

University of Mumbai



Title of the program

- A-** U.G. Certificate in Information Technology
- B-** U.G. Diploma in Information Technology
- C-** B.Sc. (Information Technology)
- D-** B.Sc. (Honours) in Information Technology
- E-** B.Sc. (Honours with Research) in Information Technology

Syllabus for Semester –

Sem I & II

Ref: GR dated 20th April, 2023 for Credit Structure of UG

(With effect from the academic year 2024-25 Progressively)

University of Mumbai



Syllabus for Approval

(As per NEP 2020)

Sr. No.	Heading	Particulars	
1	Title of program O. _____ A	A	Title of the program U.G. Certificate in Information Technology
	O. _____ B	B	U.G. Diploma in Information Technology
	O. _____ C	C	B.Sc. (Information Technology)
	O. _____ D	D	B.Sc. (Honours) in Information Technology
	O. _____ E	E	B.Sc. (Honours with Research) in Information Technology
2	Eligibility O. _____ A	A	10+2 (A learner must have completed HSC or equivalent with 45% of aggregate for open category and 40% of aggregate in case of reserved candidates in one attempt with Mathematics and/or Statistics as one of the subjects (OR) Passed Equivalent Academic Level 4.0 with CGPA equivalent to 45% for open category and 40% in case of reserved candidates with Mathematics and/or Statistics as one of the subjects
	O. _____ B	B	Under Graduate Certificate in Information Technology Academic Level 4.5
	O. _____ C	C	Under Graduate Diploma in Information Technology Academic Level 5.0
	O. _____ D	D	Bachelors of Science in Information Technology with minimum CGPA of 7.5 Academic Level 5.5
	O. _____ E	E	Bachelors of Science in Information Technology with minimum CGPA of 7.5 Academic Level 5.5
3	Duration of program	A	One Year
	R. _____	B	Two Years
		C	Three years
		D	Four years

		E	Four years
4	Intake Capacity R: _____		
5	Scheme of Examination R: _____	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination	
6	Standards of Passing R: _____	40% in each component	
7	Sem. I & II Credit Structure R: _____ A R: _____ B Sem. III & IV Credit Structure R: _____ C R: _____ D Sem. V & VI Credit Structure R: _____ E R: _____ F	Attached herewith	
8	Semesters	A	Sem I & II
		B	Sem I, II, III & IV
		C	Sem I, II, III, IV, V & VI
		D	Sem I, II, III, IV, V, VI, VII & VIII
		E	Sem I, II, III, IV, V, VI, VII & VIII
9	Program Academic Level	A	4.5
		B	5.0
		C	5.5
		D	6.0
		E	6.0
10	Pattern	Semester	
11	Status	New	
12	To be implemented from Academic Year Progressively	From Academic Year: 2023-24	

Sign of Chairperson
Dr. Mrs. R.
Srivaramangai
Ad-hoc BoS (IT)

Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology

Sign of Offg. Dean,
Prof. Shivram S. Garje
Faculty of Science &
Technology

Preamble

1) Introduction

Information technology (IT) continues to be a dynamic and rapidly evolving field with high demand for skilled professionals. The demand for IT workers is driven by various factors, and the landscape may have evolved over a period of time. NEP envisages the multidisciplinary approach thus making IT much more applicable in all fields of life. This facilitates multi-institutional mobility of the students within India as well as abroad thus making the students attain different proficiency levels right from certificate to B.Sc Honours with Research. This new syllabus under NEP will thus enable the students for higher education, research and career in the field of IT

2) Aims and Objectives

The aims and objectives of a Bachelor of Science (B.Sc) program in Information Technology (IT) generally revolve around providing students with a comprehensive understanding of the principles, technologies, and applications within the field of information technology. The entire program collectively aims to produce graduates who are well-rounded IT professionals, capable of contributing to the design, development, and management of information technology systems in various industries. The specific details of the curriculum may vary among institutions offering B.Sc in Information Technology programs.

3) Learning Outcomes

The B. Sc. (Information Technology) Programme shall prepare and enable the graduates to:

- ✓ Demonstrate proficiency in programming languages, Data structures, Design and implement software solutions with their technical competence
- ✓ Analyze user requirements and design effective IT systems or applications.
- ✓ Apply system analysis and design methodologies to address complex business challenges.
- ✓ Acquire the skills of Database Management, Networking and Security, Web Technologies
- ✓ Plan, execute, monitor, and control IT projects.
- ✓ Analyze and solve complex IT problems using critical thinking skills.
- ✓ Apply concepts of artificial intelligence, machine learning, cloud computing, and IoT
- ✓ Effectively communicate technical information both orally and in writing.

4) Any other point (if any)

PROGRAMME SPECIFIC OUTCOMES (PSO)

On completing the B. Sc.(Information Technology) at the University of Mumbai, the graduates shall be able to

- Technical Proficiency:
 - Demonstrate a comprehensive understanding of fundamental concepts, principles, and technologies in information technology.
 - Apply programming and software development skills to design and implement IT solutions.
- System Thinking and Analysis:
 - Apply system analysis and design methodologies to analyze and address

- complex problems.
- Design and develop IT systems that meet user requirements and organizational needs.
- Database Management:
 - Design, implement, and manage relational databases to store and retrieve information effectively.
 - Demonstrate proficiency in using database management systems and querying languages.
- Networking and Security:
 - Understand and implement computer networks, protocols, and security measures.
 - Evaluate and implement security solutions to protect information systems.
- Web Technologies:
 - Develop web applications using a variety of technologies and programming languages.
 - Design and create user interfaces that adhere to web design principles.
- Project Management:
 - Apply project management principles to plan, execute, and deliver IT projects.
 - Demonstrate the ability to work effectively within project teams.
- Emerging Technologies:
 - Stay informed about and adapt to emerging technologies in the IT field.
 - Apply concepts of artificial intelligence, machine learning, cloud computing, and IoT to solve real-world problems.
- Critical Thinking and Problem-Solving:
 - Analyze and solve complex IT problems using critical thinking skills.
 - Apply problem-solving strategies to troubleshoot and resolve technical issues.
- Communication Skills:
 - Effectively communicate technical information to diverse audiences, both orally and in writing.
 - Collaborate with team members and stakeholders to achieve common goals.
- Ethics and Professionalism:
 - Demonstrate ethical behavior and professionalism in all aspects of the IT profession.
 - Adhere to ethical standards and legal considerations related to information technology.

**5) Credit Structure of the Program (Sem I, II, III, IV, V and VI)
Under Graduate Certificate in Information Technology**

(Credit Structure Sem I & II)

R: _____A										
Level	Sem ester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr. / Sem.	Degr ee/ Cum. Cr.
		Mandatory	Electiv es							
	I	6		-	2+2	VSC:2, SEC:2	AEC:2, VEC:2, IKS:2	CC:2	22	UG Certificate 44
		<ul style="list-style-type: none"> • Program ming with C - 02 • Database Management Systems - 02 • Practical I - 02 				VSC : Combinational and Sequential Design- 02 SEC – 02 Office Tools for Data Management OR Fundamentals of Telecommunication Systems				
R: _____B										
	II	6		2	2+2	VSC:2, SEC:2	AEC:2,VEC:2	CC:2	22	
		<ul style="list-style-type: none"> • OOPs with C++ - 02 • Web Designing - 02 • Practica l II - 02 				<ul style="list-style-type: none"> • VSC : Assembly Language Programming – 02 • SEC: 02 <ul style="list-style-type: none"> • Web Programming OR <ul style="list-style-type: none"> • PL/SQL 				
	Cum Cr.	12	-	2	8	8	10	4	44	
Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor										

Under Graduate Diploma in Information Technology

Credit Structure (Sem. III & IV)

R: _____ C										
Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr. / Sem	Degree/ Cum. Cr.
		Mandatory	Electives							
	III	8		4	2	VSC:2	AEC:2,	FP :2 CC:2	22	UG Diploma 88
		<ul style="list-style-type: none"> • Python Programming -02 • Python Programming Practical-02 • Data Structures-02 • Data Structures Practical-02 				VSC : Operating Systems-02				
R: _____ D										
	IV	6		4	2	SEC:2	AEC: 2	CEP : 2 CC: 2	22	
		<ul style="list-style-type: none"> • Core Java - 02 • Core Java Practical-02 • Software Engineering-02 • Software Engineering Practical-02 				<ul style="list-style-type: none"> • Computer Graphics and Animation -02 OR • Mojo-02 OR • Mobile Programming-02 				
	Cum Cr.	28		10	12	12	14	12	88	
Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor										

B.Sc. (Information Technology)

Credit Structure (Sem. V & VI)

R: _____ E										
Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC, RP	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
	V	10	4	4		VSC: 2		FP/CEP:2	22	UG Degree 132
		<ul style="list-style-type: none"> • Advanced Web Programming-02 • Advanced Web Programming Practical-02 • Business Intelligence-02 • Business Intelligence Practical-02 • Software Project Management-02 	<ul style="list-style-type: none"> • Linux Administration -02 • Linux Administration Practical-02 OR • EARN-02 • EARN Practical-02 OR • Enterprise Java-02 • Enterprise Java Practical-02 			<ul style="list-style-type: none"> • Advanced Mobile Programming-02 		FP: Project Dissertation-02	22	
R: _____ E										
	VI	10	4	4				OJT:4	22	
		<ul style="list-style-type: none"> • Security in Computing -02 • Security in Computing Practical-02 • AI and ML-02 • AI and ML Practical-02 • Software Quality Assurance-02 	<ul style="list-style-type: none"> • Enterprise Networking-02 • Enterprise Networking Practical-02 OR • Principles of GIS-02 • Principles of GIS Practical-02 					<ul style="list-style-type: none"> • OJT: Project Implementation-04 		
	Cum Cr.	48	8	18	12	14	14	18	132	
Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

SEMESTER I

Syllabus
B.Sc. (Information Technology)
(Sem.- I)

Major Courses

Name of the Course: Programming with C

Sr.No	Heading	Particulars
1	Description the course : Including but Not limited to:	This course allows the students to understand the fundamental concepts of programming which will allow them to program applications in C.
2	Vertical :	Major
3	Type :	Theory
4	Credits :	2 credits (1 credit = 15 Hours for Theory in a semester)
5	Hours Allotted :	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives(CO): CO 1. To understand the concepts of computer programming. CO 2. To understand syntax and semantics of the C language CO 3. To understand loops and decision making in programming. CO 4. To understand the use of arrays, structures, union and pointers. CO 5. To understand functions for modular code and handle errors.	
8	Course Outcomes (OC): OC 1. Students can build flowcharts, pseudocode for C programs. OC 2. Students can use C language syntax and semantics in their programs. OC 3. Students can implement loops and decision making. OC 4. Students can use different types of data structures in their programs. OC 5. Students can write well-structured, readable, and maintainable C code and debug programs if there are any errors.	
9	Modules:- Module 1:	15 Hrs
	1. Introduction: Algorithms, History of C, Structure of C Program. Program Characteristics, Compiler, Linker and preprocessor, pseudo code statements and flowchart symbols, Desirable program characteristics. Program structure. Compilation and Execution of a Program, C Character Set, identifiers and keywords, data types and sizes, constants and its types, variables, Character and character strings, typedef, typecasting 2. Type of operators: Arithmetic operators, relational and logical operators, Increment and Decrement operators, assignment operators, the conditional operator, Assignment operators and expression, Precedence and order of Evaluation Block Structure, Initialization, C Preprocessor	
	Module 2:	

	<ol style="list-style-type: none"> 1. Control Flow: Statements and Blocks, If-Else, Else-If, Switch, Loops- While and For Loops Do-while, Break and Continue, Goto and Labels 2. Basics of functions. User defined and Library functions 3. Pointer and Addresses, Pointer and Function Arguments, Pointer and Arrays. 4. User-defined data types- structure and union 	15 Hrs
10	<p>Books and References:</p> <ol style="list-style-type: none"> 1. C Programming Language, Brian W. Kernighan, Dennis M. Ritchie , 2017 2. Let Us C, Yashvant Kanetkar, BPB Publications,2008. 3. Mastering in C, K. R. Venugopal and Sudeep R. Prasad, Tata McGraw-Hill Publications. 4. A Computer Science –Structure Programming Approaches using C, Behrouz Forouzan, Cengage Learning. 5.. Schaum’s outlines Programming with C, Byron S. Gottfried, Tata McGraw- Hill Publications. 6. Basics of Computer Science, by Behrouz Forouzan, Cengage Learning. 7. Programming Techniques through C, by M. G. Venkateshmurthy, Pearson Publication. 	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	<p>Continuous Evaluation through:</p> <p>Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks</p> <p>Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks</p>	Format of Question Paper: External Examination (30 Marks)– 1 hr duration
14	<p>Format of Question Paper: (Semester End Examination : 30 Marks. Duration:1 hour)</p> <p>Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks)</p>	

Name of the Course: Database Management System

Sr.No	Heading	Particulars		
1	Description the course : Including but Not limited to:	The objective of the course is to present an introduction to fundamentals of database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively -information from a DBMS.		
2	Vertical :	Major		
3	Type :	Theory		
4	Credits:	2 credits (1 credit = 15 Hours for Theory)		
5	Hours Allotted :	30 Hours		
6	Marks Allotted:	50 Marks		
7	Course Objectives(CO):	<p>CO 1. To make students aware fundamentals of database system.</p> <p>CO 2. To give idea how ERD components helpful in database design and implementation.</p> <p>CO 3. To experience the students working with database using MySQL.</p> <p>CO 4. To familiarize the student with normalization, database protection and different DDL, DML, DQL, DCL Statements</p> <p>CO 5. To make students aware about importance of protecting data from unauthorized users.</p>		
8	Course Outcomes (OC):	<p>OC 1. Define and describe the fundamental elements of relational database management system.</p> <p>OC 2. To relate the basic concepts of relational data model, entity-relationship model, relational database</p> <p>OC 3. Design ER-models to represent simple database application scenarios.</p> <p>OC 4. Understand the normalization and its role in the database design process</p> <p>OC 5. Transform the ER-model to relational tables, populate relational database and formulate SQL</p> <p>OC 6. Understand basic database storage structures and access techniques: file and page organizations, indexing methods and hashing.</p>		
9	Modules:- Module 1:	<table border="1"> <tr> <td> <p>1. Introduction to Databases and transactions What is database system, purpose of database system, view of data, relational databases, database architecture, transaction management</p> <p>2. Data Models The importance of data models, Basic building blocks, Business rules, The evolution of data models, Degrees of data abstraction</p> <p>3. Database Design, ER-Diagram Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, Codd's rules, Relational Schemas</p> <p>4. Relational database model Logical view of data, keys, integrity rules</p> </td> <td style="text-align: center; vertical-align: middle;">15 Hrs</td> </tr> </table>	<p>1. Introduction to Databases and transactions What is database system, purpose of database system, view of data, relational databases, database architecture, transaction management</p> <p>2. Data Models The importance of data models, Basic building blocks, Business rules, The evolution of data models, Degrees of data abstraction</p> <p>3. Database Design, ER-Diagram Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, Codd's rules, Relational Schemas</p> <p>4. Relational database model Logical view of data, keys, integrity rules</p>	15 Hrs
<p>1. Introduction to Databases and transactions What is database system, purpose of database system, view of data, relational databases, database architecture, transaction management</p> <p>2. Data Models The importance of data models, Basic building blocks, Business rules, The evolution of data models, Degrees of data abstraction</p> <p>3. Database Design, ER-Diagram Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, Codd's rules, Relational Schemas</p> <p>4. Relational database model Logical view of data, keys, integrity rules</p>	15 Hrs			

	Module 2:	
	<p>1. Database Design theory and normalization: Basics of functional dependencies and normalization for relational databases. Relational database design and further dependencies.</p> <p>2. SQL, Indexing: Introduction to SQL, Complex queries, triggers, views, joining database tables and schema modification. Query Processing and optimization. File structure, hashing and indexing</p> <p>3. Transaction management and concurrency control and recovery: Introduction to transaction processing concepts and theory. Concurrency control technique. Database recovery technique</p>	. 15 Hrs
10	Text Books	
	<p>1. "Fundamentals of Database System", Elmasri Ramez, Navathe Shamkant, Pearson Education, Seventh edition, 2017</p> <p>2. Database Management Systems", Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, 2014</p> <p>3. Database Systems: Design implementation and management by Carlos Coronel, Steven Morris, Peter Rob</p>	
11	Reference Books	
	<p>1. "Database System Concepts", Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw Hill, 2017</p> <p>2. "MySQL: The Complete Reference", Vikram Vaswani , McGraw Hill, 2017</p> <p>3. "Learn SQL with MySQL: Retrieve and Manipulate Data Using SQL Commands with Ease", Ashwin Pajankar, BPB Publications, 2020</p>	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	<p>Continuous Evaluation through:</p> <p>Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks</p> <p>Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks</p>	Format of Question Paper: External Examination (30 Marks)– 1 hr duration
14	<p>Format of Question Paper: (Semester End Examination : 30 Marks. Duration:1 hour)</p> <p>Q1: Attempt any two (out of four) from Module 1 (15 marks)</p> <p>Q2: Attempt any two (out of four) from Module 2 (15 marks)</p>	

Name of the Course: Major Practical 1

Sr.No	Heading	Particulars
1	Description the course : Including but Not limited to:	<u>Programming with C -practical</u> This course is stepping stone to learn other languages. This course provides students hands on experiences of coding exercises and projects. <u>Database Management System's</u> practical approach is useful to gain the knowledge for software backend development. It benefits to user by providing data definition, data access, reduced data redundancy, data integrity, data sharing, data organizing, data consistency, data accuracy, and security
2	Vertical :	Major
3	Type :	Practical
4	Credits :	2 credits (60 Hours of Practical work in a semester)
5	Hours Allotted :	30 Hours (C Programming Practical) + 30 Hours(DBMS - Practical)
6	Marks Allotted:	50 Marks
7	Course Objectives(CO):	<p>CO 1. To provide exposure in developing algorithm, flowchart and to write efficient code.</p> <p>CO 2. To understand loops and decision making in programming.</p> <p>CO 3. To understand the arrays, structures, union.</p> <p>CO 4. To understand the use of function and pointers.</p> <p>CO 5. To Identify entities and its relationship with relational model structure.</p> <p>CO 6. To understand relational database using SQL and constraints implementation using create table queries.</p> <p>CO 7. To Understand DML operations and backing of database</p> <p>CO 8. To understand how to retrieve data from database and learn how to retrieve single value after performing calculations on group of values</p> <p>CO 9. To understand built-in functions to perform operations on data</p> <p>CO 10. To understand how to fetch data from two or more tables, which is joined to appear as single set of data</p> <p>CO 11. To understand nested and larger query as advanced fetching of data to understand concept of virtual table.</p> <p>CO 12. To understand how to control user access in a database.</p>

8

Course Outcomes (OC):

- OC 1. Students can demonstrate the concepts of datatypes, variables and operators in C.
- OC 2. Students can implement the concept of control statements and looping in C program.
- OC 3. Students can demonstrate the use of arrays, strings and structures in C
- OC 4. Students can implement modular C program using functions and pointers.
- OC 5. Students can demonstrate the use of arrays, strings and structures in C.
- OC 6. Students able to perform various operations such as insert, update delete and retrieve data from database using SQL queries.
- OC 7. Students able to perform alteration in tables and can restore and take backup of the database.
- OC 8. Students able to perform operations using simple SQL Queries to fetch data and learns various aggregate functions to get single value.
- OC 9. Students able to perform SQL Queries using JOIN keyword for joining two or more tables.
- OC 10. Students able to perform nested queries using in, exists operators.
- OC 11. Students able to create new table by joining one or more tables and learn how to hide attribute from end user.
- OC 12. Students able to restrict the user from accessing data in database.
- OC 13. Students should be able to create, manipulate the database management system to evaluate the business information problem.

