
4. To acquire a solid foundation of trigonometry.
5. To learn the simulation of data.
6. To develop problem-solving skills by applying operations.

Course Outcomes: The student will able to

1. Enhance mathematical reasoning and critical thinking.
2. Easily present the data graphically.
3. Have the knowledge of geometrical shapes and their equations.
4. Have Skills of comparison through diagrams and charts.
5. Got the business ability.
6. Achieve the techniques of finding area and volume.

Course Content

Unit 1: Mensuration (08 Hours) Perimeter of circle, triangle, square and rectangle. Area of circle, square, rectangle and triangles. Surface area of cylinder, sphere, cube and cuboid. Volume of cube, cuboid, sphere, hemisphere, cylinder and cone.
Unit 2: Trigonometry (08 Hours) Degree and radian, Trigonometric ratios and identities, Angle of elevation and depression, Height and distance problems.
Unit 3: Arithmetic (08 Hours) Arithmetic Mean, Geometric Mean, Harmonic Mean, Ratio, Proportion, Percentage, Profit and Loss, Partnership, Brokerage, (True) Discount, Simple and Compound Interest, Time and Work, Distance
Unit 4: Data Interpretation (06 Hours) Tabulation, missing data problem. Graphs and Charts - Table, Line, Bar and Pie. Reference Books:

1. Objective Arithmetic, R S Aggarwal, S. Chand & Company Ltd.

2. Business Mathematics,S. K. Sharma and G. Kaur, Sultan Chand & Sons. 3.

Business Mathematics-II Edition Q. Zameerddin, V. K. Khanna, S K Bhambri.

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OE-151 MTS: Basic Mathematics - II

Course type: OE(T) No. of Credits: 02

Course Objectives:

1. To be able to use the language, symbols and notation of Mathematics.
2. To develop Mathematical curiosity.
3. To help them acquire skills in solving problems.
4. To develop an appropriate understanding of how to use mathematics in real-world prob lems.

5. To cultivate the right understanding and regain numerical aptitude.
6. To develop a logical approach toward analytical approach data.

Course Outcomes: The student be will able

1. To understand the concepts of Time, Work and Wages also be able to logical approach towards analytical approach data of real word problem
2. To understand concepts of Linear Equations and ability to solve examples in finding Age in past and future.
3. To understand concepts of Simple and Compound Interest and to develop Mathematical Competence.
4. To understand concepts of Mensuration and able to develop Mathematical competence in solving Problems.
5. To provide a platform for the students to build the fundamentals of Basic Mathematics for competitive examination preparation strategy.
6. To establish a framework for the students to help acquire the knowledge and expertise necessary to secure employment opportunities in the government sector.

Course Content

Unit 1: Time, Work and Wages (12 Hours) 1.1 Introduction to Time, Work and Wages

1.2 Finding Time and Amount of Work

1.3 Finding Speed, Distance and Time

1.4 Finding Speed of Boats and Stream

Unit 2: Problems on Ages (06 Hours) 2.1 Introduction to Linear Equations

2.2 Finding Age Some Years Ago, Present Age and Age Some Years hence Unit 3: Simple Interest and Compound Interest (06 Hours) 3.1 Introduction to Simple Interest and Compound Interest

3.2 Finding Simple Interest

3.3 Finding Compound Interest

Unit 4: Mensuration (06 Hours) 4.1 Introduction to the Concept of Mensuration

4.2 Finding Area, Perimeter, and Some Basic Facts

4.3 Introduction to Solids and Cubes

4.4 Finding Surface Area and Volume

Reference Book:
Quantitative Aptitude for Competitive Examination by Dinesh Khattar, Pearson India Educa tion Services Pvt. Ltd., Fourth Edition.

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OE-152 MTS: Applied Mathematics - II
Title : Introduction to MS Excel

Course type: OE(P) No. of Credits: 02(P)

Course Objectives: This course aims on

1. Basic Essential Computing skills companies are looking for.

2. Hands-on Practical Knowledge.
3. Boosting their resume.
4. Providing an edge over other applicants in the competitive job market.
5. Providing valuable experience and confidence.
6. Heightening their earning potential.

Course Outcomes: The student will be able to

1. Create, save and print worksheets
2. Create formulas
3. Use functions for SUM, AVERAGE, MIN, and MAX
4. Use the function for IF
5. Format cells using many of the formatting tools
6. Present the Data Graphically

Course Content

Practical 1: The Excel environment
Navigating a worksheet
Spreadsheet terminology
Getting help

Practical 2: Entering and editing data
Entering and editing text and values
Entering and editing formulas
Saving and updating workbooks

Practical 3: Modifying a worksheet
Moving and copying data
Moving and copying formulas
Inserting and deleting ranges, rows, and columns
Cell comments

Practical 4: Using functions
Entering functions
AutoSum
Other common functions
Practical 5: Formatting
Text formatting
Row and column formatting
Number formatting
Conditional formatting
Additional formatting options

Practical 6: Printing
Preparing to print
Page Setup options
Printing worksheets

Practical 7: Charts
Chart basics
Column Chart
Pie Chart
Bar Chart
Pai Chart

Line Chart

Practical 8: Case Study
Modifying existing worksheet
Use shortcut keys
Create and email worksheet

Practical 9: Review Basics
Downloading from Account Reconciliation
The Excel environment
The Sparkline
The Trendline

Practical 10: Subtotal Functions
Create an outline and consolidate data
Create subtotals in a list
Use multiple subtotal functions- SUBTOTAL, SUMIF
Create custom views to save different sets of worksheet display and print settings

Practical 11: Range names and Filter date
Define and apply cell and range names
Use names in Formulas
Filter data based on complex criteria
Use conditional filters
Copy filtered results to another range

Practical 12: Pivot Tables
Prepare data in a table format and name the table
Create a PivotTable for analysing
Use the Download Actuals page in Account
Reconciliation as example
Modify or re-arrange fields
Practical 13: Selected Functions
Using IF and SUMIF functions to calculate a value based on specified criteria
Use ROUND function to round off numbers
Use VLOOKUP to find values in worksheet data
Use HLOO

Practical 14: Simulation
Scatter
Area
Stock
Surface
Rader

Practical 15: Applications
Applications of Ms-excel
business analysis
data entry and storage
data analysis
accounting and budgeting

Reference Book:

Beginning Excel 2019 by Noreen Brown; Barbara Lave; Hallie Puncochar; Julie Romey; Mary Schatz; Art Schneider; and Diane Shingledecker
Open Oregon Educational Resources

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