K. C. E. Society's
Moolji Jaitha College
An 'Autonomous College' Affiliated to
K.B.C. North Maharashtra University, Jalgaon.
NAAC Reaccredited Grade - A (CGPA : 3.15 - 3rd Cycle)
UGC honoured "College of Excellence" (2014-2019)
DST(FIST) Assisted College

KNOWLEDGE IS POWER
ESTD. 1945

के. सी. ई. सोसायटीचे
मूळजी जेठा महाविद्यालय
क.ब.चौ. उत्तर महाराष्ट्र विद्यापीठ, जळगाव संलग्नित
'स्वायत्त महाविद्यालय'
नॅकद्वारा पुनर्मानांकित श्रेणी – 'ए' (सी.जी.पी.ए. : ३.१५ – तिसरी फेरी)
विद्यापीठ अनुदान आयोगाद्वारा घोषित 'कॉलेज ऑफ एक्सलन्स' (२०१४-२०१९)
डी.एस.टी. (फीस्ट) अंतर्गत अर्थसहाय्य प्राप्त

Date :- 01/08/2023

NOTIFICATION

Sub :- CBCS Syllabi of B. Sc. in Mathematics (Sem. I & II)

Ref. :- Decision of the Academic Council at its meeting held on 26/07/2023.

The Syllabi of B. Sc. in Mathematics (First and Second Semesters) as per **NATIONAL EDUCATION POLICY - 2020** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2023-24.

Copy of the Syllabi Shall be downloaded from the College Website (www.kcesmjcollege.in)

Sd/-
Chairman,
Board of Studies

To :

1) The Head of the Dept., M. J. College, Jalgaon.
2) The office of the COE, M. J. College, Jalgaon.
3) The office of the Registrar, M. J. College, Jalgaon.

Near Samarth Colony, Jalgaon - 425 002. (Maharashtra, India) | Ph. : +91 257 - 2237363, 2234281 | e-mail : mjcollege@kces.in | Website : mjcollege.kces.in
समर्थ कॉलनी जवळ, जळगांव – ४२५ ००२. (महाराष्ट्र, भारत) । दूरध्वनी क्र. : +९१ २५७–२२३७३६३, २२३४२८१ । ई–मेलः mjcollege@kces.in । वेबसाईटः mjcollege.kces.in

Khandesh College Education Society's

Moolji Jaitha College, Jalgaon

An "Autonomous College"

Affiliated to

Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon-425001

STRUCTURE AND SYLLABUS

B.Sc. Honours / Honours with Research (F.Y.B.Sc. Mathematics)

Under Choice Based Credit System (CBCS)
and
as per NEP-2020 Guidelines

[w.e.f. Academic Year: 2023-24]

Preface

The Moolji Jaitha College (Autonomous) has adopted a department-specific model as per the guidelines of UGC, NEP-2020 and the Government of Maharashtra. The Board of Studies in Mathematics of the college has prepared the syllabus for the first-year graduate of Mathematics. The syllabus cultivates theoretical knowledge and applications of different fields of Mathematics. The contents of the syllabus have been prepared to accommodate the fundamental aspects of various disciplines of Mathematics and to build the foundation for various applied sectors of Mathematics. The program will be enlightened the students with the advanced knowledge of Mathematics, which will help to enhance student's employability.

The overall curriculum of three/four year covers pure mathematics, applied mathematics and computational mathematics with programming. The syllabus is structured to cater the knowledge and skills required in the research field, Industrial Sector and Entrepreneurship etc.. The detailed syllabus of each paper is appended with a list of suggested readings.

Programme Outcomes (PO) for B.Sc. Mathematics honours/ Honours with Research

Upon successful completion of the B.Sc. program, student will be able to:

PO No.	PO
1	Understand the basic concepts and fundamental principles related to various science branches
2	Aquaintthe skills in handling scientific instruments and performing in laboratory experiments
3	Relate various scientific phenomena and their relevancies in the day-to-day life.
4	Analyse experimental data critically and systematically to draw the objective conclusions.
5	Develop various skills such as communication, leadership, teamwork, social, research etc., which will help in expressing ideas and views clearly
6	Develop interdisciplinary approach for providing better solutions and sustainable developments.

Programme Specific Outcome (PSO) for B.Sc. Mathematics Honours/Honours with Research:

After completion of this course, students are expected to:

PSO No.	PSO
1	Demonstrate the concepts involved in Real analysis, Matrix Theory, Differential equations, Algebra, Number Theory and Applied Mathematics.
2	Gain proficiency in mathematical techniques of both pure and applied mathematics and will be able to apply necessary mathematical methods to a scientific problem.
3	Acquire significant knowledge on various aspects related to Linear algebra, Metric spaces, Lattice theory, Integral transforms, Optimization techniques and Partial Differential equations.
4	Learn to work independently as well as a team to formulate appropriate mathematical methods.
5	Develop the ability to understand and practice the morality and ethics related to scientific research.
6	Realize the scope of Mathematics and plan continue their education as a Post-Graduate student of Mathematics and contribute to Mathematics through their research as a doctoral student.

Credit distribution structure for Three/ Four year Honors/ Honors with Research Degree Programme with Multiple Entry and Exit

Level	Sem	Major (Core) Subjects		Minor Subjects (MIN)	GE/ OE	VSC, SEC (VESC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int, RP	Cumulative Credits/Sem	Degree/ Cumulative Cr.
		Mandatory (DSC)	Elective (DSE)							
4.5	I	DSC-1 (2T) DSC-2 (2T) DSC-3 (2T)	—	MIN-1 (2T) MIN-2 (2T)	OE-1 (2T)	SEC-1 (2T) SEC-2 (1P)	AEC-1 (2T) (ENG) VEC-1 (2T) (ES) IKS (1T)	CC-1 (2)	22	UG Certificate 44
	II	DSC-4 (2T) DSC-5 (2T) (IKS) DSC-6 (2T)	...	MIN-3 (2T) MIN-4 (2T)	OE-2 (2T)	SEC-3 (2T) SEC-4 (1P)	AEC-2 (2T) (ENG) VEC-2 (2T) (CI) IKS (1T)	CC-2 (2)	22	
	Cum. Cr	12	...	8	4	6	4+4+2	4	44	
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.										
5.0	III	DSC-7 (2T) DSC-8 (2T) DSC-9 (2P) DSC-10 (2P)	...	MIN-5 (2T) MIN-6 (2P)	OE-3 (2T) OE-4 (2P)		AEC-3 (2T) (MIL)	CC-3 (2) CEP (2)	22	UG Diploma 88
	IV	DSC-11 (2T) DSC-12 (2T) DSC-13 (2P) DSC-14 (2P)	...	MIN-7 (2T) MIN-8 (2P)	OE- 5 (2T) OE-6 (2P)		AEC-4 (2T) (MIL)	CC-4 (2) FP (2)	22	
	Cum. Cr	28	...	16	10	6	8+4+2	8+2+2	88	
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.										
5.5	V	DSC-15 (2T) DSC-16 (2T) DSC-17 (2T) DSC-18 (2P) DSC-19 (2P)	DSE-1 (2T) A/B DSE-2 (2P) A/B	MIN-9 (2T/P)	...	VSC-1 (2T) VSC-2 (2P)	...	OJT/Int(2)	22	UG Degree 132
	VI	DSC-20 (2T) DSC-21 (2T) DSC-22 (2T) DSC-23 (2P) DSC-24 (2P)	DSE-3 (2T) A/B DSE-4 (2P) A/B	MIN-10(2T/P)	—	VSC-3 (2T) VSC-4 (2P)	...	OJT/Int(2)	22	
	Cum. Cr.	48	08	20	10	8+6	8+4+2	8+2+2+4	132	
Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										
6.0	VII	DSC-25 (4T) DSC-26 (4T) DSC-28 (4T) DSC-27 (2P)	DSE-5 (2T) A/B DSE-6(2P) A/B	RM (4T)	—	...	...		22	UG Honors Degree 176
	VIII	DSC-29 (4T) DSC-30 (4T) DSC-32 (4T) DSC-31 (2P)	DSE-7 (2T) A/B DSE-8(2P) A/B		—	...	...	OJT/Int (4)	22	
	Cum. Cr.	76	16	20+4	10	8+6	8+4+2	8+2+2+8	176	
Four Year UG Honors Degree in Major and Minor with 176 credits										
6.0	VII	DSC-25 (4T) DSC-26 (4T) DSC-27 (2P)	DSE-5 (2T) A/B DSE-6 (2P) A/B	RM (2T)	...	...	...	RP (6)	22	UG Honors with Research Degree 176
	VIII	DSC-29 (4T) DSC-30 (4T) DSC-31 (2P)	DSE-7 (2T) A/B DSE-8 (2P) A/B	RM (2T)	...	...	...	RP (6)	22	
	Cum. Cr.	68	16	20+4	10	8+6	8+4+2	8+2+2+8+12	176	
Four Year UG Honours with Research Degree in Major and Minor with 176 credits										