9	<p>Module 1:- Programming with C</p> <p>1. Practical 1:-</p> <ol style="list-style-type: none"> To calculate simple interest taking principal, rate of interest and number of years as input from user. Write algorithm & draw flowchart for the same. Write a program to find greatest of three numbers using conditional operator. Write algorithm & draw flowchart for the same. Write a program to check if the year entered is leap year or not. Write algorithm & draw flowchart for the same. <p>2. Practical 2:-</p> <ol style="list-style-type: none"> Write a program to calculate roots of a quadratic equation. Write a menu driven program using switch case to perform add / subtract / multiply / divide based on the users choice. Write a program to print the pattern of asterisks. <p>3. Practical 3</p> <ol style="list-style-type: none"> Write a program using while loop to reverse the digits of a number. Write a program to calculate the factorial of a given number. Write a program to print the Fibonacci series. <p>4. Practical 4</p> <ol style="list-style-type: none"> Write a program to print area of square using function. Write a program using recursive function. Write a program to square root, abs() value using function. Write a program using goto statement . <p>5. Practical 5</p> <ol style="list-style-type: none"> Write a program to print rollno and names of 10 students using array. Write a program to sort the elements of array in ascending or descending order <p>6. Practical 6</p> <ol style="list-style-type: none"> Write a program to extract the portion of a character string and print the extracted part. Write a program to find the given string is palindrome or not. Write a program to using strlen(), strcmp() function . <p>7. Practical 7</p> <p>Write a program to swap two numbers using a function. Pass the values to be swapped to this function using call-by-value method and call-by-reference method.</p> <p>8. Practical 8</p> <ol style="list-style-type: none"> Write a program to read a matrix of size m*n. Write a program to multiply two matrices using a function. <p>9. Practical 9</p> <p>Write a program to print the structure using</p> <p style="padding-left: 40px;">Title Author Subject Book ID</p> <p>Print the details of two students.</p> <p>10. Practical 10</p> <p>Create a mini project on “Bank management system”. The program should be menu driven.</p>	30 Hrs
---	--	--------

	<p>Module 2</p> <ol style="list-style-type: none"> 1. Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.) 2. Perform the following: <ul style="list-style-type: none"> • Viewing all databases • Creating a Database • Viewing all Tables in a Database • Creating Tables (With and Without Constraints) • Inserting/Updating/Deleting Records in a Table 3. Perform the following: <ul style="list-style-type: none"> • Altering a Table • Dropping/Truncating/Renaming Tables • Backing up / Restoring a Database 4. Perform the following: <ul style="list-style-type: none"> • Simple Queries • Simple Queries with Aggregate functions 5. Queries involving <ul style="list-style-type: none"> • Date Functions • String Functions • Math Functions 6. Join Queries <ul style="list-style-type: none"> • Inner Join • Outer Join 7. Subqueries <ul style="list-style-type: none"> • With IN clause • With EXISTS clause 8. Converting ER Model to Relational Model and apply Normalization on database. (Represent entities and relationships in Tabular form, Represent attributes as columns, identifying keys and normalization up to 3rd Normal Form). 9. Views <ul style="list-style-type: none"> • Creating Views (with and without check option) • Dropping views • Selecting from a view 10. DCL statements <ul style="list-style-type: none"> • Granting and revoking permissions • Saving (Commit) and Undoing (rollback) 	<p>30 Hrs</p>
<p>10</p>	<p>Text Books:</p> <ol style="list-style-type: none"> 1. "Fundamentals of Database System", Elmasri Ramez, Navathe Shamkant, Pearson Education, Seventh edition, 2017 . 2. Database Management Systems", Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, 2014 	
<p>11</p>	<p>Reference Books:</p> <ol style="list-style-type: none"> 1. MASTERING C, K. R. Venugopal and Sudeep R. Prasad, Tata McGraw-Hill Publications. 2. "A Computer Science –Structure Programming Approaches using C", Behrouz 	

	<p>Forouzan, Cengage Learning.</p> <p>3. Schaum's outlines "Programming with C", Byron S. Gottfried, Tata McGraw-Hill Publications.</p> <p>4. "Basics of Computer Science", Behrouz Forouzan , Cengage Learning.</p> <p>5. "Programming Techniques through C", M. G. Venkateshmurthy, Pearson Publication.</p> <p>6. "Programming in ANSI C", E. Balaguruswamy, Tata McGraw-Hill Education.</p> <p>7. "MySQL: The Complete Reference", Vikram Vaswani , McGraw Hill, 2017.</p> <p>8. "Learn SQL with MySQL: Retrieve and Manipulate Data Using SQL Commands with Ease", Ashwin Pajankar, BPB Publications, 2020.</p>	
12	<p>Internal Continuous Assessment: 40%</p>	<p>Semester End Examination: 60%</p>
13	<p>Continuous Evaluation through: Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totalling to 50 marks and can be converted to 20 marks.</p>	<p>30 marks practical exam of 2 hours duration</p>
14	<p>Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination</p> <p>Practical Slip:</p> <p>Q1. From Module 1 13 marks</p> <p>Q2. From Module 2 12marks</p> <p>Q3. Journal and Viva 05 marks</p>	

Vocational Skill Course (VSC)

Name of the course: **Combinational and Sequential Design**

Sr.No	Heading	Particulars
1	Description the course : Including but Not limited to:	<p>Combinational and Sequential Design is a course that focuses on digital electronics and the design of circuits that combine multiple digital components. The course covers the theoretical and practical aspects of both combinational and sequential circuit design, as well as their applications.</p> <p>Digital circuits are used in many electronic devices, including computers, smartphones, and communication systems. The design of these circuits is critical to the performance and functionality of these devices. Understanding the basics of combinational and sequential design is essential for anyone interested in pursuing a career in the field of digital electronics.</p> <p>The course will cover the various techniques and tools used in digital circuit design, including Boolean algebra and K-map simplification.</p> <p>The course is highly relevant in today's technological landscape, as all modern electronics devices are based on digital circuits. The skills learned in the course are highly useful in various fields, such as computer and electronics engineering, telecommunications, and robotics.</p> <p>The application of combinational and sequential design is quite broad, and the skills acquired from the course can be applied in various areas. Students will be able to design digital circuits, troubleshoot and repair digital circuits, and optimize circuit performance.</p> <p>The course is highly interesting and engaging, providing students with the opportunity to explore and analyze complex digital circuitry. It is also connected to other courses such as Digital Logic Design, Computer Organization, and Microcontrollers.</p> <p>The demand for professionals with digital circuit design skills is high in various industries such as electronics, semiconductors, telecommunications, and computing. There is an increasing demand for professionals with these skills,</p>

and job prospects are promising for those with a solid background in digital circuit design.

In summary, Combinational and Sequential Design is a course that offers students a comprehensive understanding of digital circuits' design principles and techniques. The knowledge and skills gained from this course are highly useful and applicable in various industries, with promising career prospects.

2	Vertical :	Vocational Skill Course(VSC)
3	Type :	Practical
4	Credits :	2 credits (60 hours in a semester)
5	Hours Allotted :	60 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives(CO):	<p>CO 1.To provide students with a comprehensive understanding of combinational and sequential circuit design principles and techniques.</p> <p>CO 2.To enable students to apply Boolean algebra, K-map simplification, and other design techniques to create optimized digital circuits.</p> <p>CO 3.To equip students with the necessary tools and skills to implement arithmetic circuits, data path circuits, and memory circuits.</p> <p>CO 4.To enable students to analyze and troubleshoot digital circuits to ensure optimal performance.</p> <p>CO 5.To provide students with hands-on practical experience in designing and implementing digital circuits using simulation software and real-world hardware.</p>
8	Course Outcomes (OC):	<p>OC 1. Students can explain the differences between combinational and sequential circuits, and identify their different applications.</p> <p>OC 2. Students can define the concept of Boolean algebra and its importance in digital circuit design.</p> <p>OC 3. Students can explain and apply the principles of K-map simplification and other design techniques.</p> <p>OC 4. Students can design and construct combinational circuits using Boolean algebra and K-maps.</p> <p>OC 5. Students can design and implement arithmetic circuits such as adders, subtractors, and multipliers.</p> <p>OC 6. Students can design and implement data path circuits such as registers, multiplexers, and decoders.</p> <p>OC 7. Students can implement digital circuits using breadboards, logic probes, and oscilloscopes.</p> <p>OC 8. Students can troubleshoot and verify the correctness of digital circuits using real-world hardware and measure their performance using various metrics.</p>
9	Modules:- Module 1:	

	<p>1. Study of Logic gates and their ICs and universal gates:</p> <p>a. Study of AND, OR, NOT, XOR, XNOR, NAND and NOR gates</p> <p>b. Study of IC 7400, 7402, 7404, 7408, 7432, 7486, 74266</p> <p>c. Implement AND, OR, NOT, XOR, XNOR using NAND gates.</p> <p>d. Implement AND, OR, NOT, XOR, XNOR using NOR gates.</p> <p>2. Implement the given Boolean expressions using minimum number of gates.</p> <p>a. Verifying De Morgan's laws.</p> <p>b. Implement other given expressions using minimum number of gates.</p> <p>c. Implement other given expressions using minimum number of ICs.</p> <p>3. Implement combinational circuits.</p> <p>a. Design and implement combinational circuit based on the problem given and minimizing using K-maps. (Various Equations, SOP, POS forms can be given)</p> <p>4. Implement code converters.</p> <p>a. Design and implement Binary – to – Gray code converter.</p> <p>b. Design and implement Gray – to – Binary code converter.</p> <p>c. Design and implement Binary – to – BCD code converter.</p> <p>d. Design and implement Binary – to – XS-3 code converter.</p> <p>5. Implement Adder and Subtractor Arithmetic circuits.</p> <p>a. Design and implement Half adder and Full adder.</p> <p>b. Design and implement BCD adder.</p> <p>c. Design and implement XS – 3 adder.</p> <p>d. Design and implement binary subtractor.</p> <p>e. Design and implement BCD subtractor.</p> <p>b. Design and implement XS – 3 subtractor.</p>	<p>30 Hrs</p>
<p>Module 2:</p>		
	<p>6. Implement Arithmetic circuits.</p> <p>a. Design and implement a 2-bit by 2-bit multiplier.</p> <p>b. Design and implement a 2-bit comparator.</p> <p>7. Implement Encode and Decoder and Multiplexer and Demultiplexers.</p> <p>a. Design and implement 8:3 encoder.</p> <p>b. Design and implement 3:8 decoder.</p> <p>c. Design and implement 4:1 multiplexer. Study of IC 74153, 74157</p> <p>d. Design and implement 1:4 demultiplexer. Study of IC 74139</p> <p>e. Implement the given expression using IC 74151 8:1 multiplexer.</p> <p>f. Implement the given expression using IC 74138 3:8 decoder.</p> <p>8. Study of flip-flops and counters.</p> <p>a. Study of flip-flops and counters.</p> <p>b. Study of IC 7473.</p> <p>c. Study of IC 7474.</p> <p>d. Study of IC 7476.</p> <p>e. Conversion of Flip-flops.</p>	<p>30 Hrs</p>

	<ul style="list-style-type: none"> f. Design of 3-bit synchronous counter using 7473 and required gates. g. Design of 3-bit ripple counter using IC 7473. <p>9. Study of counter ICs and designing Mod-N counters.</p> <ul style="list-style-type: none"> a. Study of IC 7490, 7492, 7493 and designing mod-n counters using these. b. Designing mod-n counters using IC 7473 and 7400 (NAND gates) <p>10. Design of shift registers and shift register counters.</p> <ul style="list-style-type: none"> a. Design serial – in serial – out, serial – in parallel – out, parallel – in serial – out, parallel – in parallel – out and bidirectional shift registers using IC 7474. b. Study of ID 7495. c. Implementation of digits using seven segment displays. 	
10	Text Books	
	1. Digital Electronics and Logic Design, N. G. Palan, Technova	
11	Reference Books	
	<ul style="list-style-type: none"> 1. Digital Principles and Applications, Malvino and Leach, Tata McGrawHill 2. Modern Digital Electronics, R. P. Jain, Tata McGrawHill 3. Digital Design, M. Morris R. Mano, Michael D. Ciletti, Pearson Education, 2012 	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	<p>Continuous Evaluation through:</p> <p>Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totalling to 50 marks and can be converted to 20 marks.</p>	30 marks practical exam of 2 hours duration
14	<p>Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination</p> <p>Practical Slip:</p> <ul style="list-style-type: none"> Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks 	

Skill Enhancement Course (SEC)

Name of the Course: Office Tools for Data Management

Sr.No.	Heading	Particulars
1	Description the course:	<ul style="list-style-type: none">• Introduction: The MS Access course offers a comprehensive understanding of Microsoft's relational database management system, making it a valuable skill in today's data-driven environment. This course is designed to empower individuals with the tools needed to efficiently organize, manage, and analyse data.• Relevance and Usefulness: It provides practical insights into leveraging a relational database system for enhanced efficiency and organization. The MS Access course is useful for individuals seeking to enhance their data management skills.• Applications: With applications in various sectors, from business to research and project management, MS Access is versatile. It facilitates the creation of databases for tasks ranging from contact management to complex systems for inventory and financial analysis.• Interest and Connection with Other Courses: Its practical applications and user-friendly interface make it attractive to individuals looking to boost their data management skills. The MS Access course establishes a practical link with other data-related courses, offering foundational knowledge in database management. It complements courses in data analysis, business intelligence, and information systems.• Demand in the Industry: As businesses increasingly rely on data for decision-making, there is a growing demand for professionals skilled in database management. Proficiency in MS Access is particularly sought after in roles involving data organization, analysis, and reporting.• Job Prospects: Professionals completing the MS Access course are well-positioned for roles requiring efficient data management and analysis. Job prospects include positions in database administration, data analysis, and business intelligence, where MS Access proficiency is a valuable asset.
2	Vertical :	Skill Enhancement Course(SEC)
3	Type :	Practical
4	Credits :	2 credits
5	Hours Allotted :	60 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives (CO):	

	<p>CO 1. Participants will grasp essential database concepts, including tables, relationships, and normalization principles.</p> <p>CO 2. Participants will design and construct well-organized databases in MS Access, showcasing proficiency in table design and data validation.</p> <p>CO 3. Participants will master the creation of complex queries in MS Access, enabling them to extract specific information efficiently.</p> <p>CO 4. Participants will develop expertise in crafting user-friendly forms and interfaces in MS Access, optimizing data entry processes.</p> <p>CO 5. Participants will generate comprehensive reports in MS Access, demonstrating skills in grouping, sorting, and presenting data for meaningful analysis.</p>	
<p>8</p>	<p>Course Outcomes (OC):</p> <p>OC 1. Participants can explain normalization importance, identify table relationships, and justify database design choices.</p> <p>OC 2. Participants create well-structured MS Access databases with proper relationships, data types, and normalization.</p> <p>OC 3. Participants execute advanced queries in MS Access, retrieving specific information based on diverse criteria.</p> <p>OC 4. Participants design intuitive MS Access forms, incorporating controls for an efficient and user-friendly data entry experience.</p> <p>OC 5. Participants produce insightful MS Access reports, organizing and presenting data effectively for analysis.</p>	
<p>9</p>	<p>Modules:- All Practicals are based on MS Access</p> <p>Module 1:</p> <p>Practical 1:</p> <p>A. Getting familiar with MS Access Ribbon options.</p> <p>B. With the help of access wizard Create Database. Add 2 Tables. In each table add 5 columns of different data types. Add 10-10 entries in each table. Add necessary integrity constraints.</p> <p>C. Use the Table Wizard to create a table. Add and delete fields in an existing table. Establish an input mask and validation rule for fields within a table. Switch between the Design and Datasheet views of a table.</p> <p>Practical 2:</p> <p>A. Create and use an Input Mask to enter the data in sample table.</p> <p>B. Adding records in table by using Datasheet View, using a Form and using SQL.</p> <p>C. Create the Employee Database with necessary table and data and then implement the following transitions:</p> <ul style="list-style-type: none"> • Delete the record for Kelly Marder. • Change Pamela Milgrom's salary to \$59,500. • Use the Replace command to change all occurrences of "Manager" to "Supervisor". <p>Practical 3:</p> <p>A. Create the Bookstore database with necessary table and data and modify the database to accommodate the following:</p>	<p>30 Hrs</p>

	<ul style="list-style-type: none"> i. Add the book Exploring Microsoft Office 2000 Vol II (ISBN: 013-011100-7) by Grauer/Barber, published in 1999 by Prentice Hall, selling for \$45.00. ii. Change the price of Memory Management for All of Us to \$29.95. iii. Delete The Presentation Design Book. <p>B. Create a table employ with (idno, name, job, age, salary). Insert 10 records. Create a query to display the information of all managers. Create a query to display the names of employs who"s salary is >15000.</p> <p>C. Use the Form Wizard to create a form, Move and size controls within a form. Use the completed form to enter data into the associated table.</p> <p>Practical 4:</p> <ul style="list-style-type: none"> A. Add fields to an existing table. Use the Lookup Wizard to create a combo box. Add controls to an existing form to demonstrate inheritance. Add command buttons to a form. B. Generate and use various the queries using Query Wizards. C. Generate and use various the Query with User Input. D. Demonstrate use of Expression Builder. <p>Practical 5:</p> <ul style="list-style-type: none"> A. Use the report wizard to create a new report. Modify an existing report by adding, deleting, and/or modifying its controls. B. Create a query containing a calculated control. Then, create report based on that query. Use the Sorting and Grouping command to add a group header and group footer to a report. C. Use action queries to modify a database. Create a crosstab query to display summarized values from a table. 	
Module 2:		
	<p>Practical 6:</p> <ul style="list-style-type: none"> A. Create and Open a database with multiple tables; Identify the one-to-many relationships within the database and to produce reports based on those relationships. B. Create and Open a database with multiple tables; Identify the one-to-one relationships within the database and to produce reports based on those relationships. C. Create and Open a database with multiple tables; Identify the Many-to-Many relationships within the database and to produce reports based on those relationships. <p>Practical 7:</p> <ul style="list-style-type: none"> A. Demonstrate use of look up tables. B. Use the Report Wizard to create a report having the following requirements: <ul style="list-style-type: none"> i. Select the LastName field from the Author table. ii. Select the Title and Price fields from the Book table. iii. Select the PubName field from the Publisher table. 	<p>30 Hrs</p>

- iv. View the data by Publisher.
 - v. Add a grouping level using LastName.
 - vi. Sort the report by the Title field in ascending order.
 - vii. Choose Stepped layout and Portrait orientation.
 - viii. Type Book List as the report's title.
- C. Define the relationship between two tables and add a subform to a form.

Practical 8:

- A. Import an Access table from an Excel workbook. Create a one-to-many relationship between tables in a database. Create a multiple-table query.
- B. Import external data from the Excel spreadsheet file Bookstore.
- i. Make sure Import the source data into a new table in the current database is selected.
 - ii. Select the Author worksheet.
 - iii. Make sure that First Row Contains Column Headings is selected.
 - iv. For the AuthorID field, set the Data Type option to Long Integer and set the Indexed option to Yes (No Duplicates).
 - v. Select Choose my own primary key and make sure the AuthorID field is selected.
 - vi. Save the table with the name Author.
- C. Export data from access to various formats.

Practical 9:

- A. Relationships: Create and Use Author and Book Table.
- i. Create a relationship between the AuthorID field in the Author table and the AuthorCode field in the Book table. Put a checkmark in the box labeled Enforce Referential Integrity.
 - ii. Create a relationship between the PubID field in the Publisher table and the PubID field in the Book table. Put a checkmark in the box labeled Enforce Referential Integrity.
- B. Create a switchboard; Use the Link Tables command to associate tables in one database with the objects in a different database.
- C. Create an AutoExec and a Close Database macro and demonstrate the use.

Practical 10:

- A. Create the College Library database find out the following: -
- i. Total no. of copies of books subject wise.
 - ii. A report displays all books group by Publisher.
 - iii. A report displays all books group by Book Title.
 - iv. A report displays all books group by Book Edition
- B. Demonstrate the use of Database Splitter Wizard by splitting database.
- C. Make Access database as an executable-only

10

Online reference/Text Books

1. https://www.quackit.com/microsoft_access/tutorial/

	2. https://www.tutorialspoint.com/ms_access/index.htm 3. Access 2016 in easy steps, by Mike McGrath, In Easy Steps, 1st Edition, 2017 4. Relational Databases and Microsoft Access, by Ron McFadyen, 1st Edition	
11	Reference Books 1. MICROSOFT ACCESS 2019 by David Murray, Kendall Hunt Publishing, 1 st Edition, 2020. 2. Step by Step Microsoft Access 2013, by Joyce Cox and Joan Lambert, 1 st Edition, Microsoft Press, 2013 3. Access 2019 Bible, by Michael Alexander, Richard Kusleika, Wiley, 1 st Edition, 2018 4. Access 2019 For Dummies, by Laurie A. Ulrich, Ken Cook, Wiley, 1 st Edition, 2018	
12	Internal Continuous Assessment: 40% Semester End Examination: 60%	
13	Continuous Evaluation through: Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totalling to 50 marks and can be converted to 20 marks.	30 marks practical exam of 2 hours duration
14	Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks	

Name of the Course: Fundamentals of Telecommunication Systems

Sr.No	Heading	Particulars
1	Description the course : Including but Not limited to:	<p>The course on Fundamentals of Telecommunication Systems aims to provide an in-depth understanding of the basic concepts and theories of signals and systems, as well as their applications in the field of telecommunication engineering. The course also focuses on the latest trends in 5G technology, providing students with insights into the driver, pillars, and challenges of 5G networks.</p> <p>Relevance and Usefulness: The course is highly relevant to students pursuing degrees in electronics and communication engineering, as well as those interested in telecommunications engineering. By focusing on key concepts and terminologies, such as sets, mappings, functions, and systems operators, the course provides a foundation for understanding both the theoretical and</p>

practical aspects of signals and systems. Additionally, the course helps students understand the role of 5G technology in enabling advanced wireless communication and the internet of things (IoT), which can be useful for developing innovative applications and services.

Application and Interest: By completing the course, students will be equipped to apply their knowledge and skills in a range of industries and sectors, including telecommunication, internet of things, and wireless communication. The course is also highly engaging, as it covers several fascinating topics, including wireless communication, 5G technology, and IoT, among others.

Connections with Other Courses: The course has links with other courses in electronics and communication engineering, including digital signal processing, telecommunication theory and practice, mobile communication, Information Technology and internet of things.

Demand in the Industry and Job Prospects: Graduates with a background in signals and systems and 5G technology are in high demand in the telecommunication industry, as there is an increasing need for professionals who can design, implement, and oversee advanced communication networks. Specializations in 5G technology and signals and systems can open up a range of job prospects, including roles such as telecommunications engineer, network architect, systems engineer, and wireless communication developer, among others.

In conclusion, the course in signals and systems and 5G technology is highly relevant and useful for students pursuing degrees in electronics and communication engineering and Information Technology. The course is engaging and provides a solid foundation in key concepts and technologies, enabling students to pursue a range of job prospects within the telecommunication industry.

2	Vertical :	Skill Enhancement Course(SEC)
3	Type :	Theory
4	Credits :	2 credits (30 hours in a semester)
5	Hours Allotted :	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives(CO): CO 1. Identify the fundamental concepts and terminologies of signals and systems theory through an introduction to sets, mappings, functions, and systems operators.	