Sem- Semester, **DSC**- Department Specific Course, **DSE**- Department Specific Elective, **T**- Theory, **P**- Practical, CC-Cocurricular **RM**- Research Methodology, **OJT**- On Job Training, **FP**- Field Project, **Int**- Internship, **RP**- Research Project,

Multiple Entry and Multiple Exit options:

The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Year Bachelor's Degree	120	132	6	3
6.0	Bachelor's Degree- Honours **Or** Bachelor's Degree- Honours with Research	160	176	8	4

F. Y. B. Sc. Mathematics Course Structure

Semester	Course Module	Credit	Hours/ week	TH/ PR	Code	Title
I	DSC	2	2	TH	MTH-DSC-111	Calculus-I
	DSC	2	2	TH	MTH -DSC-112	Theory of Matrices
	DSC	2	**2**	TH	MTH -DSC-113	Theory of Equations
	MIN	2	2	TH	MTH -MIN-111	Set Theory and Logic
	MIN	2	**2**	TH	MTH -MIN-112	Matrix Algebra
	OE/GE	2	2	TH	MTH -OE-111	Mathematics for Competitive Exams-I
	SEC	2	2	TH	MTH -SEC-111	Introduction to Scilab
	SEC	1	**2**	**PR**	MTH -SEC-112	Practical course on Scilab
	AEC	2	**2**	TH	ENGS-AEC-111	English
	VEC	2	**2**	TH	ES -VEC-111	Environmental Studies
	IKS	1	**1**	TH	IKS-111	Indian Knowledge System
	CC	2	**2**	**CC**	NCC-CC-111 NSS-CC-111 SPT-CC-111 CUL-CC-111	NCC NSS Sports Cultural
II	DSC	2	2	TH	MTH -DSC-121	Calculus-II
	DSC	2	2	TH	MTH -DSC-122	Ordinary Differential Equations
	DSC	2	**2**	TH	MTH -DSC-123	Numerical Analysis
	MIN	2	2	TH	MTH -MIN-121	Discrete Mathematics
	MIN	2	**2**	TH	MTH -MIN-122	Numerical Methods
	OE/GE	2	2	TH	MTH -OE-121	Mathematics for Competitive Exams-II
	SEC	2	2	TH	MTH -SEC-121	Introduction to Python
	SEC	1	**2**	**PR**	MTH -SEC-122	Practical course on Python
	AEC	2	**2**	TH	ENGS-AEC-121	English
	VEC	2	**2**	TH	CI-VEC-121	Constitution of India
	IKS	1	**1**	TH	IKS-121	Indian Knowledge System
	CC	2	**2**	**CC**	NCC-CC-121 NSS-CC-121 SPT-CC-121 CUL-CC-121	NCC NSS Sports Cultural

DSC : Department-Specific Core course
DSE : Department-Specific elective
GE/OE : Generic/ Open elective
SEC : Skill Enhancement Course
MIN : Minor course
AEC : Ability Enhancement Course
VEC : Value Education Courses

ENG : English
ES : Environmental Studies
CI : Constitution of India
IKS : Indian Knowledge System
CC : Co-curricular course
TH : Theory
PR : Practical

Exam Pattern:

- Each theory and practical course will be of 50 marks comprising of 20 marks internal and 30 marks external examination.

External Theory Examination (30 marks):

- External examination will be of 1.30 hours duration for each theory course. There shall be 3 questions while the tentative pattern of question papers shall be as follows;
- Q1 will be of 6 marks (attempt any 2 out of 3 sub-questions).
- Q2 and Q3 Attempt any 3 out of 4 sub-questions, each 4 marks.

External Practical Examination (30 marks):

- Major, SEC and Minor practical examination shall be conducted by the respective department at the end of the semester. Practical examination will be of minimum 3 hours duration and shall be conducted as per schedule. There shall be 05 marks for journal and *viva-voce* of Major and Minor practical exam. No marks for journal and *viva-voce* of SEC practical exam. Certified journal is compulsory to appear for practical examination of Major, SEC and Minor.
- Note: External practical examination of SEC will be of 25 marks and there will be no internal exam for SEC practical.

Internal Theory Examination (20 marks):

The Continuous Internal Evaluation for theory papers shall consist of two methods:

1. Continuous & Comprehensive Evaluation (CCE):

CCE will carry a maximum of 30% weightage (30/15 marks) of the total marks for a course. Before the start of the academic session in each semester, the subject teacher should choose any three assessment methods from the following list, with each method carrying 10/5 marks:

i. Individual Assignments
ii. Seminars/Classroom Presentations/Quizzes
iii. Group Discussions/Class Discussion/Group Assignments
iv. Case studies/Case lets
v. Participatory & Industry-Integrated Learning/Field visits
vi. Practical activities/Problem Solving Exercises
vii. Participation in Seminars/Academic Events/Symposia, etc.
viii. Mini Projects/Capstone Projects
ix. Book review/Article review/Article preparation
x. Any other academic activity
xi. Each chosen CCE method shall be based on a particular unit of the syllabus, ensuring that

three units of the syllabus are mapped to the CCEs.

2. Internal Assessment Tests (IAT):

IAT will carry a maximum of 10% weightage (10/5 marks) of the total marks for a course. IAT shall be conducted at the end of the semester and will assess the remaining unit of the syllabus that was not covered by the CCEs. The subject teacher is at liberty to decide which units are to be assessed using CCEs and which unit is to be assessed on the basis of IAT.

The overall weightage of Continuous Internal Evaluation (CCE + IAT) shall be 40% of the total marks for the course. The remaining 60% of the marks shall be allocated to the semester-end examinations.

The subject teachers are required to communicate the chosen CCE methods and the corresponding syllabus units to the students at the beginning of the semester to ensure clarity and proper preparation.

Internal Practical Examination (20 marks):

- Internal practical examination of 10 marks will be conducted by department as per schedule given.
- For internal practical examination student must produce the laboratory journal of practicals completed along with the completion certificate signed by the concerned teacher and the Head of the department.
- There shall be continuous assessment of 30 marks based on student performance throughout the semester. This assessment can include quizzes, group discussions, presentations and other activities assigned by the faculty during regular practicals. For details refer internal theory examination guidelines.
- Finally 40 (10+30) marks performance of student will be converted into 20 marks.

SEMESTER-I

F.Y.B.Sc. Mathematics (Major)
SEMESTER-I
MTH-DSC-111: Calculus-I

Total Hours: 30 **Credits: 2**

Course Objectives	• To know the concept of real numbers, supremum, infimum and completeness of real numbers. • Assimilate the notion of limit of a sequence. • Assimilate the notion of convergence of a series of real numbers. • To know the limit of a function at a point.	
Course Outcomes	After successful completion of this course, students are expected to: • Understand the notions of real numbers, supremum, infimum and completeness of real numbers. • Understand the notion of limit of a sequence. • Understand the notion of convergence of a series of real numbers. • Calculate the limit of a function at a point.	
Unit	**Content**	**Hours**
Unit I	**Real Numbers:** Algebraic properties of $\mathbb{R}$, Order properties of $\mathbb{R}$, Well-Ordering Property of $\mathbb{N}$. Arithmetic mean-Geometric mean inequality, Bernoulli's inequality.(Revision: essential properties should be revised with illustrative examples), Absolute value function and its properties, Triangle inequality and its consequences, neighbourhood of a point on a real line, Definitions of Upper bound, Lower bound, bounded sets, supremum, infimum of subsets of $\mathbb{R}$, completeness property of $\mathbb{R}$, Archimedean property and its consequences, the density theorem (without proof), Intervals of real line, nested interval property (statement only).	**7**
Unit II	**Sequences:** Definition and examples of sequences of real numbers, Definition of limit of sequence and uniqueness of limit, Examples of limit of sequence, Definition of bounded sequence, every convergent sequence is bounded, Algebra of limits, Monotone sequences, Monotone convergence theorem, Definition of subsequence and examples, Divergence criteria, Monotone Subsequence theorem (without proof), Bolzano-Weierstrass theorem (first proof), Cauchy sequence (definition and examples only).	**8**
Unit III	**Series:** Definition, Sequence of partial sums, Convergent series and Divergent series, Some tests for convergence of series (statements and examples only).	**7**
Unit IV	**Limits:** Functions and their Graphs, Definition of cluster point and examples, Definition of limit of a function, Sequential criterion for limits, Divergence criteria, Algebra of limits (proofs using sequential criterion), Squeeze theorem for limit, one sided limits, infinite limits (without proof).	**8**
Study Resources	• Bartle, R. G., and Sherbert, D. R., *Introduction to Real Analysis* (4th ed.). John Wiley and Sons Inc. • Malik, S. C. (2011). *Principles of Real Analysis* (2nd ed.). New Academic Science. • Howard A., Bivens, I., and Stephan D. (2016). *Calculus* (10th ed.). Wiley India.	

	• Gabriel, K. (1986). *Aspects of Calculus*. Springer-Verlag. • Wieslaw, K., and Rai B. (2003). *Calculus with Maple Labs*. Narosa. • Prasad, G. (2016). *Differential Calculus* (19th ed.). Pothishala Pvt. Ltd. • Thomas, G. B., Hass, J., Heil, C., and Weir M. D. (2018). *Thomas' Calculus* (14th ed.). Pearson Education.	

F.Y.B.Sc. Mathematics (Major)
SEMESTER-I
MTH-DSC-112: Theory of Matrices

Total Hours: 30 **Credits: 2**

Course objectives	• To know the basic need of this course is to understand the concepts and applications of matrices. • It will improve problem solving and logical thinking abilities of the students. • To study the concepts of theory of matrices in linear algebra. • To use theory of matrices in solving linear equations.	
Course outcomes	Upon successful completion of this course the student will be able to: • Understand operations on matrices. • Understand the concept of rank of a matrix and inverse of a matrix. • Understand the concept of eigenvalues and eigenvectors. • Use theory of matrices to scaling & shearing, reflection, rotation & translation.	
Unit	**Content**	**Hours**
Unit I	**Rank of Matrix:** • Elementary operations on matrices • Adjoint of a matrix & Inverse of a matrix • Existence & uniqueness theorem of inverse of a matrix • Properties of inverse of a matrix • Elementary matrices • Rank and normal form of a matrix • Reduction of a matrix to its normal form • Rank of product of two matrices	**7**
Unit II	**System of Linear Equations:** • A homogeneous and non-homogeneous system of linear equations • Consistency of system of linear equations • Application of matrices to solve the system of linear equations	**8**
Unit III	**Eigen Values and Eigen Vectors:** • Orthogonal matrices and properties of orthogonal matrices • Characteristic equation • Eigen values and Eigen vectors of matrices • Cayley Hamilton theorem (statement only) and its use to find the inverse of a Matrix	**7**
Unit IV	**Matrix Transformation:** • Two and Three-dimensional Matrix Transform • Application of matrices to Scaling & Shearing • Application of Matrices to Reflection, Rotation & Translation	**8**

Study Resources	• Datta, K. B. (2000). *Matrix and Linear Algebra*. Prentice Hall of India Pvt. Ltd, New Delhi. • Shanti, N. (2012). *A Text Book of Matrices*. S. Chand Limited, New Delhi. • Bronson, R. (1989). *Schaum's Outline of Theory and Problems of matrices*. McGraw-Hill, New York. • John, V. (2010). *Mathematics for Computer Graphics*. Springer-Verlag London.	

F.Y.B.Sc. Mathematics (Major)
SEMESTER-I
MTH-DSC-113: Theory of Equations

Total Hours: 30 **Credits: 2**

Course Objectives	• To study Principle of Mathematical Induction and Divisibility of numbers. • To study roots of polynomial equations and Fundamental theorem of algebra. • To know relations between roots and coefficients of polynomials of degree ≤ 4. • To know roots of cubic equations by using Cardon's method, biquadratic equations by Descarte's method and roots of polynomial equation s by Newton's method.	
Course Outcomes	After successful completion of this course, students are expected to: • use of Principle of Mathematical Induction and understand Divisibility of numbers with their properties. • find out roots of any equation of degree less than or equal to five. • know the relation between roots and coefficient of quadratic, cubic and biquadratic equations and their use for finding the roots of equation. • use of Cardon's method, Descarte's method for solving equations.	
Unit	**Content**	**Hours**
Unit I	**Divisibility of Integers:** • Natural numbers • Well ordering principal (statement only) • Principle of Mathematical Induction • Divisibility of integers and theorems • Division algorithm • GCD and LCM • Euclidean algorithm • Unique factorization theorem	**7**
Unit II	**Polynomials:** • Revision of Polynomials • Horner's method of synthetic division • Existence and uniqueness of GCD of two polynomials • Polynomial equations • Factor theorem and generalized factor theorem for polynomials • Fundamental theorem of algebra (Statement only) • Methods to find common roots of polynomial equation • Descarte's rule of signs • Newton's method of divisors for the integral roots	**8**
Unit III	**Theory of Equations-I:** • Relation between roots and coefficient of general polynomial equation in one variable • Relation between roots and coefficient of quadratic • cubic and biquadratic equations • Symmetric functions of roots	**7**

Unit IV	**Theory of Equations –II:** • Transformation of equations • Cardon's method of solving cubic equations • Biquadratic equations • Descarte's method of solving biquadratic equations	**8**
Study Resources	• Burton, D. M. (1989). *Elementary Number Theory*. W. C. Brown publishers, Dubuquolowa. • Hall, H. S., and Knight, S. R. (1994). *Higher Algebra*. H. M. Publications. • Datta, K. B. (2000). *Matrix and Linear Algebra*. Prentice Hall of India Pvt. Ltd., New Delhi. • Sharma, D. R. *Theory of Equations*. Sharma Publications, Jalandhar.	