	<p>CO 2. Demonstrate knowledge of the properties of continuous-time signals and systems, transformations of the independent variable, properties of functions, and representation of arbitrary functions.</p> <p>CO 3. Demonstrate knowledge of the properties of discrete-time signals and systems, transformations of the independent variable, properties of sequences, and representation of arbitrary sequences.</p> <p>CO 4. Analyze the drivers for 5G technology, identify the 10 pillars of 5G, and describe the evolution of wireless communication from LTE technology to beyond 4G.</p> <p>CO 5. Discuss the 5G internet of things (IoT), explain networking reconfiguration and virtualization support, and identify the mobility and quality of service control in 5G networks.</p> <p>CO 6. Evaluate the challenges of small cells in 5G mobile networks and identify the capacity limits and achievable gains with densification.</p>	
8	<p>Course Outcomes (OC):</p> <p>OC 1. Identify the fundamental concepts and terminologies of signals and systems theory through an introduction to sets, mappings, functions, and systems operators.</p> <p>OC 2. Demonstrate knowledge of the properties of continuous-time signals and systems, transformations of the independent variable, properties of functions, and representation of arbitrary functions.</p> <p>OC 3. Demonstrate knowledge of the properties of discrete-time signals and systems, transformations of the independent variable, properties of sequences, and representation of arbitrary sequences.</p> <p>OC 4. Analyze the drivers for 5G technology, identify the 10 pillars of 5G, and describe the evolution of wireless communication from LTE technology to beyond 4G.</p> <p>OC 5. Discuss the 5G internet of things (IoT), explain networking reconfiguration and virtualization support, and identify the mobility and quality of service control in 5G networks.</p> <p>OC 6. Evaluate the challenges of small cells in 5G mobile networks and identify the capacity limits and achievable gains with densification.</p>	
9	<p>Modules:-</p> <p>Module 1: Signals and Systems:</p> <ol style="list-style-type: none"> 1. Signals and Systems: Introduction, Signals, Systems, Why Signals and Systems? Preliminaries, Overviews, Sets, Mappings, Functions, Sequences, Abuse of notations, System operators, Basic Signal Properties. 2. Continuous-Time Signals and Systems: Overview, Transformations of the Independent Variable, Transformations and the Dependent Variable, Properties of functions, Elementary functions, Representation of Arbitrary Functions using elementary functions, Continuous -time systems, Properties of systems, 3. Discrete-Time Signals and Systems: Overview, Transformations of the independent variable, Properties of Sequences, Elementary Sequences, Representing Arbitrary Sequences Using Elementary Sequences, Discrete-Time Systems, Properties of Systems <p>Module 2: Fundamentals of 5G Networks</p> <ol style="list-style-type: none"> 4. Drivers for 5G: Introduction, Historical trend of Wireless Communication, Evolution of LTE technology to beyond 4G, 5G 	<p>15 Hrs</p> <p>15 Hrs</p>

	<p>Roadmap, 10 pillars of 5G, 5G in Europe, 5G in Asia, 5G in Asia, 5G Architecture</p> <p>5. The 5G Internet: Introduction, Internet of Things and Context-Awareness, Networking Reconfiguration and Virtualisation Support, Mobility, Quality of Service Control, Emerging Approach for Resource Over-Provisioning</p> <p>6. Small Cells for 5G Mobile Networks: Introduction, What are small cells? Capacity Limits and Achievable Gains with Densification, Mobile Data Demand, Demand vs Capacity, Small-Cell Challenges, Conclusions and future directions</p>	
10	<p>Text Books:</p> <p>1. Signals and Systems, Michael Adams, University of Victoria, 3rd Edition, 2012</p> <p>2. Fundamentals of 5G Mobile Networks, Edited by Jonathan Rodriguez, Wiley Publications, 2015</p>	
11	<p>Reference Books</p> <p>1. Signals and Systems, Michael Adams, University of Victoria, 3rd Edition, 2012</p> <p>2. Fundamentals of 5G Mobile Networks, Edited by Jonathan Rodriguez, Wiley Publications, 2015</p>	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	<p>Continuous Evaluation through:</p> <p>Class test of 1 of 15 marks</p> <p>Class test of 2 of 15 marks</p> <p>Average of the two: 15 marks</p> <p>Quizzes/ Presentations/ Assignments: 5 marks</p> <p>Total: 20 marks</p>	<p>Format of Question Paper:</p> <p>External Examination (30 Marks)–</p> <p>1 hr duration</p>
14	<p>Format of Question Paper: (Semester End Examination : 30 Marks. Duration:1 hour)</p> <p>Q1: Attempt any two (out of four) from Module 1 (15 marks)</p> <p>Q2: Attempt any two (out of four) from Module 2 (15 marks)</p>	

SEMESTER II

Syllabus
B.Sc. (Information Technology)
(Sem.- II)

Major Courses

Name of the Course: Object Oriented Programming using C++

Sr.No.	Heading	Particulars
1	Description the course : Including but Not limited to:	This course provides students knowledge and skills to understand and implement the object oriented skills. It will help them to implement OOP solutions to real-world problems.
2	Vertical :	Major
3	Type :	Theory
4	Credits :	2 credits (1 credit = 15 Hours for Theory in a semester)
5	Hours Allotted :	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives(CO):	<p>CO 1. To explain the difference between object oriented programming and procedural programming.</p> <p>CO 2. To understand OOP principles to create modular, reusable, and maintainable code.</p> <p>CO 3. To understand the concept of polymorphism ,virtual functions,inheritance and exception handling.</p> <p>CO 4. To understand file handling concepts using C++.</p>
8	Course Outcomes (OC):	<p>OC 1. Students can explain the key concept of OOP and their application in software development.</p> <p>OC 2. Students can Design and implement classes and objects to model real-world entities.</p> <p>OC 3. Students can apply the concepts of polymorphism, virtual functions, inheritance and exception handling in program.</p> <p>OC 4. Students can apply operator overloading, runtime polymorphism, generic Programming</p> <p>OC 5. Students can implement file handling concepts in program</p>
9	Modules:- Module 1:	<p>1. Object Oriented Methodology: Introduction, Advantages and Disadvantages of Procedure Oriented Languages, Application of OOPS, Principles of OOPS: Objects, Classes, Data Abstraction and Data Encapsulation, Inheritance, Polymorphism, Dynamic Binding, Message Passing.</p> <p>2. Classes and Objects: Simple classes (Class specification, class members accessing), Defining member functions, passing object as an argument, Returning object from functions, friend classes, friend function.</p>
		15 Hrs

	<p>3. Constructors and Destructors: Introduction, Default Constructor, Parameterized Constructor and examples, Destructors.</p> <p>4. Program development using Inheritance: Introduction, Advantages provided by inheritance, choosing the access specifier, Derived class declaration, derived class constructors, class hierarchies, multiple inheritance, multilevel inheritance, hybrid inheritance.</p>	
	Module 2:	
	<p>5. Polymorphism: Concept of function overloading, overloaded operators, overloading unary and binary operators.</p> <p>6. Virtual Functions: Introduction and need, Pure Virtual Functions, this Pointer, abstract classes, virtual destructors.</p> <p>7. Exception Handling: Introduction, Exception Handling Mechanism, Concept of throw & catch with example.</p> <p>8. Working with Files: Introduction, File Operations, Various File Modes, File Pointer and their Manipulation.</p>	15 Hrs
10	<p>Text Books</p> <p>1. Object-oriented Programming C++, Hari Mohan Pandey , Laxmi Publications</p> <p>2. C++ Programming: An Object-Oriented Approach, Behrouz A. Forouzan, Richard F. Gilberg , McGraw-Hill Education</p> <p>3. C++ How to Program , Paul Deitel, Harvey Deitel</p>	
11	<p>Reference Books</p> <p>1. Object Oriented Programming in C++ , E Balagurusamy</p> <p>2. Object-Oriented Programming in C++ , Robert Lafore, Pearson Education.</p> <p>3. Programming with ANSI C++ , Bhushan Trivedi</p> <p>4. Demystified Object- Oriented Programming with C++, Dorothy R. Kirk</p>	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	<p>Continuous Evaluation through:</p> <p>Class test of 1 of 15 marks</p> <p>Class test of 2 of 15 marks</p> <p>Average of the two: 15 marks</p> <p>Quizzes/ Presentations/ Assignments: 5 marks</p> <p>Total: 20 marks</p>	<p>Format of Question Paper:</p> <p>External Examination (30 Marks)–</p> <p>1 hr duration</p>
14	<p>Format of Question Paper: (Semester End Examination : 30 Marks. Duration:1 hour)</p> <p>Q1: Attempt any two (out of four) from Module 1 (15 marks)</p> <p>Q2: Attempt any two (out of four) from Module 2 (15 marks)</p>	

Name of the Course: Web Designing

Sr.No	Heading	Particulars
1	Description the course : Including but Not limited to:	The objective of Web Designing course is to provide instructions on creating and maintaining a web page for publishing on the Internet. Students will be able to use HTML editor to author pages that include text and graphics..
2	Vertical :	Major
3	Type :	Theory
4	Credits :	2 credits (1 credit = 15 Hours for in a semester)
5	Hours Allotted :	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives(CO): CO 1. To understand the fundamentals of Internet, and the principles of web design CO 2. To develop basic websites using HTML and Style Sheets. CO 3. To understand different style sheets used in web designing. CO 4. To implement JavaScript as a tool to add dynamism to static HTML pages.	
8	Course Outcomes (OC): OC 1. Learners will be able to use the HTML programming language OC 2. Learners will be able to execute web pages designed using HTML OC 3. Describe the concepts of World Wide Web, and the requirements of effective web design OC 4. List various tags in html and use these to create web page OC 5 : Gain necessary skills for designing and developing web applications	
9	Modules:- Module 1: 1. Introduction to HTML 5: What Is HTML? Understanding HTML Tags, Setting Up the Document Structure: Specifying the Document Type, Creating the HTML, Specifying a Page Title. Formatting Text by Using Tags: Creating Headings, Applying Bold and Italic Formatting, Applying Superscript and Subscript Formatting, Using Monospace and Preformatted Text. Using Lists and Backgrounds: Creating Bulleted and Numbered Lists, Creating Definition Lists, Inserting Special Characters, Inserting Horizontal Lines, Choosing Background and Foreground Colors. Creating Hyperlinks and Anchors- Hyperlinking to a Web Page, Creating Hyperlinking to an E-Mail Address, Hyperlinking to Other Content. Style Sheets and Graphics: Introduction to Style Sheets: Understanding Styles, Constructing Style Rules, Creating Styles for Nested Tags, Applying Styles to Hyperlinks, Creating and Linking to External Style Sheets.	15 Hrs

Formatting Text by Using Style Sheets: Specifying a Font Family, Specifying a Font Size and Color, Applying Bold and Italics, Applying Strikethrough and Underlining, Creating Inline Spans, Adjusting Spacing Between Letters. Formatting Paragraphs by Using Style Sheets: Indenting Paragraphs, Applying a Border to a Paragraph, Specifying the Horizontal Alignment of a Paragraph,

Displaying Graphics

Selecting a Graphics Format, Preparing Graphics for Web Use, Inserting Graphics, Arranging Elements on the Page, Controlling Image Size and Padding, Hyperlinking from Graphics, Using Thumbnail Graphics, Including Alternate Text for Graphics, Adding Figure Captions

2. Page Layout and Navigation- Creating Navigational Aids , Creating a Text-Based and Graphical Navigation Bar, Creating an Image Map, Creating Tables, Specifying the Size of a Table, Specifying the Width of a Column, Merging Table Cells. Formatting Tables-Applying Table Borders, Applying Borders by Using Attributes, Applying Borders by Using Styles, Changing Cell Padding, Spacing, and Alignment. Setting Horizontal and Vertical Alignment

Creating User Forms- Creating a Basic Form- Creating a Text Box,Special Field types for E-Mail and Web Addresses, Creating a Text Area, Creating a Submit or Clear Button, Creating Check Boxes and Option Buttons, Additional Input Types in HTML5

Incorporating Sound and Video- What's New with Audio and Video in HTML5?,Embedding Video Clips- Introducing the <video> Tag, The <embed> Tag: Your Fallback Plan, Placing a Video Clip on a Web Page. Incorporating Audio on a Web Page- Playing Audio with the <audio> Tag, Placing an Audio Clip on a Web Page

Module 2:

1. JavaScript:

Introduction to JavaScript: Variable, statements, Operators, Comments, constructs, Functions, expressions, JavaScript console, Scope, Events, Strings, String Methods, Numbers, Number Methods, Dates, Date Formats, Date,Methods,Arrays, Array Methods, Booleans, Comparisons, Control Structures: Conditions, Switch, Loop For, Loop While, Break.

Operators: Arithmetic Operators, Assignment Operators, Comparison Operators, Logical Operators, Bitwise Operators

Statements: Conditional Statements – if else, switch, Loops – while, do while, for, for in, for of, Loop Control – break, continue, labels

JavaScript Objects: User-defined Objects, with Keyword, Native Objects – Array, String, Date, Math, Number, RegExp, Cookies

Events and Event Handlers: HTML Events, DOM Events, DOM Event Listener,onAbort, onBlur, onChange, onClick, onDbIclick, onError, onFocus, onKeyDown,onKeyPress, onKeyUp, onLoad, onMouseDown, onMouseMove, onMouseOut,onMouseOver, onMouseUp, onReset, onResize, onSelect, onsubmit, onunload

2. Basics of JQuery, JQuery selection and events, JQuery Effects, JQuery traversal and manipulation, Data attributes and templates, jQuery Plugins.

15 Hrs

	3. JSON – JSON: Introduction, JSON Grammar, JSON Values, JSON Tokens, Syntax, JSON vs. XML, Data Types, Objects, Arrays, Creating JSON, JSON Object, Parsing JSON, Persisting JSON, Data Interchange, JSON HTML, JSONP	
10	Text Books <ol style="list-style-type: none"> 1. Step by Step HTML5 by Faithe Wempen, Microsoft Press, 2011 2. The Complete Reference HTML & CSS, Thomas A. Powell. McGrawHill, 5th Edition, 2010 3. The Complete Reference JavaScript Thomas A. Powell & Fritz Schneider McGrawHill 3rd 2012 4. Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Black Book Kindle Edition, by Kogent Learning Solutions Inc 5. HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, AJAX, PHP and jQuery, 2nd Kindle Edition, by DT Editorial Services 6. JSON at work, Tom MARRS, O'REILLY, First edition, 2017 	
11	Reference Books <ol style="list-style-type: none"> 1. Learning Web Design A Beginner's Guide to Html, CSS, JavaScript, And Web Graphics, Jennifer Niederst Robbins, O'Reilly, 5th Edition, 2018. 2. Ivan Bayross, "Web Enabled Commercial Applications Development using HTML, DHTML, Javascript, Perl CGI", BPB, 2004 3. HTML 5 for Web Designers (By: Jeremy Keith) – http:// freepdf-books.com 4. Introduction to JavaScript Object Notation: A To-the-Point Guide to JSON kindle Edition by Lindsay Bassett, O'REILLY 	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	Continuous Evaluation through: Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	Format of Question Paper: External Examination (30 Marks)– 1 hr duration
14	Format of Question Paper: (Semester End Examination : 30 Marks. Duration: 1 hour) Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks)	

Name of the Course: Major Practical II

Sr.No.	Heading	Particulars
1	Description the course : Including but Not limited to:	Object Oriented Programming using C++ Practical OOP encourages modular objects for reusable code, ensures well-organized and maintainable code via encapsulation, inheritance, and polymorphism, allowing flexibility and easy updates. Additionally, OOP models real-world scenarios, enhancing system understanding. Web Designing Practical Applying basic programming principles to the construction of websites

2	Vertical :	Major Practical
3	Type :	Practical
4	Credits :	2 credits (Total 60 hrs; 1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted :	60 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives(CO): CO 1. To explain the important characteristics of the C++ programming language. CO 2. To combine components of the C++ programming language to develop structured program. CO 3. To demonstrate the skills essential to compile, debug, and test C++ programs correctly. CO 4. To understand how to effectively implement HTML. CO 5. To develop the concept of basic and advanced text formatting. CO 6. To understand Hyper linking, Designing of webpage.	
8	Course Outcomes (OC): OC 1. Utilize C++ characteristics in software design and development. OC 2. Explain object-oriented techniques and explain how C++ supports them. OC 3. Employ C++ to demonstrate practical skill developing object-oriented solutions. OC 4. Examine a problem statements and design and develop object-oriented software using good coding practices and procedures. OC 5. Design static web pages using Hyper Text Markup Language (HTML). OC 6. Use their learned skills, knowledge and abilities to develop web sites OC 7. Collect information from the user with HTML Forms. OC 8. Enhance the look of web pages by implementing audio and video	
9	Module I	
	1. a. Write a C++ program to create a simple calculator. b. Write a C++ program to convert seconds into hours, minutes and seconds. c. Write a C++ program to find the volume of a square, cone, and rectangle. 2. a. Write a C++ program to find the greatest of three numbers. b. Write a C++ program to find the sum of even and odd n natural numbers c. Write a C++ program to generate all the prime numbers between 1 and n, where n is a value supplied by the user 3. a. Write a C++ program using classes and object Student to print name of the student, roll_no. Display the same. b. Write a C++ program for Structure bank employee to print name of the employee, account_no. & balance. Display the same also display the balance after withdraw and deposit	30 Hrs

c. Design the class Demo which will contain the following methods: readNo(), factorial() for calculating the factorial of a number, reverseNo() will reverse the given number, isPalindrome() will check the given number is palindrome, isArmstrong() which will calculate the given number is armStrong or not. Where readNo() will be private method.

d. Write a program to demonstrate function definition outside class and accessing class members in function definition.

4.

a. Write a friend function for adding the two complex numbers, using a single class

b. Write a friend function for adding the two different distances and display its sum, using two classes.

c. Write a friend function for adding the two matrix from two different classes and display its sum

d. Write a Program to find Maximum out of Two Numbers using friend function.

Note: Here one number is a member of one class and the other number is member of some other class.

5.

a. Design a class Complex for adding the two complex numbers and also show the use of constructor.

b. Design a class Geometry containing the methods area() and volume() and also overload the area() function

c. Design a class StaticDemo to show the implementation of static variable and static function

d. Write a C++ program to overload new/delete operators in a class.

e. Write a C++ Program to generate Fibonacci Series by using Constructor to initialize the Data Members.

6.

a. Overload the operator unary(-) for demonstrating operator overloading

b. Overload the operator + for adding the timings of two clocks, And also pass objects as an argument.

c. Overload the + for concatenating the two strings. For e.g "Py" + "thon" =Python

7.

a. Implement the concept of method overriding.

b. Show the use of virtual function

c. Show the implementation of abstract class.

8.

a. Write a C++ Program that illustrate single inheritance.

b. Write a C++ Program that illustrate multiple inheritance.

c. Write a C++ Program that illustrate multi-level inheritance.

d. Write a C++ Program that illustrate Hierarchical inheritance.

9.

a. Show the implementation of exception handling

- b. Show the implementation for exception handling for strings
 - c. Show the implementation of exception handling for using the pointers.
- 10.
- a. Design a class FileDemo open a file in read mode and display the total number of words and lines in the file.
 - b. Design a class to handle multiple files and file operations
 - c. Design a editor for appending and editing the files

Module II

- 1 Use of Basic and Advanced Tags, Lists and Backgrounds**
- a. Understanding elements, Tags and basic structure of HTML files
 - b. Design a web page using basic and advanced text formatting tags.
 - c. Design a web page using ordered, unordered list and description list.
 - d. Design a web page by choosing Background and Foreground Colors
 - e. Design a web page using Nested list and special characters.
 - f. Write an HTML code to display your CV on a web page.
- 2 Creating Hyperlinks, Anchors and style sheets**
- a. Design a web page with links to different pages and allow navigation between web pages.
 - b. Design a web page that automatically redirects the user to Other Content
 - c. Creating Hyperlinking to an E-Mail Address
 - d. Design a web page for creating Styles for Nested Tags
 - e. Design a web page by applying Styles to Hyperlinks
 - f. Design a web page by Creating and Linking to External Style Sheets.
- 3 Formatting Text and Paragraph by Using Style Sheets and displaying graphics**
- a. Design a web page by using text formatting tags
 - b. Design a web page using Indenting Paragraphs, Applying Border to a Paragraph and Specifying Horizontal Alignment of a Paragraph
 - c Implement a web page by creating inline spans and adjusting space between lines
 - d. Implement a web page by inserting a image and controlling the image size and padding
 - e. Design a web page by making image as a hyperlink
 - f. Develop a web page by using thumbnail graphics and also implement text for graphics
- 4 Tables , Page Layout and Navigation**
- a. Display a time table and display it in tabular format,
 - b. Write an html program to get the following output

30 Hrs

NAME	SUBJECT	MARKS
------	---------	-------

	Advanced Web	75
Hillary	Operating System	60
	Advanced Web	80
Lary	Operating System	75
Total Average: 72.5		

- c. Design a table by merging the table cells.
- d. Design a web page by Creating a Text-Based Navigation Bar
- e . Design a web page by Creating a Graphical Navigation Bar
- f. Design a web page with Image Map

5. Forms and Introducing video and audio tags

- a. Design a web page with a form that uses all types of controls.
- b. Design an admission form for any course in your college with text, pass word fields, check boxes, radio button and reset button.
- c. Write a program to get the following output

Sign In	
E-mail address	<input type="text"/>
Password	<input type="password"/>
<input type="button" value="Sign In"/>	

- d. Design a web page by placing a Video Clip on a Web Page
- e. Design a web page by placing an Audio Clip on a Web Page
- f. Design a web page embedding image, audio and video.