F.Y.B.Sc. Mathematics (Minor)
SEMESTER-I
MTH-MIN-111: Set Theory and Logic

Total Hours: 30 **Credits: 2**

Course Objectives	• To acquire concepts of sets, operations on sets, Venn diagrams, countable and uncountable sets. • To acquire concepts of relations, equivalence relations, functions and their types. • To acquire concepts of statements, truth values and logical equivalences. • To acquire concepts of universal and existential quantifiers.	
Course Outcomes	After successful completion of this course, students are expected to: • uses of the language of set theory, designing issues in different subjects of mathematics. Also understand the issues associated with different types of finite and infinite sets via countable and uncountable sets. • learn how to identify, represent and recognize relations and functions from schematic descriptions, arrow diagrams and graphs. • use truth tables and logical operators to solve the mathematical problems. • provide the logical mathematical reasoning to formulate theorems and definitions.	
Unit	**Content**	**Hours**
Unit I	**Sets and Subsets:** • Finite Set and Infinite set • Equality of two Sets, • Null Set, Subset, Proper subset and Symmetric difference of two sets • Universal set, Power set and Disjoint sets • Operation on sets: Union and Intersection • Venn diagram • Equivalent sets • Countable and uncountable sets	**7**
Unit II	**Relations and Functions:** • Product of sets • Relations, Types of relations, Reflexive, Symmetric, Transitive relations and Equivalence relations • Function, Types of functions, One-one, Onto, Even, Odd and Inverse function • Composite functions	**8**
Unit III	**Algebra of Propositions:** • Statements, Conjunction, Disjunction. • Negation, Conditional and Bi-Conditional statements, Propositions. • Truth table, Tautology and Contradiction. • Logical equivalence and Logical equivalent statements	**7**
Unit IV	**Quantifiers:** • Propositional functions and Truth sets • Universal quantifier, Existential quantifier • Negation of proposition which contain quantifiers and Counter	**8**

	examples	
Study Resources	• *Set Theory and Related Topics*. Schaum's Series, McGraw-Hill, New York. • Halmons, P. R. (1974). *Naïve Set Theory* (Revised ed.). Springer. • Kamke, E. (1950). *Theory of Sets*, Dover Publishers.	

F.Y.B.Sc. Mathematics (Minor)
SEMESTER-I
MTH-MIN-112: Matrix Algebra

Total Hours: 30 **Credits: 2**

Course objectives	• To know the basic need of this course is to understand the concepts and applications of matrices. • It will improve problem solving and logical thinking abilities of the students. • To study the concepts of theory of matrices in linear algebra. • To study the concepts of system of linear equation.	
Course outcomes	Upon successful completion of this course the student will be able to: • understand operations on matrices. • understand the concept of rank of a matrix and inverse of a matrix. • understand the concept of eigenvalues and eigenvectors. • to use theory of matrices in solving linear equations.	
Unit	**Content**	**Hours**
Unit I	**Rank of Matrix:** • Elementary operations on matrices • Adjoint of a matrix & Inverse of a matrix • Existence & uniqueness theorem of inverse of a matrix • Properties of inverse of a matrix • Elementary matrices • Rank and normal form of a matrix • Reduction of a matrix to its normal form • Rank of product of two matrices	**7**
Unit II	**System of Linear Equations:** • A homogeneous and non-homogeneous system of linear equations • Consistency of system of linear equations • Application of matrices to solve the system of linear equations	**8**
Unit III	**Eigen Values & Eigen Vectors:** • Orthogonal matrices and properties of orthogonal matrices • Characteristic equation • Eigen values and Eigen vectors of matrices • Cayley Hamilton theorem (statement only) and its use to find the inverse of a Matrix	**7**
Unit IV	**Direct methods for solving linear system:** • Matrix inversion method (3x3 system) • Gauss elimination method (3X3 system) • Gauss Jordan method (3x3 system)	**8**
Study Resources	• Datta, K. B. (2000). *Matrix and Linear Algebra*. Prentice Hall of India Pvt. Ltd, New Delhi. • Shanti, N. (2010). *A Text Book of Matrices*. S. Chand Limited, New Delhi. • Bronson, R. (1989). *Schaum's Outline of Theory and Problems of matrices*. McGraw-Hill, New York.	

F.Y.B.Sc. Mathematics (Open/Generic Elective)
SEMESTER-I
MTH-OE-111: Mathematics for Competitive Exams-I

Total Hours: 30 **Credits: 2**

Course Objectives	• The main aim of introducing Mathematics for Competative Examination-I for students is to develop the skill to meet the competitive examinations for better job opportunities. • Effort has been made to accommodate fundamental, mathematical aspects to instill confidence among students. • Enrich their knowledge and to develop their logical reasoning thinking abililities. • Attract the students to attain the mathematical problems and create interest in students about mathematics.	
Course Outcomes	After successful completion of this course, students are expected to: • have a strong base in the fundamental mathematical concepts. • grasp the approaches and strategies to solve problems with speed and accuracy. • gain appropriate skills to succeed in preliminary selection process for recruitment. • solve problems easily by using simple method.	
Unit	**Content**	**Hours**
Unit I	**Numbers:** • Number System • Types of Numbers • series (AP and GP) • Algebraic operations BODMAS	**7**
Unit II	**Divisibility:** • Divisibility • LCM and HCF • Fraction and Simplification	**8**
Unit III	**Time and Distance:** • Time and Distance • Problems based on Trains • Boats and Streams	**7**
Unit IV	**Clock and Calendar:** • Time, work and wages • Pipes and Cistern • Problems on Clock • Problems on Calendar	**8**

Study Resources	• Aggarwal, R. S. (2018). *Quantitative Aptitude for Competitive Examinations* (Revised ed.). S. Chand and Co. Ltd, New Delhi. • Praveen, R. V. *Quantitative Aptitude and Reasoning*. PHI publishers. • *Quantitative Aptitude: Numerical Ability* (Fully Solved) Objective Questions. Kiran Prakashan, Pratogitaprakasan, Kic X, Kiran Prakasan publishers. • Guha, A. *Quantitative Aptitude for Competitive Examination*. Tata Mc Graw hill publications.	

F.Y.B.Sc. Mathematics (Major)
SEMESTER-I
MTH-SEC-111: Introduction to Scilab

Total Hours: 30 **Credits: 2**

Course objectives	• Learn free and open-source software tools for computer programming. • Understand the main features of the Scilab program development environment to enable its usage in the higher learning. • Interpret and visualize simple mathematical functions and operations by using plots. • Implement simple mathematical functions/ equations in numerical computation environment such as Scilab.	
Course outcomes	Upon successful completion of this course the student will be able to: • create and run Scilab code using required tools. • apply Scilab code on matrices. • understand how to apply Scilab code for simulation/implementation for the verification of mathematical functions in Mechanical Engineering. • apply Scilab code to solve numerical problems in the subjects of curriculum.	
Unit	**Content**	**Hours**
Unit I	**Introduction to Scilab:** • Introduction and installation of Scilab • Basic syntax and formatting command prompt display • Operator precedence and variable browser window • Predefined constants and mathematical operators • Variable and strings • Built in functions, complex numbers and polynomials	**7**
Unit II	**Matrices:** • Construction of matrix • Matrix multiplication and trace() • Inverse of matrices, det() and rank() • Deleting a row and/or column of a matrix • Eigenvalues and eigenvector • Mathematical matrix operations	**8**

Unit III	**Plotting:**
	• 2D Plotting
	  ○ plot(x,y)
	  ○ plot2d() and plot2d2()
	  ○ plot2d3() and plot2d4()
	• Plotting multiple plots in the same graph
	• 3D Plots
		7

Unit IV	**Some Applications:** • Divisibility of integers • Inclusion exclusion principle • Recursively defined functions • Sum rule principle • Product rule principle • Permutation and combination	**8**
Study Resources	• Nagar, S. (2017). *Introduction to Scilab: For Engineers and Scientists*. Apress. • Eike, R. (2010). *An Introduction to Scilab from a Matlab User's Point of View*. INRIA. • Chancelier, J., Delebecque, F., Gomez, C., Goursat, M., Nikoukhah, R., & Steer, S. (2007). *Introduction à Scilab*. Springer.	

F.Y.B.Sc. Mathematics (Major)
SEMESTER-I
MTH--SEC-112: Practical course on Scilab

Total Hours: 30 **Credits: 1**

Course objectives	• Create Scilab code using required tools. • Understand Scilab code to compute various operations on matrices. • Interpret and visualize simple mathematical functions and operations by using plots. • Solve mathematical problems using Scilab.
Course outcomes	Upon successful completion of this course the student will be able to: • apply Scilab code to perform basic mathematical formulas. • run Scilab code to compute various operations on matrices. • plotting various graphs using Scilab. • apply Scilab for arithmetic operations.
Sr. No.	**Content**
1	Basics in Scilab
2	Mathematical Operators
3	Matrices
4	Operations on Matrices
5	2D Plotting
6	3D Plotting
7	Divisibility of Integers
8	Permutation and Combination
Study Resources	• Nagar, S. (2017). *Introduction to Scilab: For Engineers and Scientists*. Apress. • Eike, R. (2010). *An Introduction to Scilab from a Matlab User's Point of View*. INRIA. • Chancelier, J., Delebecque, F., Gomez, C., Goursat, M., Nikoukhah, R., & Steer, S. (2007). *Introduction à Scilab*. Springer.

Practical No. 1 Basics in Scilab

1. Write a code in Scilab to compute the addition of three real numbers.
2. Write a code in Scilab to print out the string "Hello World!".
3. Write a code in Scilab to compute x^y.
4. Write a code in Scilab to compute $\cos x$.
5. Write a code in Scilab to display the polynomial $x^3 + 5x^2 - 2x + 1$.

Practical No. 2 Mathematical Operators

1. Write a code in Scilab to compute the conjugate of a complex number.
2. Write a code in Scilab to change the type of a variable dynamically.

3. Write a code in Scilab to compute the roots of a quadratic equation $ax^2 + bx + c = 0$.
4. Write a code in Scilab to find the cardinality of the set $A = \{1, 3, 5, 7, 9\}$.
5. Write a code in Scilab to find the number of proper subsets of A ={Triangle, Rectangle, Square, Pentagon, Hexagon, Star}.

Practical No. 3 Matrices

1. Write a code in Scilab to creates the identity matrix of order $n \times n$.
2. Write a code in Scilab to compute the multiplication of two given matrixes.
3. Write a code in Scilab to compute the determinant of a given square matrix.
4. Write a code in Scilab to find the trace of a given matrix.
5. Write a code in Scilab to compute the inverse of a given square matrix.

Practical No. 4 Operations on Matrices

1. Write a code in Scilab to find the rank of a given matrix.
2. Write a code in Scilab to compute the transpose of a given matrix.
3. Write a code in Scilab to find a matrix or vector norm.
4. Write a code in Scilab to compute the eigenvalues and eigenvectors of a given square matrix.
5. Write a code in Scilab to compute the reduced row echelon form of a given matrix.

Practical No. 5 2D Plotting

1. Write a code in Scilab to plot the point $A = (1, 2)$ with red point.
2. Use Scilab to plot the segment [AB] in blue (by default) with $A = (1, 2)$ and $B = (3, 5)$.
3. Use Scilab to plot $y = 2x^3$.
4. Distinguish the two functions $f(x) = x^2$ and $f(x) = 2x^2$ using Scilab.
5. Use Scilab to plotting $\sin x$ using plot2d.

Practical No. 6 3D Plotting

1. Use Scilab to plotting $\sin x$ using plot2d2.
2. Use Scilab to plotting $\sin x$ using plot2d3.
3. Use Scilab to plotting $\sin x$ using plot2d4.
4. Write a code in Scilab to plot the surface $z = f(x, y)$.
5. Use Scilab to plot the surface $z = 2x^2 + y^2$.

Practical No. 7 Divisibility of Integers

1. Write a code in Scilab for the following inclusion exclusion problem:

   Out of 1200 students of a college, 552 took Economics, 627 took Mathematics, 540 took Information Technology, 217 took Economics and Mathematics, 307 took Economics and Information Technology, 240 took Mathematics and Information Technology, 213 took all the three subjects.

   a) How many took at least one of the three subjects?
   b) How many took none of the three subjects?

2. Write a code in Scilab for the following:

   If $a_n = 3a_{n-1} - 2a_{n-2}, a_1 = 3, a_2 = 5$, then prove that $a_n = 1 + 2^n, \forall\, n \in \mathbb{N}$.
3. Write a code in Scilab to compute factorial by recursively defined functions.
4. Write a code in Scilab to evaluate the following polynomials:
   a) $f(x) = x^3 - 2x + 1$ at $x = 2$.
   b) $g(x) = x^2 - 1$ at $x = 3$.
5. Write a code in Scilab to compute greatest common divisor.

Practical No. 8 Permutation and Combination

1. Write a code in Scilab for the following problems:
   a) Suppose a bookcase shelf has 6 Mathematics textbooks, 5 Programming textbooks and 3 Networking textbooks. Find the number of ways a student can choose a textbook.
   b) Find number of ways to select an integer between 1 to 20 which are divisible by 4 or prime.
2. Write a code in Scilab for the following problems:
   a) Suppose a bookcase shelf has 6 Mathematics textbooks, 5 Programming textbooks and 3 Networking textbooks. Find the number of ways a student can choose one of each type of textbook.
   b) How many four-digit numbers can be formed with digits 0 – 9 if repetition of digits not allowed?
3. Write a code in Scilab to calculate Binomial Coefficient $\binom{n}{r}$, where n and r values are given by user (n=10 & r=7) and to verify $\binom{n}{r} = \binom{n}{n-r}$ (for n=8 & r=5).
4. Write a code in Scilab for the following:
   a) A teacher is preparing an examination time table for 5 papers to be held on 5 consecutive days. How many different time table can she make?
   b) A manager has 10 persons working under him and he is expected to award 3 prizes to the persons whom he ranks are the top three achievers in the previous year. How many choices does he have?
5. Write a code in Scilab for the following:
   a) In how many ways can a committee of 8 people be formed out of a group of 10 men and 5 women?
   b) In how many ways can a committee of 6 men and 2 women be formed out of a group of 10 men and 5 women?