6 .Basics of java script

- a. Using JavaScript, design a web page to accept a number from the user and print its Factorial.
- b. Using JavaScript, a web page that prints Fibonacci series/any given series.
- c. Write a JavaScript program to display all the prime numbers between 1 and 100.
- d. Write a JavaScript program to accept a number from the user and display the sum of its digits.

7. Java Script: Validating User fields

- a. Demonstrate the use of Document object methods.
- b. Using java script, demonstrate validating Text Input Fields, Drop-down Lists and Checkboxes
- c. Using java script, demonstrate validating Radio buttons and Validating Multi-Select Boxes
- d. Write a Java script to prompt for users name and display it on the screen.

	<p>8. Java Script : Handling the events</p> <p>a. Using java script, demonstrate the use of onAbort, onBlur, onChange, onClick, onDbClick events</p> <p>b. Using java script, demonstrate the use of onDragDrop, onError, onFocus events</p> <p>c. Using java script, demonstrate the use of onKeyDown, onKeyPress, onKeyUp, onLoad, onReset, onResize, onSelect, onSubmit, onUnload events</p> <p>d. Using java script, demonstrate the use of onMouseDown, onMouseMove, onMouseOut, onMouseOver, onMouseUp, onMouse events.</p> <p>e. Using java script, demonstrate the use of onKeyDown, onKeyPress, onKeyUp, onLoad, onReset, onResize, onSelect, onSubmit, onUnload events</p> <p>9. JQuery</p> <p>a. use JQuery effect in page</p> <p>b. Write a jQuery Code to find the data passed with the on() method for each element.</p> <p>c. Use JQuery Events</p> <p>d. JQuery traversal and manipulation</p> <p>10. JSON Basics and Working with JSON</p> <p>a. Creating JSON</p> <p>b. Parsing JSON</p> <p>c. Persisting JSON</p> <p>d. Demonstrate use of JSON objects in array, print array on web page using document object</p> <p>e. Read data from json file and convert it into a JavaScript object and display the data in web page using document object</p>	
10	<p>Text Books</p> <ol style="list-style-type: none"> Object-oriented Programming C++, Hari Mohan Pandey C++ Programming: An Object-Oriented Approach, Behrouz A. Forouzan, Richard F. Gilberg C++ How to Program, Paul Deitel, Harvey Deitel Step by Step HTML5, Faithe Wempen, Microsoft Press, 2011 The Complete Reference HTML & CSS, Thomas A. Powell. McGraw Hill, 5th Edition, 2010 	
11	<p>Reference Books</p> <ol style="list-style-type: none"> Object Oriented Programming in C++, E Balagurusamy Object-Oriented Programming in C++ by Robert Lafore Programming with ANSI C++, Bhushan Trivedi Demystified Object- Oriented Programming with C++, Dorothy R. Kirk Learning Web Design A Beginner's Guide to Html, CSS, JavaScript, And Web Graphics, Jennifer Niederst Robbins, O'Reilly, 5th Edition, 2018. "Web Enabled Commercial Applications Development using HTML, DHTML, Javascript, Perl CGI", Ivan Bayross, BPB, 2004 HTML 5 for Web Designers (By: Jeremy Keith) – http:// freepdf-books.com 	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%

13	<p>Continuous Evaluation through: Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totalling to 50 marks and can be converted to 20 marks.</p>	30 marks practical exam of 2 hours duration
14	<p>Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks</p>	

Vocational Skill Courses (VSC)

Name of the Course: Assembly Language Programming

Sr.No	Heading	Particulars
1	Description the course : Including but Not limited to:	<p>Introduction: The 8085 Assembly Language Programming course covers the principles and practices of writing low-level software that controls the 8085 microprocessor. This course provides an in-depth understanding of the 8085 microprocessor architecture and its instruction set, as well as how to write, debug, and optimize assembly language programs for this microprocessor.</p> <p>Relevance and Usefulness: The course is relevant to computer science/engineering students interested in learning about microprocessors and embedded systems programming. The course provides the fundamental knowledge and skills required to design and implement computer systems with low-level software control. Assembly language programming is the foundation of modern computer technology, which makes the course relevant to anyone interested in computer systems and programming.</p> <p>Application and Interest: The course is essential for students aspiring to work in the field of embedded systems, microcontroller/microprocessor programming, or any programming role that involves low-level software development. By the end of the course, students will be able to write efficient and optimized assembly language programs that control the functionality of a microprocessor.</p> <p>Connection with Other Courses: 8085 Assembly Language Programming is a fundamental course that provides an understanding of how computer systems work at the lowest level. It connects with several other computer science courses, such as Computer Organization and Architecture, Operating Systems, Compiler Design, and Embedded Systems Design.</p> <p>Demand in the Industry and Job Prospects: There is a high demand in the industry for programmers who possess knowledge of low-level software development, such as programming microprocessors with assembly language. Many industries, including aerospace, automotive, healthcare, and consumer electronics, require low-level software development skills in their employees. Job prospects for graduates with expertise in 8085 Assembly language</p>

		programming are abundant in these sectors. Job roles may include embedded software engineer, hardware engineer, firmware developer, software developer, and testing/validation engineer.
2	Vertical :	Vocational Skill Course(VSC)
3	Type :	Practical
4	Credits :	2 credits (60 hours in a semester)
5	Hours Allotted :	60 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives(CO): CO 1. To gain a thorough understanding of the 8085 microprocessor architecture and its associated instruction set. CO 2. To develop the ability to write and debug assembly language programs for the 8085 microprocessor. CO 3. To learn the principles of computer organization and how they relate to the 8085 microprocessor. CO 4. To become proficient in the use of 8085 assembly language programming tools, simulators, and debuggers. CO 5. To learn how to interface different input/output devices with the 8085 microprocessor. CO 6. To understand the concept of interrupts and how they are used in 8085 assembly language programming.	
8	Course Outcomes(CO): OC 1. Explain the architecture of the 8085 microprocessor and its associated instruction set. OC 2. Identify the different types of registers and their functions in the microprocessor. OC 3. Describe the memory organization and addressing modes of the 8085 microprocessor. OC 4. Write assembly language programs for the 8085 microprocessor using various instructions and addressing modes. OC 5. Debug and troubleshoot assembly language programs for the 8085 microprocessor using simulators and debuggers. OC 6. Implement conditional branching and looping constructs in assembly language programs. OC 7. Use 8085 assembly language programming tools, such as editors, assemblers, and emulators for developing and testing programs. OC 8. Simulate microprocessor operations using emulators and debuggers. OC 9. Connect input/output devices, such as LEDs, switches, and displays, to the 8085 microprocessor. OC 10.	
9	Modules:- Module 1:	
	1. Perform the following Operations related to memory locations. a. Store the data byte 32H into memory location 4000H. b. Exchange the contents of memory locations 2000H and 4000H	30 Hrs
	2. Simple assembly language programs.	

- a. Subtract the contents of memory location 4001H from the memory location 2000H and place the result in memory location 4002H.
- b. Subtract two 8-bit numbers.
- c. Add the 16-bit number in memory locations 4000H and 4001H to the 16-bit number in memory locations 4002H and 4003H. The most significant eight bits of the two numbers to be added are in memory locations 4001H and 4003H. Store the result in memory locations 4004H and 4005H with the most significant byte in memory location 4005H.
- d. Add the contents of memory locations 40001H and 4001H and place the result in the memory locations 4002H and 4003H.
- e. Subtract the 16-bit number in memory locations 4002H and 4003H from the 16-bit number in memory locations 4000H and 4001H. The most significant eight bits of the two numbers are in memory locations 4001H and 4003H. Store the result in memory locations 4004H and 4005H with the most significant byte in memory location 4005H.
- f. Find the 1's complement of the number stored at memory location 4400H and store the complemented number at memory location 4300H.
- g. Find the 2's complement of the number stored at memory location 4200H and store the complemented number at memory location 4300H.

3. Packing and unpacking operations.

- a. Pack the two unpacked BCD numbers stored in memory locations 4200H and 4201H and store result in memory location 4300H. Assume the least significant digit is stored at 4200H.
- b. Two digit BCD number is stored in memory location 4200H. Unpack the BCD number and store the two digits in memory locations 4300H and 4301H such that memory location 4300H will have lower BCD digit.

4. Register Operations

- a. Write a program to shift an eight bit data four bits right. Assume that data is in register C.
- b. Program to shift a 16-bit data 1 bit left. Assume data is in the HL register pair
- c. Write a set of instructions to alter the contents of flag register in 8085.
- d. Write a program to count number of 1's in the contents of D register and store the count in the B register.

5. Multiple memory locations.

- a. Calculate the sum of series of numbers. The length of the series is in memory location 4200H and the series begins from memory location 4201H.
 - a. Consider the sum to be 8 bit number. So, ignore carries. Store the sum at memory location 4300H.
 - b. Consider the sum to be 16 bit number. Store the sum at memory locations 4300H and 4301H
- b. Multiply two 8-bit numbers stored in memory locations 2200H and 2201H by repetitive addition and store the result in memory locations 2300H and 2301H.
- c. Divide 16 bit number stored in memory locations 2200H and 2201H by the 8 bit number stored at memory location 2202H. Store the quotient in memory locations 2300H and 2301H and remainder in memory locations 2302H and 2303H.

- d. Find the number of negative elements (most significant bit 1) in a block of data. The length of the block is in memory location 2200H and the block itself begins in memory location 2201H. Store the number of negative elements in memory location 2300H
- e. Find the largest number in a block of data. The length of the block is in memory location 2200H and the block itself starts from memory location 2201H. Store the maximum number in memory location 2300H. Assume that the numbers in the block are all 8 bit unsigned binary numbers.

Module 2:

1. Calculations with respect to memory locations.

- a. Write a program to sort given 10 numbers from memory location 2200H in the ascending order.
- b. Calculate the sum of series of even numbers from the list of numbers. The length of the list is in memory location 2200H and the series itself begins from memory location 2201H. Assume the sum to be 8 bit number so you can ignore carries and store the sum at memory location 2Sample problem:
- c. Calculate the sum of series of odd numbers from the list of numbers. The length of the list is in memory location 2200H and the series itself begins from memory location 2201H. Assume the sum to be 16-bit. Store the sum at memory locations 2300H and 2301H.
- d. Find the square of the given numbers from memory location 6100H and store the result from memory location 7000H
- e. Search the given byte in the list of 50 numbers stored in the consecutive memory locations and store the address of memory location in the memory locations 2200H and 2201H. Assume byte is in the C register and starting address of the list is 2000H. If byte is not found store 00 at 2200H and 2201H
- f. Two decimal numbers six digits each, are stored in BCD package form. Each number occupies a sequence of byte in the memory. The starting address of first number is 6000H Write an assembly language program that adds these two numbers and stores the sum in the same format starting from memory location 6200H
- g. Add 2 arrays having ten 8-bit numbers each and generate a third array of result. It is necessary to add the first element of array 1 with the first element of array-2 and so on. The starting addresses of array 1, array2 and array3 are 2200H, 2300H and 2400H, respectively

2. Assembly programs on memory locations.

- a. Write an assembly language program to separate even numbers from the given list of 50 numbers and store them in the another list starting from 2300H. Assume starting address of 50 number list is 2200H
- b. Write assembly language program with proper comments for the following:
- c. A block of data consisting of 256 bytes is stored in memory starting at 3000H. This block is to be shifted (relocated) in memory from 3050H onwards. Do not shift the block or part of the block anywhere else in the memory.

30 Hrs

- d. Add even parity to a string of 7-bit ASCII characters. The length of the string is in memory location 2040H and the string itself begins in memory location 2041H. Place even parity in the most significant bit of each character.
- e. A list of 50 numbers is stored in memory, starting at 6000H. Find number of negative, zero and positive numbers from this list and store these results in memory locations 7000H, 7001H, and 7002H respectively
- f. Write an assembly language program to generate Fibonacci number.
- g. Program to calculate the factorial of a number between 0 to 8.

3. String operations in assembly programs.

- a. Write an 8085 assembly language program to insert a string of four characters from the tenth location in the given array of 50 characters
- b. Write an 8085 assembly language program to delete a string of 4 characters from the tenth location in the given array of 50 characters.
- c. Multiply the 8-bit unsigned number in memory location 2200H by the 8-bit unsigned number in memory location 2201H. Store the 8 least significant bits of the result in memory location 2300H and the 8 most significant bits in memory location 2301H.
- d. Divide the 16-bit unsigned number in memory locations 2200H and 2201H (most significant bits in 2201H) by the B-bit unsigned number in memory location 2300H store the quotient in memory location 2400H and remainder in 2401H
- e. DAA instruction is not present. Write a sub routine which will perform the same task as DAA.

4. Calculations on memory locations.

- a. To test RAM by writing '1' and reading it back and later writing '0' (zero) and reading it back. RAM addresses to be checked are 40FFH to 40FFH. In case of any error, it is indicated by writing 01H at port 10
- b. Arrange an array of 8 bit unsigned no in descending order
- c. Transfer ten bytes of data from one memory to another memory block. Source memory block starts from memory location 2200H where as destination memory block starts from memory location 2300H
- d. Write a program to find the Square Root of an 8 bit binary number. The binary number is stored in memory location 4200H and store the square root in 4201H.
- e. Write a simple program to Split a HEX data into two nibbles and store it in memory

5. Operations on BCD numbers.

- a. Add two 4 digit BCD numbers in HL and DE register pairs and store result in memory locations, 2300H and 2301H. Ignore carry after 16 bit.
- b. Subtract the BCD number stored in E register from the number stored in the D register
- c. Write an assembly language program to multiply 2 BCD numbers

10	<p>Text Books</p> <ol style="list-style-type: none"> 1. 8080A/8085 Assembly Language Programming, Lance A. Leventhel, Osborne, 1978
-----------	---

11	Reference Books 1. Microprocessors Architecture, Programming and Applications with the 8085, Fifth Edition, Penram Publications, 2012	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	Continuous Evaluation through: Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totalling to 50 marks and can be converted to 20 marks.	30 marks practical exam of 2 hours duration
14	Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks	

Skill Enhancement Courses (SEC)

Name of the course : Web Programming

Sr.No.	Heading	Particulars
1	Description the course : Including but Not limited to:	<p>This course covers a range of topics aimed at equipping students with the skills and knowledge needed to create visually appealing, functional, and user-friendly websites.</p> <p>The course provides an insight into emerging technologies to design and develop state of the art web applications using client-side scripting, server-side scripting, and database connectivity.</p> <p>website development includes all related development tasks, such as client-side scripting, server-side scripting, server and network security configuration, eCommerce development, and content management system (CMS) development.</p> <p>Website design is a combination of different elements that work together to create an effective and user-friendly experience. These include the use of typography, layout, color theory, grid systems, motion graphics, and responsive designs.</p>
2	Vertical :	Skill Enhancement Course(SEC)
3	Type :	Practical
4	Credits:	2 credits (1 credit = 30 Hours of Practical work in a semester)
5	Hours Allotted :	60 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives (CO)	<p>CO1: To understand how to use Java script objects and XML.</p> <p>CO2: To create well organized, styled web pages</p> <p>CO3: To add versatility to a web page using jQuery</p> <p>CO4: To deploy a local web server and run a simple web application.</p> <p>CO5: To read and process data in MySQL using PHP.</p> <p>CO6: To understand usage of Bootstrap</p>
8	Course Outcomes (OC)	<p>OC1: Knowledge in different java script objects.</p> <p>OC2: How to use XML with CSS and XSL</p> <p>OC3: validate a form using jQuery</p> <p>OC4: handle asynchronous requests</p> <p>OC4: Write and deploy PHP with database and to simplify web development.</p> <p>OC5: Create a responsive layout using the Bootstrap</p>

<p>9</p>	<p>Modules: Module 1: 1. Write JavaScript code for a. Demonstrating different JavaScript Objects such as String, RegExp, Math, Date b. Demonstrating different JavaScript Objects such as Window, Navigator, History, Location, Document c. Storing and Retrieving Cookies 2. Create a XML file with Internal / External DTD and display it using a. CSS b. XSL 3. Write PHP scripts for- Performing certain mathematical operations such as calculating factorial / finding Fibonacci Series / Displaying Prime Numbers in a given range / Evaluating Expressions 4. Write PHP scripts for a. Retrieving data from HTML forms b. Working with Arrays c. Working with Files (Reading / Writing) 5. Advanced PHP a. Write a PHP program to demonstrate use of sessions and cookies. b. Write a PHP program to demonstrate use of filters.</p>	<p>30 Hrs</p>
	<p>Module 2 6. PHP and MySQL a. Write a PHP program to create: Create a database College b. Create a table Department (Dname, Dno, Number_of_faculty) c. Write a PHP program to create a database named "College". Create a table named "Student" with following fields (sno, sname, percentage). Insert 3 records of your choice. Display the names of the students whose percentage is between 35 to 75 in a tabular format. 7. Write a PHP program a. Update rows in a table b. Delete rows from a table 8. Design a PHP page for authenticating a user 9. Write PHP scripts for a. Storing and Retrieving Cookies b. Storing and Retrieving Sessions 10. Perform the following using Bootstrap: a. Create a responsive layout using the Bootstrap grid system b. Create a simple Bootstrap navbar with dropdown menus c. Create a basic Bootstrap form with validation</p>	<p>30 Hrs</p>
<p>10</p>	<p>Text Books</p> <ul style="list-style-type: none"> • HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, AJAX, PHP and jQuery, 2ed, Dreamtech Press, 2016 • Web Programming and Interactive Technologies, scriptDemics, StarEdu Solutions India, 2018 	

	<ul style="list-style-type: none"> • PHP: A Beginners Guide, Vikram Vaswani, TMH 	
11	Reference Books <ul style="list-style-type: none"> • HTML, XHTML, and CSS Bible Fifth Edition, Steven M. Schafer, WILEY, 2011 • Learning PHP, MySQL, JavaScript, CSS & HTML5, Robin Nixon, O'Reilly, 2018 • PHP, MySQL, JavaScript & HTML5 All-in-one for Dummies, Steve Suehring, Janet Valade Wiley, 2018 	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	Continuous Evaluation through: Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totalling to 50 marks and can be converted to 20 marks.	30 marks practical exam of 2 hours duration
14	Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks	

Name of the Course: PLSQL Practical

Sr.No.	Heading	Particulars
1	Description the course : Including but Not limited to:	PL/SQL ,Oracle's procedural extension language for SQL, allows developers to include procedural language components such as loops, conditional statements and functions. The course enables students with practical experience in using PL/SQL for effective database programming and development.
2	Vertical :	Skill Enhancement Course(SEC)
3	Type :	Practical
4	Credits :	2 credits
5	Hours Allotted :	60 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives(CO):	
	CO 1. Comprehend the basics of PL/SQL and gain knowledge about control and conditional statement in PL/SQL.	
	CO 2. Understand working with cursors,collections and composite data types in PL/SQL.	
	CO 3. Develop expertise in creating stored procedures and functions.	
	CO 4. Explore the use of triggers to automate responses to events within the database.	
	CO 5. Understand the concept of Exception handling.	
	CO 6. Design modular applications using packages.	
8	Course Outcomes (OC):	
	OC 1. Use PL/SQL variables ,data types, control and conditional statement.	
	OC 2. Apply sequences and cursor in PL/SQL.	
	OC 3. Work with Collection and Composite Data Types.	
	OC 4. Develop PL/SQL structures like functions, procedures and triggers for database applications.	
	OC 5. Handle errors and exceptions in PL/SQL programs.	
	OC 6. Develop PL/SQL packages.	
9	Modules:-	
	Module 1:	
	1. PL/SQL Basics- Use of variables, Write executable statement, Interacting with Oracle Server, Create anonymous PL/SQL block,Sequences	30 Hrs
	2. Control Structure in PL/SQL- Using while loop, Do loop, For loop, Use of GOTO statement	
	3. Create conditional statement using PL/SQL- Using if statement, Using if else statement, Using elsif ladder, Using case expression.	
	4. Create cursor in PL/SQL- Implicit cursor, Explicit cursor, Parameterized cursor	
	5. Collection and Composite Data Types - Working with Collections,Working with Composite Data Types	

	Module 2:	
	1. Creation of Procedures in PL/SQL 2. Functions in PL/SQL 3. Creation of Trigger – Create Row level trigger, Create Statement level trigger, Create instead of trigger 4. Handling exceptions- Creation of user defined exception, Creation of system defined exception 5. Creation of Package in PL/SQL	30 Hrs
10	Text Books	
	1. Programming with PL/SQL for Beginners , H. Dand, R. Patil and T. Sambare, X –Team 2. Oracle pl/sql Programming ,Feuerstein, S., & Pribyl, B. ," O'Reilly Media, Inc.".	
11	Reference Books	
	1. Oracle Database PL/SQL Language Reference, 12c Release 1 (12.1) E50727-04 , Alpern, D., Belden, E., Agrawal, S., Baer, H., Castledine, S., Chang, T., & Yang, M. 2. Oracle PL/SQL for dummies , Rosenblum, M., & Dorsey, P. (2006), John Wiley & Sons. 3. PL/SQL Programming ,Ivan Bayross, BPB	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	Continuous Evaluation through: Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totalling to 50 marks and can be converted to 20 marks.	30 marks practical exam of 2 hours duration
14	Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks	

QUESTION PAPER PATTERN

(External and Internal)

I	A Theory of 2 credits is evaluated for a total of 50 Marks	
	Internal Continuous Assessment:	40%[20 Marks]
	Continuous Evaluation through: Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	
	External Semester End Examination: 60%[30 Marks]	
	Format of Question Paper: (Semester End Examination : 30 Marks. Duration:1 hour) Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks)	
II	A Practical of 2 credits is evaluated for a total of 50 Marks	
	Internal Continuous Assessment:	40%[20 Mrks]
	Continuous Evaluation through: Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totalling to 50 marks and can be converted to 20 marks.	
	Semester End Examination: 60%[30 Marks]	
	Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination(30 Marks) Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks	

Examination and Standard of Passing:

Regulations regarding the scheme of exams, number of credits and standard of passing will be as prescribed by the University of Mumbai.