SEMESTER-II

F.Y.B.Sc. Mathematics (Major)
SEMESTER-II
MTH-DSC-121: Calculus-II

Total Hours: 30 **Credits: 2**

Course Objectives	• Use the fact that the derivative is the slope of the tangent line to the curve at a given point to help determine the derivatives of simple linear functions. • The basic need of this course is to understand the concepts Limits, Derivative and applications of calculus. • Use the Intermediate Value Theorem to identify an interval where a continuous function has a root. • This course will improve problem solving and logical thinking abilities of the students.	
Course outcomes	After successful completion of this course, students are expected to: • understand basic concepts on limits and continuity. • understand use of differentiations in various theorems. • know the Mean value theorems and its applications. • make the applications of Taylor's, Maclaurin's theorem.	
Unit	**Content**	**Hours**

Unit I	**Limit and Continuity**
	• Epsilon-delta definition of limit of a function
	• Basic properties of limit, Indeterminate form
	• L-Hospital's rule
	• Examples of limit
	• Continuous function
	• Properties of continuous function on closed and bounded interval.
	  o Boundedness
	  o Attains its bounds
	  o Indeterminate mean value theorem
		7

Unit II	**Mean Value Theorems** • Differentiability • Definition of derivative • Theorem on continuity and examples • Roll's theorem • Langrage's Mean value theorem • Cauchy's mean value theorem • Examples on Roll's theorem • Langrage's Mean value theorem & Cauchy's mean value theorem • Geometrical interpretation and application • Increasing and Decreasing function	**8**

Unit III	**Successive Differentiation**
	• The nth derivative of some standard functions:
	  o e^{ax+b}
	  o x^m
	  o $(ax+b)^m$
	  o $\frac{1}{ax+b}$
	  o $\log(ax+b)$
		7

	○ $\sin(ax+b)$ ○ $\cos(ax+b)$ ○ $e^{ax}\sin(ax+b)$ ○ $e^{ax}\cos(ax+b)$ • Leibnitz's Theorem and examples on it	
Unit IV	**Application of differential Calculus** • Taylor's theorem with Lagrange's form of remainder and related examples • Maclaurin' theorem with Lagrange's form of remainder and related examples • Reduction formulae ○ $\int_0^{\pi/2}(\sin x)^n\,dx$ ○ $\int_0^{\pi/2}(\cos x)^n\,dx$ ○ $\int_0^{\pi/2}(\sin x)^m(\cos x)^n\,dx$ ○ $\int\left(\frac{\sin nx}{\sin x}\right)dx$ and examples on it	**8**
Study Resources	• Wrede, R., and Spiegel M. R. (2002). *Theory and Problems of Advanced Calculus* (2nd ed.). McGraw-Hill Company, New York. • Prasad, G. (1959). *Text Book on Differential calculus*. Pothishala Private Ltd., Allahabad. • Prasad, G. *Integral calculus*. Pothishala Private Ltd., Allahabad. • Maron, I. A. *Problems in Calculus of One Variable*. CBS Publishers & Distributors	

F.Y.B.Sc. Mathematics (Major)
SEMESTER-II
MTH-DSC-122: Ordinary Differential Equations

Total Hours: 30 **Credits: 2**

Course Objectives	• The basic need of this course is to understand the different methods of solving differential equations and their applications to solve problems arrives in engineering and technology. • Evaluate first order differential equations including homogeneous, exact and linear differential equations. • Solve second order and higher orders linear differential equations. • To know the concept of homogeneous linear differential equations.	
Course Outcomes	After successful completion of this course, students are expected to: • understand basic concepts in differential equations. • understand method of solving differential equations • understand use of differential equations in various fields. • understand the method of solving the homogeneous linear differential equation.	
Unit	**Content**	**Hours**
Unit I	**Differential Equations of First Order and First Degree:** • Partial derivatives of first order & second orders and Examples • Exact differential equations • Condition for exactness • Integrating factor • Rules for finding integrating factors • Linear differential equations • Bernoulli's Differential Equation • Equation reducible to linear form	**7**
Unit II	**Differential Equations of First Order and Higher Degree:** • Differential equations of first order and higher degree • Equation solvable for p • Equation solvable for y • Equation solvable for x • Clairaut's form	**8**
Unit III	**Linear Differential Equations of Second and Higher Order:** • Linear differential equations with constant coefficients • Complementary functions • Particular integrals of $f(D)y = X$, where $X = e^{ax}, \sin(ax), \cos(ax), x^n, e^{ax}V, xV$ with usual notations	**7**

Unit IV	**Homogeneous Linear Differential Equations:** • Homogeneous linear differential equations (Cauchy's differential equations) • Example of Homogeneous linear differential equations • Equations reducible to homogeneous linear differential equations (Legendre's equations) • Example of Equations reducible to homogeneous linear differential equations	**8**
Study Resources	• Murray, D. A. **(**1967**).** *Introductory Course in Differential Equations***.** Orient Congman (India). • Simmons, G. F. **(**1972**).** *Differential Equations*, Tata McGraw Hill.	

F.Y.B.Sc. Mathematics (Major)
SEMESTER-II
MTH-DSC-123: Numerical Analysis

Total Hours: 30 **Credits: 2**

Course objectives	• To study the basic numerical analysis which is applicable to problems like finding interpolation and solution of first order differential equations. • To know approximate solutions can be obtained by using numerical methods. • To know concept of Numerical methods to develop mathematical skills in solving various scientific problems. • To know concept of numerical integration with the help of various formulae and rules.	
Course outcomes	Upon successful completion of this course the student will be able to: • understand basic concepts of methods of solutions of equations. • understand methods of forward and backward differences. • find solution of numerical integration by Trapezoidal rule, Simpson's one-third rule. • apply appropriate numerical methods to solve the problem with most accuracy.	
Unit	**Content**	**Hours**
Unit I	**Algebraic and Transcendental Equation:** • Introduction to Errors • The Bisection method • The iteration method • Method of False position • Newton-Raphson Method	**7**
Unit II	**Calculus of Finite Differences:** • Differences • Forward Differences • Backward Differences • Central Differences • Other Differences (Δ, μ operators) • Properties of Operators • Relation between Operators	**8**
Unit III	**Interpolation:** • Newton's Gregory Formula for Forward interpolation • Newton's Gregory Formula for Backward Interpolation • Lagrange's Interpolation Formula • Divided Difference • Newton's Divided Difference Formula	**7**
Unit IV	**Numerical Integration:** • General Quadrature Formula • Trapezoidal Rule • Simpson's One-Third Rule • Simpson's Three-Eight Rule	**8**

Study resources	• Shastry, S. S. (2012). *Introductory Methods of Numerical Analysis* (5th ed). Prentice Hall India Learning Private Limited, New Delhi. • Froberg, Carl-Erik, (1979). *Introduction to Numerical Analysis* (2nd ed). Addison-Wesley, California - London • Jain, M. K., Iyenger, S. R. K., & Jain, R. K. (1999). *Numerical methods for scientific and engineering computation*. New Age International Publisher Pvt. Ltd., New Delhi. • Saxena, H. C. (2005). *Finite differences and Numerical Analysis*, S. Chand and Company. • Atkinson, K. E. (1989). *An Introduction to Numerical Analysis*(2nd ed). Wiley Publications, Canada.	

F.Y.B.Sc. Mathematics (Minor)
SEMESTER-II
MTH-MIN-121: Discrete Mathematics

Total Hours: 30 **Credits: 2**

Course Objectives	• To study the basic problems on permutation and combinations. • To know discrete numeric functions and generating functions. • To know the basic concept of graphs and their matrix representation. • To know the concept of finite state machines as language recognizers.	
Course Outcomes	After successful completion of this course, students are expected to: • Understand basic concepts of permutation and combinations and can apply it to real life situation. • Understand the use of discrete numeric functions and generating functions for combinatorial problems. • Understand graph, isomorphism of graphs, Hand-shaking lemma, adjacency and incidence matrix representation of graphs. • Understand the use of finite state machine to recognize patterns.	
Unit	**Content**	**Hours**
Unit I	**Permutation and Combination:** • Meaning of permutation and combination • Fundamental principle of counting • Meaning of Factorial of a number • Statement of basic properties of factorial of a number • Statement of formula for number of permutations of different objects when objects are taken at a time • Statement of formula for number of combinations of different objects taken at a time • Simple numerical problems from real life situations	**7**
Unit II	**Discrete Numeric Functions:** • Discrete numeric functions • Operations on numeric functions • Asymptotic behavior of numeric functions • Properties of asymptotic dominance • Generating functions • Combinatorial problems	**8**
Unit III	**Fundamentals of Graph Theory:** • Graph • Simple graph • Degree of vertex • Hand-shaking lemma • Isomorphism of graphs • Adjacency and incidence matrix of a graph	**7**

Unit IV	**Formal Languages and Finite State Machines:** • Ordered sets • Languages • Phrase structure grammars • Types of grammars and languages • Equivalent Machines • Finite state machines as language recognizers	**8**
Study Resources	• Ghosh, R. K., and Saha, S. (2008). *Business Mathematics and Statistics*(2nd.ed.). New Central Book Agency (P) Ltd. • Lipschutz, S., Lipson, M. L., and Patil, V. H. (2006). *Discrete Mathematics* (3rd.ed.). Tata McGraw Hill Publishing Company Limited. • Deo, N. *Graph Theory with applications to Engineering and computer science*. Prentice Hall of India Pvt. Ltd. • Liu, C. L. *Elements of Discrete Mathematics* (2nd.ed.). Mc Graw Hill.	

F.Y.B.Sc. Mathematics (Minor)
SEMESTER-II
MTH-MIN-122: Numerical Methods

Total Hours: 30 **Credits: 2**

Course objectives	• To study the basic numerical analysis which is applicable to problems like finding interpolation and solution of first order differential equations. • To know approximate solutions can be obtained by using numerical methods. • To know concept of Numerical methods to develop mathematical skills in solving various scientific problems. • To know concept of numerical solution of ordinary differential equations.	
Course outcomes	Student will be able to: • understand basic concepts of methods of solutions of equations. • understand methods of forward and backward differences. • find solution of ordinary differential equation of first order by Euler, Taylor and Runge-kutta methods. • apply appropriate numerical methods to solve the problem with most accuracy.	
Unit	**Content**	**Hours**
Unit I	**Algebraic and Transcendental Equation:** • Introduction to Errors • The Bisection method • The iteration method • Method of False position • Newton-Raphson Method	**7**
Unit II	**Calculus of Finite Differences:** • Differences • Forward Differences • Backward Differences • Central Differences • Other Differences (∇, μ operators) • Properties of Operators • Relation between Operators	**8**
Unit III	**Interpolation:** • Newton's Gregory Formula for Forward interpolation • Newton's Gregory Formula for Backward Interpolation • Lagrange's Interpolation Formula • Divided Difference • Newton's Divided Difference Formula	**7**
Unit IV	**Numerical Solution of Ordinary Differential Equation:** • Numerical solution of first order ODE by Taylor's series • Euler's Method, Euler's Modified Method • Runge-Kutta Methods • Runge–Kutta second and fourth order formulae	**8**

Study resources	• Shastry, S. S. (2012). *Introductory Methods of Numerical Analysis* (5th ed), Prentice Hall India Learning Private Limited, New Delhi. • Froberg, Carl-Erik. (1979). *Introduction to Numerical Analysis* (2nd ed). Addison-Wesley, California - London • Jain, M. K., Iyenger S. R. K., & Jain, R. K. (1999). *Numerical methods for scientific and engineering computation*. New Age International Publisher Pvt. Ltd., New Delhi. • Saxena, H. C. (2005). *Finite differences and Numerical Analysis*, S. Chand and Company. • Atkinson, K. E. (1989). *An Introduction to Numerical Analysis*(2nd ed). Wiley Publications, Canada.	

F.Y.B.Sc. (Open/Generic Elective)
SEMESTER-II
MTH-OE-121: Mathematics for Competitive Exams-II

Total Hours: 30 **Credits: 2**

Course Objectives	• The main aim of introducing Mathematics for Competative Examination-I for students is to develop the skill to meet the competitive examinations for better job opportunities. • Effort has been made to accommodate fundamental, mathematical aspects to instill confidence among students. • Enrich their knowledge and to develop their logical reasoning thinking abililities. • Attract the students to attain the mathematical problems and create interest in students about mathematics.	
Course Outcomes	After successful completion of this course, students are expected to: • have a strong base in the fundamental mathematical concepts. • grasp the approaches and strategies to solve problems with speed and accuracy. • gain appropriate skills to succeed in preliminary selection process for recruitment. • solve problems easily by using simple method.	
Unit	**Content**	**Hours**
Unit I	**Percentage and Average:** • Percentage, Average • Problems based on Ages • Ratio and Proportion	**7**
Unit II	**Partnership and Share:** • Partnership and share • Mixtures. • Shares and Debentures	**8**
Unit III	**Profit, Loss and Discount:** • Profit, Loss and Discount • Simple Interest • Compound Interest	**7**
Unit IV	**Permutations and Combinations:** • Permutations and Combinations • Probability • True discount and Banker's discount	**8**
Study Resources	• Aggarwal, R. S. (2018). *Quantitative Aptitude for Competitive Examinations* (Revised ed.). S. Chand and Co. Ltd, New Delhi. • Praveen, R. V. *Quantitative Aptitude and Reasoning*. PHI publishers. • *Quantitative Aptitude: Numerical Ability* (Fully Solved) Objective Questions. Kiran Prakashan, Pratogitaprakasan, Kic X, Kiran Prakasan publishers. • Guha, A. *Quantitative Aptitude for Competitive Examination*. Tata Mc Graw hill publications.	

F.Y.B.Sc. Mathematics (Major)
SEMESTER-II
MTH-SEC-121: Introduction to Python

Total Hours: 30 **Credits: 2**

Course objectives	• Understand the core syntax and semantics of Python programming language. • Familiarize the process of structuring the data using lists, dictionaries, tuples and sets. • Illustrate the use of regular expressions and built-in functions to navigate the file system. • Find the applications of Python in a real life.	
Course outcomes	Upon successful completion of this course the student will be able to: • create and run Python programs using required tools. • explain basic principles of Python programming language. • implement object-oriented concepts. • apply Python program to solve numerical problems in the subjects of curriculum.	
Unit	**Content**	**Hours**
Unit I	**Introduction to Python:** • Introduction and installation of Python • Values and types (int, float and str) • Print function, assignment statements and printing variable values • Types of variables • Operators (mathematical Operators, arithmetic operator, relational operator, boolean operator) • String operations and mathematical functions (math, cmath modules, random module)	**7**
Unit II	**String, List and Tuple:** • Strings, len function, string traversal • String slice, comparison operators • Lists, list operations, use of range function and accessing list elements • List membership, for loop, list operations and updating list • Defining a tuple, index operator and slice operator • Tuple assignment and tuple as a return value	**8**
Unit III	**Iterations and Conditional Statements:** • Conditional and alternative statements • Chained and nested conditionals (if, if-else, if-elif-else, nested if, nested if-else) • Looping statements (while, for) • Tables using while, calling functions (type, id) • Composition of functions, returning values from functions • User defined functions, parameters and arguments	**7**

Unit IV	**Some Applications:** • Installation of NumPy and SciPy • Addition, subtraction, multiplication of matrices • Powers and inverse of a matrices • Reduced row echelon form, null space, column space and rank • Determinant, eigenvalues and eigenvectors • Roots of polynomials	**8**
Study Resources	• Downey, A. (2015). *Think Python: How to Think Like a Computer Scientist* (2nd ed.). O'Reilly Media, Inc. • Johansson, R. (2019). *Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy and Matplotlib* (2nd ed.). Apress. • Langtangen, H. P. (2009). *Python Scripting for Computational Science* (3rd ed.). Springer Berlin Heidelberg.	