A student is said to have passed if he/she secures 40% of marks allotted in each head of passing. External evaluation of 30 marks and Internal evaluation of 20 marks are treated as separate heads of passing.

The Ten Point Grading System prescribed by the University of Mumbai will be as follows:

Letter Grades and Grade Points

Semester GPA/ Program CGPA Semester/ Program	% of Marks	Alpha-Sign / Letter GradeResult	Grade Points
9.00-10.00	90.0-100	O (Outstanding)	10
8.00-<9.00	80.0-<90.0	A+ (Excellent)	9
7.00-<8.00	70.0-<80.0	A (Very Good)	8
6.00-<7.00	60.0-<70.0	B+ (Good)	7
5.50-<6.00	55.0-<60.0	B (Above Average)	6
5.00-<5.50	50.0-<55.0	C (Average)	5
4.00-<5.00	40.0-<50.0	P (Pass)	4
Below 4.00	Below 40	F (Fail)	0
Ab (Absent)	-	Absent	0

This syllabus is applicable to IDOL students as well, w.e.f. 2025-26

Justification for B.Sc. (Information Technology)

1.	Necessity for starting the course:	A large amount of The demand for IT professionals is consistently high, and individuals with a B.Sc in IT can find opportunities in various sectors, including technology companies, healthcare, finance, government, and more.
2.	Whether the UGC has recommended the course:	Yes
3.	Whether all the courses have commenced from the academic year 2024-2025	To be implemented from 2024-2025 onwards
4.	The courses started by the University are self-financed, whether adequate number of eligible permanent faculties are available?:	Self-financed Yes. Some experts are called as visiting faculties
5.	To give details regarding the duration of the Course and is it possible to compress the course?:	4 years. Not possible to compress the program
6.	The intake capacity of each course and no. of admissions given in the current academic year:	60 seats for one division. Admissions will be held from 2024-2025 onwards
7.	Opportunities of Employability / Employment available after undertaking these courses:	B.Sc in Information Technology can open up a wide range of opportunities and employment prospects across various industries. Additionally, as technology continues to advance, new roles and specialties within the IT field are continually emerging, providing diverse career paths for IT graduates.

Sign of Chairperson
Dr. Mrs. R.
Srivaramangai
Ad-hoc BoS (IT)

Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology

Sign of Offg. Dean,
Prof. Shivram S. Garje
Faculty of Science &
Technology

AC –20.04.2024
Item No. –5.6 (N) Sem I (1a)

As Per NEP 2020

University of Mumbai



Syllabus for Basket of AEC	
Board of Studies in English	
UG First Year Programme B.Sc	
Semester	I
Title of Paper	Credits
Introduction to Communication Skills in English I	2
From the Academic Year	2024-2025

Sr. No.	Heading	Particulars
1	Description of the course: Including but Not limited to:	<p>Introduction to Communication Skills in English I</p> <p>Effective academic communication skills are essential for success in scholarly pursuits. In the academic realm, proficiency extends beyond verbal articulation to encompass precise and coherent written expression. Students are not only required to engage in thoughtful discussions and articulate complex ideas verbally but must also demonstrate their understanding through well-crafted written assignments, and presentations. Academic communication involves the mastery of scholarly conventions, such as adherence to academic writing styles, and the ability to engage in dialogue with peers and scholars. It encompasses the skillful navigation of academic discourse, fostering an environment where ideas are shared, challenged, and refined. Developing strong academic communication skills empower individuals to contribute meaningfully to intellectual conversations, enriching both their academic journey and the broader scholarly community.</p> <p>This course with its 30:20 pattern will also help in accomplishing this goal. The course is aimed at honing their cognitive, analytical, linguistic and creative skills. It is hoped that by the end of the academic year, the learners will have developed confidence in using the English language both for oral and written communication as well as develop interest in enhancing these skills later on.</p>
2	Vertical:	AEC (Ability Enhancement Course)
3	Type:	Theory
4	Credit:	2 credits (1credit=15 Hours for Theory in a semester)
5	Hours Allotted:	30Hours
6	Marks Allotted:	50Marks
7	Course Objectives:	<ol style="list-style-type: none"> 1. To cultivate a comprehensive understanding of communication skills 2. To enhance reading proficiency with a diverse range of written texts with different genres and styles of written communication. 3. To develop proficiency in grammatical accuracy with specific focus on common grammatical errors and provide targeted exercises for improvement. 4. To equip learners with proficient presentation and conversation skills by integrating practical exercises for public speaking and interpersonal communication. 5. To provide practical experience in formal writing, including Statement of Purpose (SoP) preparation.

8 Course Outcomes:

At the end of the course, learners will:

- Demonstrate an understanding of essential aspects of communication skills
- Exhibit the ability to Read a variety of written text using subskills such as skimming and scanning.
- Identify and rectify common grammatical errors in English.
- Show competence in delivering compelling presentations and engage in articulate and effective conversations in English across different contexts.
- Display advanced formal writing skills in crafting job application letters, CVs, and Statements of Purpose.

9 Modules: -

Module1: (15 Lectures)

A) Introduction to Communication Skills

- The Seven Cs of Effective Communication
- Verbal and Non-Verbal Communication
- Cross-cultural communication
- Technology-enabled Business Communication
- Features of Effective Written Communication
- Characteristics of an Effective Speech
- Effective Listening Skills

B) Reading Skills:

- Scanning a text for information
- Skimming a passage to look for main ideas, understanding text type
- Guessing meaning of an expression (word/phrase/clause)
- Building inference skills

Passages from academic, professional, and literary domains around 200- 250 words, could be chosen in this section.

C) Grammar

- Subject Verb Agreement
- Tenses
- Question Tag
- Change the Voice
- Framing Interrogative sentence
- Synonyms and Antonyms
- Misplaced modifiers

Grammar should be taught with a remedial approach so as to enable learners to avoid common errors in their written and spoken communication.

Module 2: (15 Lectures)

A) Speaking Skills in English

Conversation skills

- Opening a conversation
- Introducing oneself in various contexts
- Introducing others formally and informally

Presentation Skills

- Introduction: Essentials of Presentation skills
- Analysis of model Presentations
- Planning and Delivering the Presentation
- Developing & Displaying Visual Aids
- Handling Questions from the Audience

B) Formal Writing Skills:

- Interpreting and describing different types of visual information
- Job applications with bio data (solicited and unsolicited)
- Statement of Purpose

10 Text Books: N.A.

11 References:

- Bellare, Nirmala. *Reading & Study Strategies*. Books. 1 and 2. Oxford University Press, 1997, 1998
- Bellare, Nirmala. *Easy Steps to Summary Writing and Note-Making*. Amazon Kindle Edition, 2020
- Comfort, Jeremy, et al. *Speaking Effectively: Developing Speaking Skills for Business English*. Cambridge University Press, 1994.
- Das, Bikram K., et. al. *An Introduction to Professional English and Soft Skills*. Cambridge University Press India Pvt. Ltd., 2010
- Das, Yadjnaseni & R. Saha (eds.) *English for Careers*. Pearson Education India, 2012.
- Dimond-Bayir, Stephanie. *Unlock Level 2 Listening and Speaking Skills Student's Book and Online Workbook: Listening and Speaking Skills Student's Book+ Online Workbook*. Cambridge University Press, 2014.
- Doff, Adrian and Christopher Jones. *Language in Use* (Intermediate and Upper Intermediate). CUP, 2004.
- Glendinning, Eric H. and Beverley Holmstrom. Second edition. *Study Reading: A Course in Reading Skills for Academic Purposes*. CUP, 2004
- Goodale, Malcolm. *Professional Presentations Video Pack: A Video Based Course*. Cambridge University Press, 1998.
- Grellet, F. *Developing Reading Skills*. Cambridge: Cambridge University Press, 1981
- Grussendorf, Marion. *English for Presentations*. Oxford University Press, 2007.

- Hamp- Lyons, Liz and Ben Heasley. Second edition. *Study Writing: A Course in Writing Skills for Academic Purposes*. CUP, 2006
- Labade, Sachin, Katre Deepa et al. *Communication Skills in English*. Orient Blackswan, Pvt Ltd, 2021.
- Lewis, N. *How to Read Better & Faster*. New Delhi, Goyal Publishers & Distributors Pvt. Ltd, 2006.
- McCarthy, Michael and Felicity O'Dell. *English Vocabulary in Use*. Cambridge: Cambridge University Press, 2001.
- Mohan, RC Sharma Krishna. *Business Correspondence and Report Writing*. Third edition. Tata McGraw-Hill Education, 2002.
- Murphy, Raymond, et al. *Grammar in use: Intermediate*. Cambridge University Press, 2000
- Raman, Meenakshi, and Singh, Prakash. *Business Communication*. India, Oxford University Press, 2006.
- Richards, Jack C., and Chuck Sandy. *Passages Level 2 Student's Book*. Cambridge University Press, 2014.
- Sadanand, Kamlesh & S. Punitha. *Spoken English: A Foundation Course*. (Part 1 & 2). Orient Blackswan. 2009.
- Sasikumar, V., et al. *A Course in Listening & Speaking I*. 2005. Cambridge University Press India Pvt. Ltd. (under the Foundation Books Imprint), 2010
- Savage, Alice, et al *Effective Academic Writing*. Oxford: OUP, 2005
- Sethi, J. *Standard English and Indian usage: Vocabulary and grammar*. PHI Learning Pvt. Ltd., 2011.
- Taylor, Grant. *English Conversation Practice*. 1967. Tata McGraw-Hill, 2013
- Turton, Nigel D. *A B C of Common Grammatical Errors*. 1995. Macmillan India Ltd., 1996
- Vas, Gratian. *English Grammar for Everyone*. Mumbai, Shree Book Centre, 2015
- Watson, T. *Reading Comprehension Skills and Strategies: Level 6*. Saddleback Educational Publishing, 2002

Web link Resources:

- A conversation about household appliances: <https://youtu.be/rAPI0fSborU> 13.
- Video on psychology: Why do we dream? <https://youtu.be/2W85Dwxx218>
- Video on social media: What is a social media influencer? <https://youtu.be/39A3og7enz8>
- Tips on communication (TED Talk): The Secrets of Learning a New Language https://youtu.be/o_XVt5rdpFY
- Expressing opinions: If Cinderella Were a Guy: <https://youtu.be/p40yCNctKXg>
- Video on the English language: Where did English come from? <https://youtu.be/YEaSxhcns7Y>

12	Internal Continuous Assessment: 40%	Semester End Examination: 60%								
13	<p>Continuous Evaluation through:</p> <ul style="list-style-type: none"> • Participation in an activity based on Presentation Skills and Conversation skills each (Module 2 A) (10 marks) The class may be divided into batches by creating formal schedule for the same before the semester End Examination. • Participation in two classroom activities involving skills other than presentation and conversation skills (05 marks) • Overall attendance (05 marks) (Percentage of learners' attendance in class to be considered) <p>Suggested Activities:</p> <ul style="list-style-type: none"> ▪ Listening to audio clips/ books to enhance listening skills ▪ Reading aloud from newspapers, magazines, stories, non-fiction followed by classroom discussion on these to enhance reading and speaking skills 									
14	<p>Format of Question Paper: for the final examination</p> <table border="0" style="width: 100%;"> <tr> <td>Q.1. Short notes (2 out of 4) – On Module 1 (A)</td> <td style="text-align: right;">10 marks</td> </tr> <tr> <td>Q.2. A. Unseen Passage (200-250 words) (Module 1 B)</td> <td style="text-align: right;">06 marks</td> </tr> <tr> <td> B. Questions on grammar (Module 1 C)</td> <td style="text-align: right;">04 marks</td> </tr> <tr> <td>Q. 3. Writing Skills (1 out of 2) on Module 2 (B)</td> <td style="text-align: right;">10 marks</td> </tr> </table>		Q.1. Short notes (2 out of 4) – On Module 1 (A)	10 marks	Q.2. A. Unseen Passage (200-250 words) (Module 1 B)	06 marks	B. Questions on grammar (Module 1 C)	04 marks	Q. 3. Writing Skills (1 out of 2) on Module 2 (B)	10 marks
Q.1. Short notes (2 out of 4) – On Module 1 (A)	10 marks									
Q.2. A. Unseen Passage (200-250 words) (Module 1 B)	06 marks									
B. Questions on grammar (Module 1 C)	04 marks									
Q. 3. Writing Skills (1 out of 2) on Module 2 (B)	10 marks									

**Sign of BOS Chairman
Prof. Dr. Shivaji Sargar
Board of Studies in
English**

**Sign of the Offg.
Associate Dean
Dr. Suchitra Naik
Faculty of
Humanities**

**Sign of the Offg.
Associate Dean
Dr. Manisha Karne
Faculty of
Humanities**

**Sign of the Dean
Prof. Dr. Anil Singh
Faculty of
Humanities**

AC – 20/04/2024
Item No. – 6.6 Sem. I (7a)

As Per NEP 2020

University of Mumbai



Syllabus for Basket of OE	
Board of Studies in Statistics	
UG First Year Programme	
Semester - I	
Title of Paper	Credits 2
I) Introduction to Basic Statistics-I	2 credit
II)	
III)	
From the Academic Year	2024-25

Semester-I
Open Electives-I
Name of the course: Introduction to Basic Statistics-I

Sr. No	Heading	Particulars
1	Description the course : Including but Not limited to :	<p>Introduction:</p> <p>Introduction to Basic statistics-I course is focuses on basic statistics such as collection of data and how to measure variables on different scale. Student will equip with to identify the scale of measurement and analyze elementary statistical analysis through graphical presentation. Also student will learn to identify nature of the data through statistical methods. This course mainly emphasizes the method of collecting data, summarizing and presenting data, and drawing inferences from the data.</p> <p>This course will be useful for science, humanity and commerce faculty. This course will be offered other than science faculty students which will be very useful to gain knowledge about basic statistics in their field. This course will be applicable to various field to analyze their basic data structure.</p> <p>This course is focuses practical as well as theoretical aspects of basic statistics along with subjects from psychology, Economics, sociology, commerce, Computers , Mathematics , IT etc.</p> <p>There is growing demand for highly skilled statisticians in the 21st century in many fields including government, banking sector, health sciences, veterinary sciences, agricultural sciences, business, and social sciences etc</p>
2	Vertical :	Open Elective
3	Type :	Theory
4	Credit:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)

5	Hours Allotted :	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives: Students will be able to, <ol style="list-style-type: none"> 1. Understand the meaning of Statistics and scope of Statistics. 2. Understand techniques of data collection and its presentation. 3. Compute various measures of central tendencies to know the entire data by a centralized single value. 4. Understand spread and variation of data using various techniques of measure of dispersion. 5. Understand the behavior of data using skewness and kurtosis and study the nature of probability curve. 	
8	Course Outcomes: : on successful completion of the course Students Should be able to, <ol style="list-style-type: none"> 1. Calculate arithmetic mean and its applicability 2. Differentiate between qualitative and quantitative data through scale of measurement. 3. Construct graphs and diagrams from data and interpret the result. 4. Compute Skewness and Kurtosis of the data to describe nature of data distribution. 	

9	Modules:-	Lect ures
	Module 1: Classification, Tabulation and Presentation of data.	
	<ul style="list-style-type: none"> • Definition and scope of Statistics • Types of data: Qualitative and Quantitative data, Geographical data, Time series data and Crosssection data • Measurement of scales: Nominal, Ordinal, Interval and Ratio. • Primary data and Secondary data • Classification and Tabulation (One way and Two way). • Frequency distributions: Uni-variate and Bi-variate • Diagrammatic representation of data 	15

<p>Simple bar diagram, Multiple bar diagram, Subdivided bar diagram and Pie-chart</p> <ul style="list-style-type: none"> Graphical representation of data Histogram, Frequency Polygon, Frequency Curve, Cumulative frequency curve (Less than and more than type). 	
<p>Module 2: Measures of central tendency and Measures of Dispersion</p>	<p>15</p>
<p>Measures of central tendency</p> <ul style="list-style-type: none"> Concept and Requirements of good measures of central tendency. Arithmetic mean (Simple, weighted mean, combined mean)for grouped and un-grouped data, Merits, demerits and its applicability Positional averages: Median, Mode, and Quartiles (for grouped and un-grouped data) Merits, demerits and its applicability Graphical representation of mode, median and Quartiles. Empirical relation between mean, median and mode (Only statement) <p>Measures of Dispersion</p> <ul style="list-style-type: none"> Concept and requirements of good measures of dispersion. Absolute and Relative measures of dispersion: Range, Quartile Deviation , Mean absolute deviation, Variance and Standard deviation (for grouped and un-grouped data) Merits, demerits and its applicability Raw moments and central moments , relation between them upto order four (only statement). Measures of Skewness and Kurtosis: Karl Pearson's measure of Skewness , <ul style="list-style-type: none"> Measures of skewness and kurtosis based on moments.(Only formulae) and their interpretation 	

Reference Books

- David S. : Elementary Probability, Cambridge University Press.
- Hoel P.G. : Introduction to Mathematical Statistics, Asia Publishing House.
- Hogg R.V. and Tannis E.P. : Probability and Statistical Inference. McMillan Publishing Co. Inc.
- Pitan Jim : Probability, Narosa Publishing House.
- Goon A.M., Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II :The World Press Private Limited, Calcutta.
- Mukhopadhyay P. An Introduction to the Theory of Probability, World Scientific Publishing Company, 2011.
- Grewal P. S, Methods of Statistical Analysis, Sterling Publishers, 1990
- S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons

Format of Question Paper:

Internal Continuous Assessment: (20 marks)

Assignment/viva Quizzes, Class Tests, presentation, project, assignment etc	Class Test	Total
05	15	20

Semester End Examination: (30 marks)

Semester End Examination will be of 30 marks of 01 hour duration covering entire syllabus of the semester. All questions are Compulsory.

Theory Question Paper Pattern:

Q 1	Attempt any one question out of two questions (Module I and II)	Max. marks: 10
Q 2	Attempt any two questions out of three questions (Module I)	Max. marks: 10
Q 3	Attempt any two questions out of three questions (Module II)	Max. marks: 10

**Sign of the BOS
Chairman
Dr. Santosh Gite
Board of Studies in
Statistics**

**Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology**

**Sign of the
Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology**

As Per NEP 2020

University of Mumbai



Syllabus for Basket of OE	
Board of Studies in Statistics	
UG First Year Programme	
Semester - II	
Title of Paper	Credits 2
I) Introduction to Basic Statistics-II	2 credit
II)	
III)	
From the Academic Year	2024-25

Open Elective-I
Name of the Course: Introduction to Basic Statistics-II

Sr. No.	Heading	Particulars
1	Description the course : Including but Not limited to :	<p>Introduction:</p> <p>Introduction to Basic Statistics-II course is focuses on to equip students with basic theory of probability and standard discrete distributions. Student will learn basic elementary probability theory, discrete random variables and continuous random variables. Also students will be acquiring knowledge about correlation and predictive analysis.</p> <p>This course will be useful for science, humanity and commerce faculty. This course will be offered other than science faculty students which will be very useful to gain knowledge about basic statistics in their field. This course will be applicable to various field to analyze their basic data structure.</p> <p>This course is focuses practical as well as theoretical aspects of basic statistics along with subjects from psychology, Economics, sociology, commerce, Computers , Mathematics , IT etc.</p> <p>There is growing demand for highly skilled statisticians in the 21st century in many fields including government, banking sector, health sciences, veterinary sciences, agricultural sciences, business, and social sciences etc</p>
2	Vertical :	Minor
3	Type :	Theory
4	Credit:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted :	30 Hours
6	Marks Allotted:	50 Marks

7	<p>Course Objectives: : Students will be able to,</p> <ol style="list-style-type: none"> 1. Understand difference between random and non-random experiment. 2. Understand the concept of probability and its applications 3. Understand the meaning of continuous and discrete random variable. 4. Understand discrete distributions and their properties. 5. Solve the examples on probability and probability distributions. 						
8	<p>Course Outcomes: On successful completion of this course Students Should be able to,</p> <ol style="list-style-type: none"> 1. Identify the types of events 2. Calculate probabilities and conditional probabilities. 3. Apply the concept of probability in real-life situations. 4. Compute the expectation of the uni-variate discrete random variable. 5. Write probability mass functions (p.m.f.) of various discrete distribution and their real-life applications. 6. Understand the concept and difference between correlation and regression 						
9	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Modules:-</th> <th style="text-align: center;">Lect ures</th> </tr> </thead> <tbody> <tr> <td>Module 1: Elementary Probability Theory</td> <td></td> </tr> <tr> <td> <ul style="list-style-type: none"> • Definitions: Trial, random and non-random experiment, sample point and sample space. • Definition of an event and different types of events: complementary event, equally likely events, certain event, impossible event, independent events, mutually exclusive and exhaustive events. • Different definitions of Probability: Classical (Mathematical), Empirical(Statistical) and Axiomatic definitions of Probability. • Conditional probability. • Theorems (without proof) and their applications: <ol style="list-style-type: none"> i. Addition theorem on probability for two and three events ii. Multiplication theorem on probability for two events. iii. Bayes' theorem. <p>Simple examples based on all concepts.</p> <ul style="list-style-type: none"> • Random variable: discrete and continuous random variables. </td> <td style="text-align: center; vertical-align: top;">15</td> </tr> </tbody> </table>	Modules:-	Lect ures	Module 1: Elementary Probability Theory		<ul style="list-style-type: none"> • Definitions: Trial, random and non-random experiment, sample point and sample space. • Definition of an event and different types of events: complementary event, equally likely events, certain event, impossible event, independent events, mutually exclusive and exhaustive events. • Different definitions of Probability: Classical (Mathematical), Empirical(Statistical) and Axiomatic definitions of Probability. • Conditional probability. • Theorems (without proof) and their applications: <ol style="list-style-type: none"> i. Addition theorem on probability for two and three events ii. Multiplication theorem on probability for two events. iii. Bayes' theorem. <p>Simple examples based on all concepts.</p> <ul style="list-style-type: none"> • Random variable: discrete and continuous random variables. 	15
Modules:-	Lect ures						
Module 1: Elementary Probability Theory							
<ul style="list-style-type: none"> • Definitions: Trial, random and non-random experiment, sample point and sample space. • Definition of an event and different types of events: complementary event, equally likely events, certain event, impossible event, independent events, mutually exclusive and exhaustive events. • Different definitions of Probability: Classical (Mathematical), Empirical(Statistical) and Axiomatic definitions of Probability. • Conditional probability. • Theorems (without proof) and their applications: <ol style="list-style-type: none"> i. Addition theorem on probability for two and three events ii. Multiplication theorem on probability for two events. iii. Bayes' theorem. <p>Simple examples based on all concepts.</p> <ul style="list-style-type: none"> • Random variable: discrete and continuous random variables. 	15						

<p>Definition and properties of probability mass function . cumulative distribution function.</p> <ul style="list-style-type: none"> • Expectation and variance of a random variable. Theorems and properties on Expectation and variance of random variables without proof. • Raw and Central moments (definition only) and their relationship. (up to order four). • Joint probability mass function of two discrete random variables. Covariance 	
<p>Module 2: Correlation and Regression Analysis.</p>	<p>15</p>
<ul style="list-style-type: none"> • Correlation analysis: Meaning, types of correlation • Scatter Diagram, product moment or Karl Pearson's correlation coefficient and its properties. • Spearman's Rank correlation (With and without ties) • Concept of linear regression, Principle of least squares, fitting of regression lines by method of least squares. • Properties of regression equations. • Relation between regression coefficients and correlation coefficient. • Concept and use of coefficient of determination (R^2). • Introduction of discrete distributions- Discrete Uniform distribution, Binomial distribution, Poisson distribution and their characteristics (without proof) formulae) and their interpretation 	
<p>Reference Books</p> <ul style="list-style-type: none"> • David S. : Elementary Probability, Cambridge University Press. • Hoel P.G. : Introduction to Mathematical Statistics, Asia Publishing House. • Hogg R.V. and Tannis E.P. : Probability and Statistical Inference. McMillan Publishing Co. Co. Inc. • Pitan Jim : Probability, Narosa Publishing House. • Goon A.M., Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II :The World Press Private Limited, Calcutta. 	