F.Y.B.Sc. Mathematics (Major)
SEMESTER-II
MTH-SEC-122: Practical course on Python

Total Hours: 30 **Credits: 1**

Course objectives	• Create and run Python program using required tools. • Use built-in data structure and modules in Python. • Interpret and visualize simple mathematical functions and operations by using plots. • Understand Python program to compute various operations on matrices.
Course outcomes	Upon successful completion of this course the student will be able to: • apply Python program to perform basic mathematical formulas. • write Python program for mathematical functions. • apply Python program for arithmetic operations. • run Python program to compute various operations on matrices.
Sr. No.	**Content**
1	Basics in Python
2	Operators
3	String and List
4	Tuple
5	Conditional Statements
6	Functions
7	Linear Algebra in Python
8	Mathematical Matrix Operations
Study Resources	• Downey, A. (2015). *Think Python: How to Think Like a Computer Scientist* (2nd ed.). O'Reilly Media, Inc. • Johansson, R. (2019). *Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy and Matplotlib* (2nd ed.). Apress. • Langtangen, H. P. (2009). *Python Scripting for Computational Science* (3rd ed.). Springer Berlin Heidelberg.

Practical No. 1 Basics in Python

1. Write a Python program to print the following string in a specific format (see the output).

   Sample String : "Twinkle, twinkle, little star, How I wonder what you are! Up above the world so high, Like a diamond in the sky. Twinkle, twinkle, little star, How I wonder what you are"

   Output :

   Twinkle, twinkle, little star,

   How I wonder what you are!

   Up above the world so high,

Like a diamond in the sky.

Twinkle, twinkle, little star,

How I wonder what you are

2. Write a Python program to find out what version of Python you are using.
3. Write a Python program to display the current date and time.

   Sample Output :

   Current date and time :

   2014-07-05 14:34:14
4. Write a Python program that calculates the area of a circle based on the radius entered by the user.

   Sample Output :

   r = 1.1

   Area = 3.8013271108436504
5. Write a Python program that accepts the user's first and last name and prints them in reverse order with a space between them.

Practical No. 2 Operators

1. Write a Python program to display the examination schedule. (extract the date from exam_st_date).

   exam_st_date = (11, 12, 2014)

   Sample Output : The examination will start from : 11 / 12 / 2014
2. Write a Python program that accepts a filename from the user and prints the extension of the file.

   Sample filename: abc.java

   Output : java
3. Write a Python program that prints the calendar for a given month and year.

   Note: Use 'calendar' module.
4. Write a Python program to get the volume of a sphere with radius six.
5. Write a Python program to calculate the number of days between two dates.

   Sample dates: (2014, 7, 2), (2014, 7, 11)

   Expected output : 9 days

Practical No. 3 String and List

1. Write a Python program to create a histogram from a given list of integers.
2. Write a Python program to display the first and last colors from the following list.

   color_list = ["Red","Green","White" ,"Black"]
3. Write a Python program that accepts an integer (n) and computes the value of n + nn + nnn.

   Sample value of n is 5

   Expected Result: 615
4. Write a Python program to sum all the items in a list.

5. Write a Python program to get n (non-negative integer) copies of the first 2 characters of a given string. Return n copies of the whole string if the length is less than 2.

Practical No. 4 Tuple

1. Write a Python program that concatenates all elements in a list into a string and returns it.
2. Write a Python program to parse a string to float or integer.
3. Write a Python program to create a tuple of numbers and print one item.
4. Write a Python program that accepts a sequence of comma-separated numbers from the user and generates a list and a tuple of those numbers.

   Sample data: 3, 5, 7, 23

   Output:

   List : ['3', ' 5', ' 7', ' 23']

   Tuple : ('3', ' 5', ' 7', ' 23')
5. Write a Python program to print all even numbers from a given list of numbers in the same order and stop printing any after 237 in the sequence.

   Sample numbers list:

   numbers = [

   386, 462, 47, 418, 907, 344, 236, 375, 823, 566, 597, 978, 328, 615, 953, 345,

   399, 162, 758, 219, 918, 237, 412, 566, 826, 248, 866, 950, 626, 949, 687, 217,

   815, 67, 104, 58, 512, 24, 892, 894, 767, 553, 81, 379, 843, 831, 445, 742, 717,

   958,743, 527

   ]

Practical No. 5 Conditional Statements

1. Write a Python program to find those numbers which are divisible by 7 and multiples of 5, between 1500 and 2700 (both included).
2. Write a Python program to construct the following pattern, using a nested for loop.

```
*
* *
* * *
* * * *
* * * * *
* * * *
* * *
* *
*
```

3. Write a Python program that prints all the numbers from 0 to 6 except 3 and 6.

   Note: Use 'continue' statement.

   Expected Output: 0 1 2 4 5
4. Write a Python program to get the Fibonacci series between 0 and 50.

   Note: The Fibonacci Sequence is the series of numbers:

   0, 1, 1, 2, 3, 5, 8, 13, 21, ...

   Every next number is found by adding up the two numbers before it.

   Expected Output : 1 1 2 3 5 8 13 21 34
5. Write a Python program that accepts a sequence of comma separated 4 digit binary numbers as its input. The program will print the numbers that are divisible by 5 in a comma separated sequence.

   Sample Data: 0100,0011,1010,1001,1100,1001

   Expected Output: 1010

Practical No. 6 Functions

1. Write a Python program that accepts a string and calculates the number of digits and letters.

   Sample Data: Python 3.2

   Expected Output:

   Letters 6

   Digits 2
2. Write a Python program to find numbers between 100 and 400 (both included) where each digit of a number is an even number. The numbers obtained should be printed in a comma-separated sequence.
3. Write a Python program to print the alphabet pattern 'M'.

   Expected Output:

```
*       *
*       *
* *   * *
*   *   *
*       *
*       *
*       *
```

4. Write a Python program to check whether an alphabet is a vowel or consonant.

   Expected Output:

   Input a letter of the alphabet: k

   k is a consonant.
5. Write a Python program to find the median of three values.

Practical No. 7 Linear Algebra in Python

1. Write a NumPy program to compute the multiplication of two given matrixes.

2. Use Python to compute the determinant of $A = \begin{bmatrix} 6 & 1 & 1 \\ 4 & -2 & 5 \\ 2 & 8 & 7 \end{bmatrix}$.
3. Write a NumPy program to compute the eigenvalues and right eigenvectors of a given square array.
4. Use Python to compute the inverse of $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$.
5. Write a NumPy program to find the rank of a given matrix.

Practical No. 8 Mathematical Matrix Operations

1. Use Python to compute the reduced row echelon form of$A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 5 & 6 & 8 \\ 3 & 4 & 10 & 12 \end{bmatrix}$.
2. Use Python to compute the null space of $A = \begin{bmatrix} 1 & 2 & 0 \\ 2 & 4 & 0 \\ 3 & 6 & 1 \end{bmatrix}$.
3. Write a NumPy program to compute the condition number of a given matrix.
4. Write a NumPy program to find a matrix or vector norm
5. Write a NumPy program to find the roots of the following polynomials.

   a) $x^2 - 4x + 7$.

   b) $x^4 - 11x^3 + 9x^2 + 11x - 10$.

Equivalence
F.Y. B.Sc. Mathematics

Old syllabus AY 2019-20	NEP based syllabus AY 2023-24
SEM-I	
MTH-111 Calculus	MTH-DSC-111 Calculus-I
MTH-112 Co-ordinate Geometry	MTH-MIN-121 Discrete Mathematics
MTH-113(A) Matrix Algebra	MTH-MIN-112 Matrix Algebra
MTH-113(B) Applied Matrix Algebra	MTH-DSC-112 Theory of Matrices
SEM-II	
MTH-121 Ordinary Differential Equations	MTH-DSC-122 Ordinary Differential Equations
MTH-122 Theory of Equations	MTH-DSC-113 Theory of Equations
MTH-123(A) Numerical Analysis	MTH-DSC-123 Numerical Analysis
MTH-123(B) Numerical Methods	MTH-MIN-122 Numerical Methods

AY: Academic Year