- Mukhopadhyay P. An Introduction to the Theory of Probability, World Scientific Publishing Company, 2011.
- Grewal P. S, Methods of Statistical Analysis, Sterling Publishers, 1990
- S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons

Format of Question Paper:

Internal Continuous Assessment: (20 marks)

Assignment/viva Quizzes, Class Tests, presentation, project, assignment etc	Class Test	Total
05	15	20

Semester End Examination: (30 marks)

Semester End Examination will be of 30 marks of 01 hour duration covering entire syllabus of the semester. All questions are Compulsory.

Theory Question Paper Pattern:

Q 1	Attempt any one question out of two questions (Module I and II)	Max. marks: 10
Q 2	Attempt any two questions out of three questions (Module I)	Max. marks: 10
Q 3	Attempt any two questions out of three questions (Module II)	Max. marks: 10

**Sign of the BOS
Chairman
Dr. Santosh Gite
Board of Studies in
Statistics**

**Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology**

**Sign of the
Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology**

As Per NEP 2020

University of Mumbai



Title of the Program

Introduction to Cultural Activities

SEM I

Syllabus for Two Credit

(With effect from the academic year 2024-25)

Aims and Objectives

- To study the importance of cultural activities in India.
- To discuss the historical importance of cultural activities.
- To define and describe the overview of cultural practices at Indian and Global level.
- To list the various forms of cultural activities and its applied skills.
- To describe the role of organizations for organizing cultural activities in India.

Learning Outcomes

- Understand the significance of cultural activities
- Sensitize students towards Indian culture and its preservation
- Apply the knowledge and skills of the cultural activities in their practical life
- Participate in the various cultural activities

Modules at Glance Semester I

Module No.	Unit	Content	No. of Hours
1	I	Overview to Cultural Activities	05
	II	History of Student Cultural Activities	05
2	III	Forms / Types of Literary and Fine Arts Activities and its Applied Skills	10
	IV	Forms / Types of Performing Arts Activities and its Applied Skills	10
Total No. of Hours			30

Module No.	Unit	Content	No. of Hours
1	I	1.1 Overview to Cultural Activities <ul style="list-style-type: none">• Definition of culture and its manifestations• Understanding cultural diversity and inclusivity• The role of cultural activities in preserving heritage• Overview of Indian cultural practices• Overview of global cultural practices	05
	II	2.1 History of Student Cultural Activities <ul style="list-style-type: none">□ Role of student cultural activities□ History of student cultural activities in India	05

		<ul style="list-style-type: none"> • Role of AIU in preserving cultural heritage of India • History of student cultural activities in Maharashtra • Student Cultural activities at University of Mumbai 	
2	III	<p>3.1 Forms / Types of Literary and Fine Arts Activities and its Applied Skills</p> <p>3.1.1 Various Forms of Literary Arts</p> <ul style="list-style-type: none"> • Elocution: Reading Skills, Soft Skills, Languages, Communication Skills, etc. • Debate: Reading Skills, Soft Skills, Languages, Communication Skills, etc. • Story Writing: Introduction, Plot, Characterization, Presentation, Relevance, Language Style, etc. • Story Telling: Introduction, Plot, Characterization, Presentation, Relevance, Language Style, etc. • Quiz: General Knowledge skills <p>3.1.2 Various Forms of Fine Arts</p> <ul style="list-style-type: none"> • Painting: Visualization, Delivery of the Subject, Composition, Colour Application, Presentation and Overall Impact • Collage: Visualization, Delivery of the Subject, Handling of Medium, Composition, Presentation and Overall Impact • Poster Making: Visualization, Delivery of the Subject, Presentation, Tagline and Overall Impact • Clay Modeling: Visualization, Delivery of the Subject, Handling of Medium, Composition, Presentation and Overall Impact • Cartooning: Visualization, Delivery of the Subject, Characters, Synchronization, Colour Application, Composition, Presentation and Overall Impact • Rangoli: Visualization, Delivery of the Subject, Colour Scheme, Elements, Presentation and Overall Impact • Mehendi Designing: Originality, Creativity, Decorative Art with Aesthetic Sense, Presentation and Overall Impact 	10

		<ul style="list-style-type: none"> • Spot Photography: Impact, Composition, Technical Quality and Suitability for the Specific Theme • Installation: Visualization, Delivery of the Subject, Handling of Medium, Synchronization, Composition, Presentation and Overall Impact 	
	IV	<p>4.1 Forms / Types of Performing Arts Activities and its Applied Skills</p> <p>4.1.1 Various Forms of Dance</p> <ul style="list-style-type: none"> • Folk Dance: History and Origin of Folk Dance In India, Types and their Uniqueness, Significance of Folk Dance, Folk Dances in Maharashtra • Classical Dance: History of Classical Dance, Types and their Peculiarities, Significance of Classical Dances in India <p>4.1.2 Various Forms of Theatre</p> <ul style="list-style-type: none"> • History of Indian Theatre • Types and their Uniqueness • Significance of Indian Theatre • Various Forms of Theatre: One Act Play, Skit, Mime, Mimicry <p>4.1.3 Various Forms of Music</p> <ul style="list-style-type: none"> • History of Indian Music, • Types and their Uniqueness, • Significance of Music in India • Various Forms of Music: Classical Singing, Light Vocal, Percussion, Non-Percussion, Nattiyasangeet, Western Vocal, Western Instrumental 	10

Scheme of Evaluation

The Scheme of Examination shall be of 50 marks. It will be divided into Internal Evaluation (20 marks) and Semester End Examination (30 Marks).

Semester I (50 Marks, 2 Credits) Internal Evaluation (20 Marks)

Sr. No.	Particulars	Marks
---------	-------------	-------

1	Presentation OR Project OR Assignment	15
2	Participation in Workshop / Conference / Seminar (as decided by the Teacher) OR Participation in Online Workshop / Conference / Seminar (as decided by the Teacher) OR Field Visit OR Attendance	5
Total		20

Semester End Examination (30 Marks)

Question No.	Particulars	Marks
1	Objective Type Questions (All Units)	6
2	Descriptive Question(s) on Unit I [This question may be divided into sub questions like (a) (b) for 3 Marks + 3 Marks or 4 Marks + 2 Marks pattern]	6
3	Descriptive Question(s) on Unit II [This question may be divided into sub questions like (a) (b) for 3 Marks + 3 Marks or 4 Marks + 2 Marks pattern]	6
4	Descriptive Question(s) on Unit III [This question may be divided into sub questions like (a) (b) for 3 Marks + 3 Marks or 4 Marks + 2 Marks pattern]	6
5	Descriptive Question(s) on Unit IV [This question may be divided into sub questions like (a) (b) for 3 Marks + 3 Marks or 4 Marks + 2 Marks pattern]	6
Total		30

Reference Books

- 1) Rabindranath Tagore, The Centre of Indian Culture. Rupa and Co, India, 2017.
- 2) Chopra, J. K. Indian Heritage and Culture. Unique Publisher, India, 2013.
- 3) Patnaik Devdatta, Indian Culture, Art and Heritage. Pearson, India, 2021.
- 4) Cassady Marsh, An Introduction to the Art of Theatre: A comprehensive text- Past, Present and Future. Colorado Springs, Colo, 2017.
- 5) Pingle Bhavanrav A., History of Indian Music: with particular reference to theory and practice, Dev Publishers and Distributors, India, 2021.
- 6) Popley Herbert A., The Music of India. Central Archaeological Library, New Delhi, 1921.

- 7) Tomory Edith, History of Fine Arts in India and the West. Orient Longman, Mumbai, 1989.
- 8) Arthur Schopenhauer, The Art of Literature, S. Sonnenschein and co London. 1981.
- 9) M. Keith Booker, A Practical Introduction to Literary theory and Criticism. Routledge. Michigan, 1996.
- 10) Vatsyayan Kapila, Indian Classical Dance. Publications Division, Ministry of Information and Broadcasting, Govt. of India, 1992.
- 11) Phyllia S. Weikart, Teaching folk dance: successful steps. High/Scope Press, Mchigan, 1997.
- 12) Gosvami O., The story of Indian Music, its growth and synthesis. Bombay, New York, Asia Pub. House, 1961.

AC – 20.04.2024
Item No. – 5.6 (N) Sem II (1a)

As Per NEP 2020

University of Mumbai



Syllabus for Basket of AEC	
Board of Studies in Marathi	
UG First Year Programme	
Semester	II
Title of Paper	Credits
लेखन कौशल्ये १- (कार्यालयीन लेखनव्यवहार आणि पत्रव्यवहार)	2
From the Academic Year	2024-25

Sr. No.	Heading	Particulars
1	Description the course : Including but Not limited to :	<p style="text-align: center;">लेखन कौशल्ये १- (कार्यालयीन लेखनव्यवहार आणि पत्रव्यवहार)</p> <p>लेखन ओळख ते लेखन कौशल्य हा बराच मोठा प्रवास आहे. वाचन आणि लेखनाच्या सरावाने, लेखन कौशल्य विकसित करता येते. बहुतेक वेळा आपण मिळवलेले ज्ञान हे लिखित स्वरूपात मांडावे लागते. त्यासाठी आपण लेखन कौशल्याचे योग्य उपयोजन करतो. लेखन म्हणजे मजकूर तंतोतंत उतरवणे नव्हे. एखादे निवेदन, वृत्त, निबंध, पुस्तकाची टिपणे, अर्ज यांसाठी लेखन आवश्यक असते. कार्यालयीन पत्रव्यवहार, कार्यवृत्ते, नोंदी, जाहिरात, टिप्पणी ही सर्व उपयोजित लेखन कौशल्ये आहेत. कार्यालयीन पत्रव्यवहार करणे हे एक वेगळ्या प्रकारचे कौशल्य आहे. त्यातील काही उपयोजन कौशल्यांचा विचार या अभ्यासपत्रिकेत अपेक्षित आहे. कार्यालयीन लेखन व्यवहार आणि पत्रव्यवहार या अभ्यासपत्रिकेत शिकविला जाईल.</p>
2	Vertical :	Ability Enhancement Course
3	Type :	Theory + Practical
4	Credit:	02 (1 credit = 15 Hours for Theory in a semester)
5	Hours Allotted :	30
6	Marks Allotted:	50
7	Course Objectives: (List some of the course objectives) १. कार्यालयीन लेखन व्यवहार स्वरूप समजावून सांगणे. २. कार्यालयीन पत्रव्यवहाराचे स्वरूप समजावून सांगणे. ३. प्रभावी कार्यालयीन लेखनासाठी आवश्यक असणाऱ्या क्षमता आणि तंत्रांचा परिचय करून देणे.	
8	Course Outcomes: (List some of the course outcomes) १. विद्यार्थ्यांना कार्यालयीन लेखन व्यवहाराचे स्वरूप समजेल. २. विद्यार्थ्यांना कार्यालयीन पत्रव्यवहाराचे स्वरूप समजेल. ३. प्रभावी कार्यालयीन लेखनासाठी आवश्यक असणाऱ्या तंत्रांचा विद्यार्थ्यांना परिचय होईल.	
9	Modules:- Per credit One module can be created घटक एक घटक एक : कार्यालयीन लेखनव्यवहार - १. जाहीर निवेदन आणि माहितीपत्रक २. इतिवृत्त लेखन ३. टिप्पणी लेखन (६० मिनिटांच्या १५ तासिका) श्रेयांकन १.	

घटक दोन : घटक दोन : पत्रव्यवहार -२	
<p>१.कार्यालयीन/प्रशासनिक पत्र</p> <p>२. नोकरीसाठी अर्जलेखन</p> <p>३. पत्रात्मक लेखन : नवी रूपे (शुभेच्छा, निमंत्रण)</p> <p>(६० मिनिटांच्या १५ तासिका) श्रेयांकन १.</p>	
10	Text Books: N.A.
11	Reference Books: संदर्भसूची : <p>१. प्रशासनिक लेखन, भाषा संचालनालय, महाराष्ट्र शासन, मुंबई, १९६६</p> <p>२. भाषिक सर्जन आणि उपयोजन, राजन गवस, अरुण शिंदे, गोमटेश्वर पाटील, दर्या प्रकाशन, पुणे, २०१२</p> <p>३. परब प्रकाश, व्यावहारिक मराठी, मिथुन प्रकाशन, डोंबिवली पूर्व, मुंबई, १९८९</p> <p>४. नाईक सदानंद, राजभाषा मराठी, व्यावहारिक मराठी, प्रका-नागरी सेवा प्रबोधिनी, मुंबई, २००२</p> <p>५. तावरे स्नेहल (संपा.), व्यावहारिक मराठी, स्नेहवर्धन प्रकाशन, पुणे, चौथी आवृत्ती, २०११</p> <p>६. केतकी मोडक, संतोष शेणई, सुजाता शेणई (संपा.), उपयोजित मराठी, पद्मगंधा प्रकाशन, २०१२</p> <p>७. नसीराबादकर ल. रा., व्यवहारिक मराठी, भाषा विकास संशोधन संस्था, कोल्हापूर २०२३</p>
12	Internal Continuous Assessment: 40%
	External, Semester End Examination 60% Individual Passing in Internal and External Examination
13	Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)
	अंतर्गत चाचणी परीक्षा : २० गुण चाचणी परीक्षा /लेखी/ ऑनलाईन/ प्रकल्प/ गृहपाठ - २० गुण
14	Format of Question Paper: for the final examination बहिर्गत परीक्षा ३० गुण (वेळ एक तास) <ul style="list-style-type: none"> ● एकूण तीन प्रश्न विचारावेत. ● प्रत्येक घटकावर अंतर्गत पर्याय असलेले प्रत्येकी १० गुणांचे दोन प्रश्न विचारावेत. ● तिसरा प्रश्न हा घटक १ आणि २ वर आधारित अंतर्गत पर्यायासह दोन टीपा/लघुप्रश्न स्वरूपाचा असावा.

Sign of the BOS
Chairman
Name of the
Chairman
Name of the BOS

Sign of the
Offg. Associate Dean
Name of the Associate
Dean
Name of the Faculty

Sign of the
Offg. Dean
Name of the Offg. Dean
Name of the Faculty

AC -28/06/2024

Item No. - 5.7 (N)

University of Mumbai



Syllabus for Extension Work in Vertical VI - CC

Board of Studies in Extension Work

UG First Year Program

Semester

II

Title of Paper

Credit

Extension Work

2

From the Academic Year

2024-25

Introduction

The National Education Policy (NEP) 2020 is a comprehensive framework introduced by the Government of India to revamp the country's education system. It has replaced the previous National Policy on Education, which has aim to ensure universal access to quality education from preschool to higher education, including vocational education. NEP 2020 emphasizes a more holistic, multidisciplinary, and flexible curriculum which lay emphasis on conceptual understanding rather than rote learning allowing students to choose subjects across disciplines without strict boundaries.

The National Education Policy (NEP) 2020 of India addresses the role of higher education institutions in fostering community engagement and extension work. It highlights the social responsibility of higher education institutions towards their communities. It encourages institutions to engage with local communities, address societal challenges, and contribute to sustainable development. The policy promotes the implementation of outreach programs by higher education institutions to disseminate knowledge, provide services, and support community development. These programs may include literacy campaigns, career development programs, social issues awareness programs, health and hygiene initiatives, skill development workshops, and technology-oriented activities. The policy suggests integrating extension work into the curriculum of higher education programs. This allows learners to gain practical experience, develop leadership skills, and contribute to community development while pursuing their studies. It recognizes incentives to encourage active engagement in community service and extension activities.

Overall, NEP 2020 recognizes the significant role of higher education institutions in promoting community engagement, social responsibility, and sustainable development through extension work. By integrating extension activities into their mission and operations, institutions can contribute to building inclusive and resilient societies.

Extension work in the context of education refers to the activities and programs conducted by educational institutions to engage with communities, address societal needs, and promote social development.

Aim of Extension Work under NEP:

- Extension work aims to identify and address the specific needs and challenges faced by communities. NEP 2020 encourages higher education institutions to engage with local communities and contribute to their development by offering programs and services that

address social needs, such as literacy programs, health awareness campaigns, and vocational training.

- Extension work aims to empower communities by providing them with the knowledge, skills, and resources they need to address their own requirements and improve their quality of life.

Key objectives of Extension Work under NEP:

- To ensure equal access to quality education and educational opportunities to aspirants.
- To support the government initiatives in achieving universal foundational literacy and numeracy as per sustainable development program.
- To organize remedial programs to address the learning breaches among the youth and provide unending education opportunities.
- To offer more holistic, multidisciplinary, and flexible curricular activities with an emphasis on conceptual understanding and personality development.
- To offer a wide range of activities & promote critical thinking, creativity, and innovation.
- To provide aspirants with multiple pathways for skill development and employment.
- To implement outreach programs to disseminate knowledge, provide services, and support community development.

Extension Work Activities:

Extension Work activities introduced by DLLE are a crucial aspect of the educational environment, offering multifaceted benefits that extend beyond academic learning. Many extension activities focus on social issues, sustainability, and environmental conservation. These activities educate the communities on sustainable practices which promote inclusivity and social justice. These activities focus especially on training women in various skills, including entrepreneurship and digital literacy through various vocational skill-oriented projects offered by the department. These activities have significantly contributed to skill development among community members, leading to improved employment opportunities and personality development. Learners participate in extension work activities as part of their curriculum, to gain practical experience and to contribute to community development. Thus, engaging in extension work fosters a sense of social responsibility and civic engagement among the learners and facilitators.

THE EXTENSION DIMENSION (Reach to Unreached)

The college students are enrolled for extension work projects and perform various activities for the **social awareness based on various issues / problems in the society such as Save Girl Child, Pollution, Aids, Global Warming, Environment, Tree Plantation, Importance of Education, Illiteracy, Child Labour, Dowry Deaths, Malnutrition, Watershed Management and so many.** The students are creating awareness about these social problems / issues through various activities such as Street Play, Exhibition, Poster Making, Songs, Speech, Survey, Elocution, and participation in Seminar & Conferences. For this purpose, students are going to remote areas and involve the community and make them aware of our role in eradicating social problems faced by the society and trying to convince the people human duties as an ideal citizen.

To facilitate the sensitization of the student to the socio-cultural realities, the Department offers extension work projects encompassing social issues for the student. There are many Extension Work Projects being offered by the department under the two different units for enhancing the employability and IT skills of the student. The projects are given below for which the details are available on DLLE website at www.mudlle.ac.in

I) Vocational Career Oriented Projects

1. Career Project [CP]
2. Industry Orientation Project [IOP]
3. Anna Poorna Yojana [APY]
4. Skill Development (SD)

II) Community Oriented Projects

1. Population Education Club (PEC)
2. Survey Research
3. Education for All (EFA- NIOS, IDOL)
4. Environment Education
5. Civic Sense (CS)
6. Consumer Guidance

Given below are the activities / programs to be conducted by the colleges as a part of Extension Work as enlisted topics. The learner will focus on enlisted topics and participate in following activities during Semester II in this academic year.

ACTIVITIES FOR SEMESTER II = 2 Credits

Sr. No.	Unit	No. of Lectures
1.	<p><u>Organising & Participation in Training Session</u></p> <p>Every learner should attend the orientation / training session organised by their college for orientation of annual extension work program. Attendance is compulsory. In this session the learners will be oriented about the activities to be conducted during the semester followed by question-and-answer session. The learner must read resource material and guideline carefully and plan his / her activities for the semester during academic year.</p>	2 Lectures
2.	<p><u>Participation in Project /Activities</u> (as given below)</p> <p>In this session learners will be oriented about any 5 Topics selected by college (preferably which are not taken in Semester 1) for awareness under Extension Work. The college may select more than 5 topics if the enrolment of learners is more than 200. The learners will participate in activities based on these topics selected by college.)</p> <ol style="list-style-type: none"> 1. Maharashtra Policy for women. 2. Status of women in India. / Women achievers of modern India 3. Banking procedures. 4. Legal procedures. 5. Violence against women / Laws protecting women/ Inheritance laws. 6. Child Labour. 7. Environment- pollution and its effect / Save Trees and Natural Resources 8. Water Harvesting. 	22 Lectures including guidance for practice session, preparations and actual conduct of program.

9. Pollution (Noise pollution / industrial pollution etc.)
10. Issues related to LGBT.
11. HIV –AIDS / Covid 19 etc.
12. Consumer Awareness (Act 2019), Need and Importance
13. E-waste management
14. Stress and Harassment.
15. Global warming
16. Importance of Ethics and Values
17. Old Age Homes / Status of Senior Citizens
18. Distance Education Opportunities
19. First Aid Awareness
20. Voting rights / Human Rights

Learners will be oriented and motivated to participate in minimum four activities given below based on above topics:

1. Seminar /conferences, discussion sessions, debate, rallies
2. Competitions (essay/creative writing, elocution, poster/ video/ rangoli making etc. – Minimum 2 competitions)
3. Extension Work group activities of other groups in the college.
4. Prepare your PPT, design your posters / charts.
5. Survey / short term academic courses / innovative programs.
6. Field visit / field work / case studies / developing innovative engineering models / projects
7. Participation in Street Plays
8. Event / hospitality / human resource management program /assignment
9. Novel formulation development (pharmacy),
10. Self-medication survey (pharmacy),

Learners are required to prepare short videos (duration 3-4 minutes) of the activity where the college will organize such competition.

	<p>The learners will be oriented about various career development opportunities in University of Mumbai, and schemes of student development by the Government.</p> <p><u>Learners will be oriented and given an opportunity for:</u></p> <ul style="list-style-type: none"> - Script writing / Direction for street play. - Composing / Singing (Songs, Powada) - Playing Musical Instrument during the event. - Participation in various college and university level competitions. - Participate in Cultural Performance / Organising Committee for Festival / Programs / Event Management. 	
3	<p><u>Participation Video / Stage Performance / Assignment / Report Writing and submission</u></p> <ul style="list-style-type: none"> - Present your report / video during the college program. - All learners enrolled in Extension Work can make activity video or stage performance (3-4 minutes duration) creating awareness about any social issues / topics enlisted here followed by assignment / report writing as per format. - College will organise a program in the hall / classroom for all learners and give them an opportunity to present their assignment / report with PPT / video presentation followed by question answer session / test / interview by the college. 	6 Lectures including guidance for practice session, preparations and actual conduct of program.

Evaluation Pattern

Internal Assessment

Sr. No.	Assessment Criteria	Maximum Marks
1	Attendance, punctuality, completion of hours, participation in programs, presentations and feedback.	10
2	Proficiency in required skill sets, overall performance, submission of written report / assignments and expected development.	10
	Total	20 Marks

External Assessment

(Based on Extension Work guidelines and five enlisted topics chosen by the college.)

Question Paper Pattern

Time: 1.00 Hours

Total Marks 30

Instructions: 1. All questions are compulsory.

2. Figures to the right indicate maximum marks.

Q.1. Rewrite the following statement by choosing correct alternative given below. - 06 Marks
(6 statements. One mark each)

Q.2. Write short Notes On (Any Two out of Four) - 06 Marks

Q.3. Answer the following questions. (Any Three out of Five) - 18 Marks

References:

- Guidelines for Extension Work published by Department of Lifelong Learning and Extension, University of Mumbai.
- Agricultural Extension: Principles and Methods" by "Ray V. Herren (2008)
- Agricultural Extension by G. S. R. Murthy (2010)
- Introduction to Agricultural Extension by S. S. Acharya (2015)
- Agricultural Extension in Developing Countries by R. W. Snapp (2012)
- Extension Communication and Management by B. M. Panda (2016)

**Sign of BOS Chairman
Prof. Kunal Jadhav
Ad-hoc Board of
Studies in Extension
Work**

**Sign of the Offg.
Associate Dean
Dr. Suchitra Naik
Faculty of
Humanities**

**Sign of the Offg.
Associate Dean
Dr. Manisha Karne
Faculty of
Humanities**

**Sign of the Dean
Prof. Dr. Anil Singh
Faculty of
Humanities**

AC –28/06/204

Item No. – 5.6 (N)

University of Mumbai



Syllabus for Extension Work in Vertical VI - CC

Board of Studies in Extension Work

UG First Year Program

Semester

I

Title of Paper

Credit

Extension Work

2

From the Academic Year

2024-25

Introduction

The National Education Policy (NEP) 2020 is a comprehensive framework introduced by the Government of India to revamp the country's education system. It has replaced the previous National Policy on Education, which has aim to ensure universal access to quality education from preschool to higher education, including vocational education. NEP 2020 emphasizes a more holistic, multidisciplinary, and flexible curriculum which lays emphasis on conceptual understanding rather than rote learning allowing students to choose subjects across disciplines without strict boundaries.

The National Education Policy (NEP) 2020 of India addresses the role of higher education institutions in fostering community engagement and extension work. It highlights the social responsibility of higher education institutions towards their communities. It encourages institutions to engage with local communities, address societal challenges, and contribute to sustainable development. The policy promotes the implementation of outreach programs by higher education institutions to disseminate knowledge, provide services, and support community development. These programs may include literacy campaigns, career development programs, social issues awareness programs, health and hygiene initiatives, skill development workshops, and technology-oriented activities. The policy suggests integrating extension work into the curriculum of higher education programs. This allows learners to gain practical experience, develop leadership skills, and contribute to community development while pursuing their studies. It recognizes incentives to encourage active engagement in community service and extension activities.

Overall, NEP 2020 recognizes the significant role of higher education institutions in promoting community engagement, social responsibility, and sustainable development through extension work. By integrating extension activities into their mission and operations, institutions can contribute to building inclusive and resilient societies.

Extension work in the context of education refers to the activities and programs conducted by educational institutions to engage with communities, address societal needs, and promote social development.

Aim of Extension Work under NEP:

- Extension work aims to identify and address the specific needs and challenges faced by communities. NEP 2020 encourages higher education institutions to engage with local communities and contribute to their development by offering programs and services that

address social needs, such as literacy programs, health awareness campaigns, and vocational training.

- Extension work aims to empower communities by providing them with the knowledge, skills, and resources they need to address their own requirements and improve their quality of life.

Key objectives of Extension Work under NEP:

- To ensure equal access to quality education and educational opportunities to aspirants.
- To support the government initiatives in achieving universal foundational literacy and numeracy as per sustainable development program.
- To organize remedial programs to address the learning breaches among the youth and provide unending education opportunities.
- To offer more holistic, multidisciplinary, and flexible curricular activities with an emphasis on conceptual understanding and personality development.
- To offer a wide range of activities & promote critical thinking, creativity, and innovation.
- To provide aspirants with multiple pathways for skill development and employment.
- To implement outreach programs to disseminate knowledge, provide services, and support community development.

Extension Work Activities:

Extension Work activities introduced by DLLE are a crucial aspect of the educational environment, offering multifaceted benefits that extend beyond academic learning. Many extension activities focus on social issues, sustainability, and environmental conservation. These activities educate the communities on sustainable practices which promote inclusivity and social justice. These activities focus especially on training women in various skills, including entrepreneurship and digital literacy through various vocational skill-oriented projects offered by the department. These activities have significantly contributed to skill development among community members, leading to improved employment opportunities and personality development. Learners participate in extension work activities as part of their curriculum, to gain practical experience and to contribute to community development. Thus, engaging in extension work fosters a sense of social responsibility and civic engagement among the learners and facilitators.

THE EXTENSION DIMENSION (Reach to Unreached)

The college students are enrolled for extension work and perform various activities for the **social awareness based on various issues / problems in the society such as Save Girl Child, Pollution, Aids, Global Warming, Environment, Tree Plantation, Importance of Education, Illiteracy, Child Labour, Dowry Deaths, Malnutrition, Watershed Management and so many.** The students are creating awareness about these social problems / issues through various activities such as Street Play, Exhibition, Poster Making, Songs, Speech, Survey, Elocution, and participation in Seminar & Conferences. For this purpose, students are going to remote areas and involve the community and make them aware of our role in eradicating social problems faced by the society and trying to convince the people human duties as an ideal citizen.

To facilitate the sensitization of the student to the socio-cultural realities, the Department offers extension work projects encompassing social issues for the student. There are many Extension Work Projects being offered by the department under the two different units for enhancing the employability and IT skills of the student. The projects are given below, for which the details are available on DLLE website at www.mudlle.ac.in.

I) Vocational Career Oriented Projects

1. Career Project [CP]
2. Industry Orientation Project [IOP]
3. Anna Poorna Yojana [APY]
4. Skill Development (SD)

II) Community Oriented Projects

1. Population Education Club (PEC)
2. Survey Research
3. Education for All (EFA- NIOS, IDOL)
4. Environment Education
5. Civic Sense (CS)
6. Consumer Guidance

Given below are the activities / programs to be conducted by the colleges as a part of Extension Work Syllabus as enlisted. The learner will participate in the following activities during Semester I in this academic year.

ACTIVITIES FOR SEMESTER I = TOTAL 2 Credits

Sr. No.	Unit / Activities	No. of Lectures
1	<p><u>Exhibit your talent (Talent Search Program)</u></p> <p>Talent Search: Need, Aim and Objectives, Nurturing Talent. Usefulness in Extension Work.</p> <p><u>Organizing Talent Search Program.</u></p> <p>The Extension Work Teacher will orient the learners and organize such program during lecture hours.</p> <p style="padding-left: 40px;">A talent search program is a critical component of modern human resource management that compel sensitization of self-awareness. By systematically identifying, attracting, and nurturing talent, the colleges can build a workforce that is capable, diverse, and aligned with their strategic goals to achieve objectives of extension work.</p> <p style="padding-left: 40px;">The following talents / skills are expected from learners to conduct training, extension work and field outreach activities. (Organization, Crowd control, Storytelling, Stage performance (singing, acting, musical instrument playing), Script writing, Poetry composition, Drawing & painting, Collage, Drafting and writing report, PPT presentation and Video Making.</p>	<p>Total 8 Lectures including guidance for preparations and actual conduct of program.</p>
2	<p><u>Organizing & Participation in Training Session and Note Making</u></p> <p>Every learner should attend the training session organized by their college for orientation of annual extension work program. Attendance is compulsory.</p> <p>In this session the learners will be oriented about all the extension work topics / activities as enlisted followed by question-and-answer session.</p> <p>The learner must read resource material and guidelines carefully</p>	

	<p>and understand the structure of Extension Work under NEP 2020 and accordingly plan for participation in various programs, college level and field outreach activities as given below. Documentation of the activity and report preparation needs to be completed by the learners.</p>	
3	<p><u>Self- Introductory Video / Stage Performance</u></p> <p>All learners enrolled in Extension Work subject can make self-introductory video or stage performance (3-4 minutes duration) stating his / her name, college, areas of interest, reason to join Extension Work, goals, why did he / she choose the particular topic /activity, how will he/she perform & achieve his/her objectives etc. followed by 2-page report writing to be submitted to college. Report writing proforma to be prepared by college.</p> <p>In this session the learners will be oriented about making self-introductory video/ stage performance, prior preparations, grooming styles and presentation skills, practice sessions and other requirements.</p>	
4	<p><u>Participation in Activities /Programs</u> as given below.</p> <p>- Organize and participate in activities / programs related to five enlisted social issues / government policies. The Learners will be oriented to following activities and motivated to participate in:</p> <ol style="list-style-type: none"> 1. Seminar /conferences, discussion sessions, debate, rallies 2. Competitions (essay/creative writing, elocution, poster/ video/ rangoli making etc.- Minimum 2 competitions) 3. Extension Work group activities of other groups in the college. 4. Prepare your PPT, design your posters / charts. 5. Survey / short term academic courses / innovative programs. <p>Learners should perform and <u>participate in above activities (Minimum 3)</u> related to enlisted topics and strictly follow the guidelines. All the activities / programs must be related to extension work topics to fulfil the DLLE objectives.</p>	<p>20 Lectures including guidance for practice session, preparations and actual conduct of program.</p>

	<p>The learners will be oriented about <u>any 5 Topics</u> selected by college for awareness under Extension Work. The college may select more than 5 topics if the enrolment of learners is more than 200. The learners will participate in above activities based on these topics selected by college.)</p> <ol style="list-style-type: none"> 1. Maharashtra Policy for women. 2. Status of women in India. / Women achievers of modern India 3. Banking procedures. 4. Legal procedures. 5. Violence against women / Laws protecting women/ Inheritance laws. 6. Child Labour. 7. Environment- pollution and its effect / Save Trees and Natural Resources 8. Water Harvesting. 9. Pollution (Noise pollution / industrial pollution etc.) 10. Issues related to LGBT. 11. HIV –AIDS / Covid 19 etc. 12. Consumer Awareness (Act 2019), Need and Importance 13. E-waste management 14. Stress and Harassment. 15. Global warming 16. Importance of Ethics and Values 17. Old Age Homes / Status of Senior Citizens 18. Distance Education Opportunities 19. First Aid Awareness 20. Election Literacy / Voting rights / Human Rights 	
5	<p><u>Report Writing and Final submission of assignment / report</u></p> <p>The learners will be oriented to prepare final assignment / report of the activities to the college. Present report during the college program. Proforma of Report to be prepared by college.</p> <ul style="list-style-type: none"> - College will organize a program in the hall / classroom for all learners and give them opportunity to present their assignment 	2 Lectures

	/ report with PPT presentation followed by question answer session / test / interview by the college.	
--	---	--

Evaluation Pattern

Internal Assessment

Sr. No.	Assessment Criteria	Maximum Marks
1	Attendance, punctuality, completion of hours, participation in programs, presentations and feedback.	10
2	Proficiency in required skill sets, overall performance, submission of written report / assignments and expected development.	10
	Total	20 Marks

External Assessment

(Based on Extension Work guidelines and five enlisted topics chosen by the college.)

Question Paper Pattern

Time: 1.00 Hours

Total Marks 30

Instructions: 1. All questions are compulsory.

2. Figures to the right indicate maximum marks.

Q.1. Rewrite the following statement by choosing correct alternative given below. - 06 Marks
(6 statements. One mark each)

Q.2. Write short Notes On (Any Two out of Four) - 06 Marks

Q.3. Answer the following questions. (Any Three out of Five) - 18 Marks

References:

- Guidelines for Extension Work published by Department of Lifelong Learning and Extension, University of Mumbai.
- Agricultural Extension: Principles and Methods" by "Ray V. Herren (2008)
- Agricultural Extension by G. S. R. Murthy (2010)
- Introduction to Agricultural Extension by S. S. Acharya (2015)
- Agricultural Extension in Developing Countries by R. W. Snapp (2012)
- Extension Communication and Management by B. M. Panda (2016)

**Sign of BOS Chairman
Prof. Kunal Jadhav
Ad-hoc Board of
Studies in Extension
Work**

**Sign of the Offg.
Associate Dean
Dr. Suchitra Naik
Faculty of
Humanities**

**Sign of the Offg.
Associate Dean
Dr. Manisha Karne
Faculty of
Humanities**

**Sign of the Dean
Prof. Dr. Anil Singh
Faculty of
Humanities**

As Per NEP 2020

University of Mumbai



**Syllabus for Major
Vertical – 1 & 4**

Name of the Programme – B.Sc. (Information Technology)		
Faulty of Science and Technology		
Board of Studies in Information Technology		
U.G. Second Year Programme	Exit Degree	U.G. Diploma in Information Technology
Semester		III & IV
From the Academic Year		2025-26

University of Mumbai



(As per NEP 2020)

Sr. No.	Heading	Particulars
1	Title of program O: _____	B.Sc. (Information Technology)
2	Exit Degree	U.G. Diploma in Information Technology
3	Scheme of Examination R: _____	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	Standards of Passing R: _____	40%
5	Credit Structure R. SU-510C R. SU-510D	Attached herewith
6	Semesters	Sem. III & IV
7	Program Academic Level	5.00
8	Pattern	Semester
9	Status	New
10	To be implemented from Academic Year	2025-26

Sd/-

Sign of the BOS
Chairman
Dr. Srivaramangai R
BOS in Information
Technology

Sd/-

Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology

Sd/-

Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology

Under Graduate Diploma in Information Technology

Credit Structure (Sem. III & IV)

(B. Sc.)- Major & Minor

R. SU-510C										
Level	Semester	Major		Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC,RP	Cum. Cr. / Sem.	Degree/ Cum. Cr.
		Mandatory	Electives							
5.0	III	8	...	4	2	VSC:2, APPLIED MATHEM ATICS	AEC:2	FP: 2 CC:2	22	UG Diploma 88
		Python Programming								
		DATA STRUCTURES								
		Operating System								
		Major Practical 3								
R. SU-510D										
	IV	8	...	4	2	SEC:2 Comput er Graphics OR Mobile Program ming	AEC:2	CEP: 2 CC:2	22	
		Core Java								
		Software Engineering								
		Computer Networks								
		Major Practical 4								
Cum Cr.		28		10	12	6+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

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

Sem. - III

Vertical – 1 Major

Syllabus

B.Sc. (Information Technology)

(Sem.- III)

Title of Paper: Python Programming

Sr.No.	Heading	Particulars
1	Description the course: Including but not limited to:	<p>Introduction to Programming with Python course is designed to help beginners learn Python, a versatile and beginner-friendly language known for its simplicity and readability. Python is an excellent choice for newcomers to programming due to its clear syntax and broad applications in fields like web development, data analysis, and artificial intelligence. In today's technology-driven world, programming skills are increasingly essential, and Python's popularity has surged due to its ease of use and extensive support community.</p> <p>Python is also a gateway language, allowing learners to transition easily into more advanced topics such as machine learning, data science, and web development. As an interpreted, high-level language, Python is particularly relevant across industries like technology, healthcare, finance, and academia, making Python proficiency a highly sought-after skill.</p> <p>The course focuses on core programming concepts like syntax, data structures, and control flow, ensuring that learners can write efficient and functional code.</p> <p>The course also encourages further learning, serving as a stepping stone for advanced Python courses or specialized areas like machine learning and web development. Python's beginner-friendly nature and expansive libraries make it an enjoyable language to learn, fostering both interest and engagement.</p> <p>By combining theory with hands-on projects, the course aims to spark curiosity and provide learners with tangible results from their efforts. As learners gain proficiency in Python, they will have the tools to tackle more complex programming challenges, making this course an invaluable starting point for anyone interested in programming or pursuing a career in tech.</p> <p>Demand in the Industry: Python's popularity in the industry is soaring. Professionals proficient in Python are in high demand across various sectors, including technology, finance, healthcare, and academia. Completion of this Course opens doors to entry-level positions in software development, quality assurance, data analysis, and scripting.</p>
2	Vertical:	Major
3	Type:	Theory
4	Credits:	2 credits (1 credit = 15 Hours for Theory in a semester, Total 30 hours)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50

7	<p>Course Objectives (CO):</p> <p>CO 1. Master the core features of Python, including its execution model and a wide range of data types.</p> <p>CO 2. Develop proficiency in control flow by working with conditional statements, loops and other control structures.</p> <p>CO 3. Work efficiently with arrays, strings, and complex data structures, leveraging Python's capabilities for data manipulation.</p> <p>CO 4. Apply functions, modules, and string operations to solve real-world programming problems with flexibility and ease.</p> <p>CO 5. Manage file operations, utilize regular expressions, and handle date and time functions for comprehensive Python programming tasks.</p>	
8	<p>Course Outcomes (OC):</p> <p>OC 1. Demonstrate mastery of Python features to tackle a wide range of programming challenges.</p> <p>OC 2. Utilize control flow statements to ensure accurate and logical program execution.</p> <p>OC 3. Efficiently manipulate arrays, strings, and data structures to enhance data handling and problem-solving.</p> <p>OC 4. Design modular, efficient programs by leveraging functions, modules, and string operations.</p> <p>OC 5. Manage file operations, employ regular expressions, and manipulate date and time data to improve program functionality and performance.</p>	
9	<p>Module 1:</p> <p>Basic Elements of Python Programming:</p> <p>Features of Python, Execution of a Python Program, Python Interpreter, Comments, IDLE, Data types, Dictionary, Sets, Mapping, Basic Elements of Python, Variables, Input Function, Output Statements, Command Line Arguments. Operators, Precedence of Operators, Associativity of Operators</p> <p>Control Statements:</p> <p>The if statement, The if ... else Statement, The if ... elif ... else Statement, Loop Statement- while loop, for loop, Infinite loop, Nested loop, The else suite, break statement, continue statement, pass statement, assert statement, return statement.</p> <p>Arrays:</p> <p>Creating Arrays, Indexing and Slicing of Arrays, Basic Array Operations, Arrays Processing, Mathematical Operations on Array, Aliasing Arrays, Slicing and Indexing in NumPy Arrays, Basic slicing, Advanced Indexing, Dimensions and Attributes of an Array</p> <p>Functions:</p> <p>Function definition and call, Returning Results, Returning Multiple Values from a Function, Built-in Functions, Difference between a Function and a Method, Pass Value by Object Reference, Parameters and Arguments, Recursive Functions, Anonymous or Lambda Functions. Modules in Python. Strings: Creating Strings, Functions of Strings, Working with Strings, Formatting Strings, Finding the Number of Characters and Words, Inserting Substrings into a String.</p>	15 Hrs

	Module 2:	
	<p>List: Exploring List, Tuples and Dictionaries: Lists, List Functions and Methods, List Operations, List Slices, Nested Lists, Tuples, Functions in Tuple. Working with Dictionaries: Creating a Dictionary, Operators in Dictionary, Dictionary Methods, Using for Loop with Dictionaries, Operations on Dictionaries</p> <p>Files in Python: Opening and Closing a File, Working with Text Files, , Working with Binary Files, The 'with' statement, Pickle in Python, The seek() and tell() Methods, Random Accessing of Binary Files, Zipping and Unzipping Files, Working with Directories</p> <p>Regular Expressions: Introduction, Sequence Characters in Regular Expressions, Special Characters in Regular Expressions, Using Regular Expression on Files, Retrieving Information from an HTML File</p> <p>Date And Time in Python: Time, Date, Date and Time Now, combining date and times, formatting date and time, Finding and comparing dates, Sorting dates, Knowing the Time taken by a Program, Working with Calendar Module</p>	15 Hrs
10	<p>Books and References:</p> <p>Textbooks</p> <ol style="list-style-type: none"> 1. Learning Python, Fourth Edition by Mark Lutz Copyright © 2009 Mark Lutz. Published by O'Reilly Media, Inc. 2. Python Basics: A Practical Introduction to Python 3 Revised and Updated 4th Edition David Amos, Dan Bader, Joanna Jablonski, Fletcher Heisler <p>Reference Books</p> <ol style="list-style-type: none"> 1. Let Us Python, Yashwant. B. Kanetkar, BPB Publication, 2019 2. Python: The Complete Reference, Martin C. Brown, McGraw Hill, 2018 3. Beginning Python: From Novice to Professional, Magnus Lie Hetland, Apress, 2017 	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	<p>Continuous Evaluation through:</p> <p>Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks</p>	Format of Question Paper: External Examination (30 Marks)– 1 hr duration
14	<p>Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)</p> <p>Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks) Or Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)</p>	

Title of Paper: DATA STRUCTURES

Sr.No.	Heading	Particulars
1	Description the course: Including but Not limited to:	Data Structures is a fundamental subject that focuses on the organization, storage, and manipulation of data. It provides the tools and techniques to efficiently manage and process data, forming the backbone of algorithms and software development.
2	Vertical:	Major
3	Type:	Theory
4	Credits:	2 credits (1 credit = 15 Hours for Theory in a semester, Total 30 hours)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives (CO):	
	<ol style="list-style-type: none"> 1. To understand the fundamental concepts of data structures and their applications. 2. To analyze the efficiency of algorithms and operations on data structures. 3. To provide practical exposure to implementing data structures in programming. 4. To understand the properties and applications of arrays, linked lists, stacks, and queues. 5. To translate data structure concepts into working code using a programming language. 6. To apply data structures to solve real-world problems like searching and sorting. 7. To grasp the structure and traversal methods of binary trees and binary search trees. 	
8	Course Outcomes (OC): Students will be able to:	
	<p>OC 1. Demonstrate knowledge of core data structures and their operations</p> <p>OC 2. Analyze the time and space complexity of algorithms and choose the most efficient solution for a given problem.</p> <p>OC 3. Translate algorithmic solutions into correctly functioning code using their chosen programming language.</p> <p>OC 4. Implement and traverse binary trees and binary search trees, demonstrating their understanding of these structures.</p>	
9	Module 1:	
	<p>1. Introduction Basic terminology: data, information, data structure, abstract data type (ADT) Classification of data structures: linear, non-linear Algorithm analysis: time complexity, Big O notation</p> <p>2. Arrays and Linked Lists Array representation and operations (traversal, insertion, deletion, searching) Linked lists: singly linked lists (representation, insertion, deletion, traversal) Comparison of arrays and linked lists, advantages and disadvantages.</p> <p>3. Stacks and Queues Stack ADT: push, pop, peek operations Array implementation of stacks Applications of stacks: expression evaluation (infix to postfix conversion) Queue ADT: enqueue, dequeue, peek operations Array implementation of queues Applications of queues: basic scheduling scenarios</p> <p>4. Recursion Concept of recursion, base case, recursive step Examples: factorial, Fibonacci sequence</p>	15 Hrs

	Module 2:	
	1.Trees Binary trees: representation, traversal (inorder, preorder, post order) Binary search trees: insertion, deletion, search Applications of trees: basic hierarchical data representation 2.Hashing Hash functions and hash tables Collision handling: separate chaining Applications of hashing: dictionaries 3. Sorting and Searching Sorting algorithms: bubble sort, insertion sort, selection sort Searching algorithms: linear search, binary search	15 Hrs.
10	Books and References: <ol style="list-style-type: none"> 1. Data Structures and Algorithms made Easy: Data Structures and Algorithmic Puzzles, Narasimha Karumanchi ,5th Edition 2017 2. A Simplified Approach to Data Structures, Lalit Goyal, Vishal Goyal, Pawan Kumar SPD,1st 2014 3. Problem Solving in Data Structures & Algorithms Using C by Hemant Jain ,1st Edition, BPB Publications, 2018 4. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 4th Edition, MIT Press,2022 	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	Continuous Evaluation through: Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	Format of Question Paper: External Examination (30 Marks)– 1 Hr. duration
14	Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour) Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks) Or Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)	

Title of Paper: Operating System

Sr.No.	Heading	Particulars
1	Description the course : Including but Not limited to:	Introduce operating system concepts (i.e., processes, threads, scheduling, synchronization, deadlocks, memory management, file systems and protection) Introduce the issues to be considered in the design and development of operating system (memory, file and disk).
2	Vertical :	Major
3	Type :	Theory
4	Credits :	2 credits (1 credit = 15 Hours for Theory in a semester, Total 30 hours)
5	Hours Allotted :	30
6	Marks Allotted:	30
7	Course Objectives(CO):	
	<ol style="list-style-type: none"> 1. Understand basic knowledge of computer operating system 2. structures and functioning. 3. Understand the process management mechanism 4. CO 3. Ability to apply CPU scheduling algorithms to manage tasks. 5. CO 4. Discuss methods of prevention and recovery from system deadlock 6. CO 5. Understand the implementation of file systems and directories 	
8	Course Outcomes (OC):	
	<ol style="list-style-type: none"> 1. Outline the basic concept of operating systems 2. Analyze the working of operating system 3. Examine the working of various scheduling approaches 4. Apply the concepts of synchronization and deadlock 5. Apply the file access mechanisms 	
9	Modules:-	
	Module 1:	
	<p>Operating System Overview: Basics of operating systems: Generations, Types, Structure, Services, System Calls, System Boot, System Programs, Protection and Security.</p> <p>Process Management: Process Concepts, Process States, Process Control Block, Scheduling-Criteria, Scheduling Algorithms and their Evaluation, Threads, Threading Issues.</p> <p>Process Synchronization: Background, Critical-Section Problem, Peterson's Solution. Synchronization Hardware, Semaphores, Classic Problems of Synchronization.</p>	15 Hrs
	Module 2:	
	<p>Memory Management: Main Memory, Swapping, Contiguous Memory Allocation, Paging, Structure of Page Table, Segmentation, Virtual Memory, Demand Paging, Page Replacement Algorithms, Allocation of Frames, Thrashing.</p> <p>Deadlock: System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery from Deadlock.</p> <p>File System Interface: File Concept, Access Methods, Directory Structure, and File System Structure.</p>	15 Hrs

10	Books and Reference: <ol style="list-style-type: none"> 1. Operating Systems – Internals and Design Principles William Stallings, Pearson 9th , 2009 2. Operating System Concepts, Abraham Silberschatz, Wiley, 8th Edition 3. Operating Systems, Godbole and Kahate, Godbole and Kahate, 3rd Edition. 	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	Continuous Evaluation through: Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	Format of Question Paper: External Examination (30 Marks)– 1 hr duration
14	Format of Question Paper: (Semester End Examination : 30 Marks. Duration:1 hour) Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks) Or Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)	

Title of Paper: Major Practical 3

Sr.No.	Heading	Particulars
1	Description the course: Including but not limited to:	This course offers a comprehensive exploration of advanced Python programming concepts, designed to equip students with the tools to tackle real-world problems efficiently. It covers a range of topics, including text processing with regular expressions to identify patterns and extract meaningful data, as well as file handling techniques for both text and binary files. Students will also gain expertise in manipulating and comparing dates using Python's built-in date and time modules, along with performing calendar-based operations. The course emphasizes performance optimization by teaching students how to measure and improve program execution time. Additionally, students will learn how to extract structured data, such as hyperlinks from HTML files, and apply these techniques in practical scenarios. By the end of the course, students will be adept at solving complex problems, optimizing their Python solutions, and utilizing advanced programming concepts to handle diverse data processing tasks.
2	Vertical:	Major
3	Type:	Practical
4	Credits:	2 credits (30 Hours of Practical work in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives (CO):	<ol style="list-style-type: none">1. Understand fundamental programming concepts in Python, including input/output operations, conditional statements, and loops.2. Understand and apply array operations, indexing, slicing, and mathematical functions using NumPy.3. Develop problem-solving skills by using functions, recursive logic, lambda expressions, and modular programming.4. Use data structures like lists and dictionaries and perform file operations.5. Work with text processing, file handling, date manipulation, and performance analysis using advanced Python programming concepts6. To provide hands-on experience in implementing fundamental data structures like arrays, linked lists, stacks, queues, trees, and graphs.7. To develop skills in algorithm design and analysis for solving computational problems using data structures.8. To enable students to choose appropriate data structures for different applications and justify their choices.9. To enhance understanding of dynamic memory allocation and efficient data management techniques.10. To equip students with the ability to debug and optimize code for data structure operations.
8	Course Outcomes (OC):	<ul style="list-style-type: none">. OC 1. Apply Python programming concepts like input/output, conditional statements, and loops, to solve fundamental problems effectively.. OC 2. Demonstrate proficiency in performing basic operations, indexing, slicing, and analyzing attributes of arrays using NumPy.. OC 3. Apply functions, recursion, and lambda expressions to solve computational problems, and implement modular programming for reusable and efficient code design.

	<p>b. Create a file geometry.py to calculate base areas for shapes square and circle. In another file, write a function pointyShapeVolume(x, y, squareBase) that calculates the volume of a square pyramid if squareBase is True and of a right circular cone if squareBase is False. x is the length of an edge on a square if squareBase is True and the radius of a circle when squareBase is False. y is the height of the object. First use squareBase to distinguish the cases. Use the circleArea and squareArea from the geometry module to calculate the base areas.</p> <p>7. Write programs for the following:</p> <ol style="list-style-type: none"> Write a program that takes two lists and returns True if they have at least one common member. Write a Python script to sort (ascending and descending) a dictionary by value. <p>8. Write programs for the following:</p> <ol style="list-style-type: none"> Write a program to accept and pass radius to a function that returns area and circumference (using tuple). Write a program to perform basic file operations on text files and binary files. Write a Python program to read last n lines of a file. <p>9. Write programs for the following:</p> <ol style="list-style-type: none"> Write a program to count the occurrences of a specific word in a file using regular expressions. Write a program to extract all hyperlinks () from an HTML file. <p>10. Write programs for the following:</p> <ol style="list-style-type: none"> Write a program that compares two dates (in DD/MM/YYYY format) and prints which one is earlier. Write a program to measure program execution time. Write a program using the calendar module to print the weekday of the first day of a given month and year. 	
	Module 2	30 Hrs
	<ol style="list-style-type: none"> Array Operations: Write a program to implement basic array operations: <ol style="list-style-type: none"> Insert an element at a specific position in an array. Delete an element from a specific position in an array. Search for an element in an array (linear search). Linked List Manipulation: Write a program to: <ol style="list-style-type: none"> Create a singly linked list. Insert a node at the beginning, end, and at a given position in a linked list. Delete a node from a given position in a linked list. Stack Application: Write a program to: <ol style="list-style-type: none"> Implement a stack using an array. Convert an infix expression to postfix notation using a stack. Queue Application: Write a program to: <ol style="list-style-type: none"> Implement a queue using an array. Simulate a simple queuing system (e.g., customer service queue). Binary Search Tree: Write a program to: <ol style="list-style-type: none"> Create a binary search tree. Insert nodes into a binary search tree. Search for a node in a binary search tree. Tree Traversal: Write a program to: <ol style="list-style-type: none"> Implement pre-order, in-order, 	

	<p>c. Post-order traversal of a binary tree.</p> <p>7.Hash Table: Write a program to:</p> <p>a. Implement a hash table with separate chaining for collision handling.</p> <p>b. Store and retrieve data from the hash table.</p> <p>8.Sorting Algorithms: Write programs to implement and compare the following sorting algorithms:</p> <p>a. Bubble sort</p> <p>b. Insertion sort</p> <p>c. Selection sort</p> <p>9.Searching Algorithms: Write programs to implement and compare:</p> <p>a. Linear search</p> <p>b. Binary search (on a sorted array)</p> <p>10.Combined Application</p> <p>a. Design a simple program that uses multiple data structures .</p>	
10	<p>Text Books:</p> <ol style="list-style-type: none"> 1. Learning Python, Fourth Edition by Mark Lutz Copyright © 2009 Mark Lutz. Published by O'Reilly Media, Inc. 2. Python Basics: A Practical Introduction to Python 3 Revised and Updated 4th Edition David Amos, Dan Bader, Joanna Jablonski, Fletcher Heisler 3. Data Structures and Algorithms made Easy: Data Structures and Algorithmic Puzzles, Narasimha Karumanchi ,5th Edition 2017 	
11	<p>Reference Books:</p> <ol style="list-style-type: none"> 1. Let Us Python, Yashwant. B. Kanetkar, BPB Publication, 2019 2. Python: The Complete Reference, Martin C. Brown, McGraw Hill, 2018 3. Beginning Python: From Novice to Professional, Magnus Lie Hetland, Apress, 2017 4. A Simplified Approach to Data Structures, Lalit Goyal, Vishal Goyal, Pawan Kumar SPD,1st 2014 5. Problem Solving in Data Structures & Algorithms Using C by Hemant Jain ,1st Edition, BPB Publications, 2018 6. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, 4th Edition, MIT Press,2022 	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	<p>Continuous Evaluation through: Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totaling to 50 marks and can be converted to 20 marks.</p>	30 marks practical exam of 2 hours duration
14	<p>Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination</p> <p>Practical Slip:</p> <p>Q1. From Module 1 13 marks</p> <p>Q2. From Module 2 12marks</p> <p>Q3. Journal and Viva 05 marks</p>	

Sem. - IV

Vertical – 1 Major

Title of Paper :Core Java

Sr.No.	Heading	Particulars
1	Description the course : Including but Not limited to:	Core Java course focuses on teaching students how to design, develop, and maintain software applications using the Java programming language. The course covers fundamental to advanced concepts of Java, enabling students to understand object-oriented programming (OOP) principles, data structures, algorithms, and real-world application development.
2	Vertical :	Major
3	Type :	Theory
4	Credits :	2 credits (1 credit = 15 Hours for Theory in a semester, Total 30 hours)
5	Hours Allotted :	30 Hr
6	Marks Allotted:	50
7	Course Objectives(CO): CO 1: Understand and Apply Object-Oriented Programming (OOP) Concepts. CO 2: Identify the key components of a class and object in Java, including attributes (fields), methods, and constructors. CO 3: Apply sound software engineering principles in Java by organizing code into classes and methods with proper access control identifiers CO 4: Use tools and techniques like unit testing, as well as IDE debugging tools to find and fix issues within Java programs. CO 5. Effectively use Java's collection framework (e.g., Lists, Sets, Maps) to manage and process groups of related objects. CO 6. Use OOP concepts in designing and building solutions to real-world problems, ensuring the application is modular, maintainable, and reusable.	
8	Course Outcomes (OC): OC1. Understand the basics of Java and its runtime environment. OC2. Be proficient in using Java's data types, control flow statements, and OOP principles such as classes, inheritance, and exception handling. OC3. Creating own classes and objects OC4. Develop mini projects using Class, Interface and exception handling	
9	Modules:- Module 1: Introduction to Java Programming -History of Java and its Evolution,Features of Java (Platform Independence, Object-Oriented),Data Types and Variables,Operators Constants and Literals,Type Casting Decision Making and Loops :If-else Statements,Switch Statement, Loops (For, While, Do-While),Break and Continue Statements Classes and Objects :Array,ArraysString class and String methods, StringBuffer and StringBuilder, Object-Oriented Programming Concepts, Defining Classes and Creating Objects, Instance Variables and Methods, Constructors, this Keyword, super keyword, Types of Classes, Scope Rules, Access Modifier, constants, static members of a class, garbage collection.	15 Hrs

	<p>Inheritance: Its types, Superclass and Subclass, Final classes and methods</p> <p>Polymorphism: Compile-time and Runtime Polymorphism</p>	
	Module 2:	
	<p>Interfaces: Defining and Implementing Interfaces, Abstract Classes and Methods, Multiple Interface Implementation</p> <p>Packages: Introduction to predefined packages, User Defined Packages, Access specifier, Java Built-in packages</p> <p>Exception handling- Try, Catch, and Finally Blocks, Throw and Throws Keywords</p> <p>Introduction to Threads: Creating and Running Threads, Thread Lifecycle</p>	15 Hrs
10	<p>Books and References:</p> <ol style="list-style-type: none"> 1. Java: The Complete Reference Herbert Schildt MC-Graw HILL 12th EDITION 2022 2. Core Java, Volume I: Fundamentals Hortsman Pearson 9th 2013 3. Core Java, Volume II: Advanced Features Gary Cornell and Hortsman Pearson 8th 2008 	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	<p>Continuous Evaluation through:</p> <p>Class test of 1 of 15 marks</p> <p>Class test of 2 of 15 marks</p> <p>Average of the two: 15 marks</p> <p>Quizzes/ Presentations/ Assignments: 5 marks</p> <p>Total: 20 marks</p>	<p>Format of Question Paper: External Examination (30 Marks)– 1 hr duration</p>
14	<p>Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour)</p> <p>Q1: Attempt any two (out of four) from Module 1 (15 marks)</p> <p>Q2: Attempt any two (out of four) from Module 2 (15 marks)</p> <p>Or</p> <p>Q1: Attempt any three (out of five) from Module 1 (15 marks)</p> <p>Q2: Attempt any three (out of five) from Module 2 (15 marks)</p>	

Title of Paper: Software Engineering

Sr.No	Heading	Particulars
1	Description the course: Including but Not limited to:	This course provides an in-depth understanding of Scrum, an Agile framework for developing, delivering, and sustaining complex products. Students will learn the principles and practices of Scrum, including roles (Scrum Master, Product Owner, Development Team), events (Sprint, Scrum Meetings), and artifacts (Product Backlog, Sprint Backlog, Increment). The course emphasizes hands-on exercises, real-world scenarios, and collaborative activities to master iterative development and enhance team productivity. By the end, learners will be equipped to implement Scrum in software engineering projects effectively and drive organizational agility.
2	Vertical :	Major
3	Type :	Theory
4	Credits :	2 credits (1 credit = 15 Hours for Theory in a semester, Total 30 hours)
5	Hours Allotted :	30
6	Marks Allotted:	50
7	Course Objectives (CO): CO1: Understand the core principles of Agile and the Scrum framework. CO2: Explore the high-level Scrum process and its key components. CO3: Develop skills in managing the Product Backlog effectively. CO4: Learn techniques for Sprint planning, execution, and tracking. CO5: Gain insights into Scrum-based project, quality, and risk management. CO6: Master the art of writing clear and actionable user stories.	
8	Course Outcomes (OC): OC1: Demonstrate a comprehensive understanding of Agile concepts and Scrum practices. OC2: Apply Scrum processes to effectively manage software development life cycles. OC3: Create and prioritize user stories for efficient Product Backlog management. OC4: Utilize metrics to evaluate and enhance Sprint performance and team productivity. OC5: Implement strategies for cost, customer, and risk management in Scrum projects. OC6: Formulate effective Sprint retrospectives to drive continuous improvement.	
9	Module 1:	
	Software and Software Engineering, Process Models, Introduction to Agile Concepts, All about Scrum, Scrum Process: High-Level View. Product Backlog Management, Sprint Planning, Writing Effective User Stories, Sprint Execution and Tracking, Sprint Review, Sprint Retrospectives	15 Hrs
	Module 2:	
Measurements and Metrics in Scrum, Software Development Life Cycle and Waterfall Model, Project Management in Scrum and Waterfall, Quality Management in Scrum, Customer Management in Scrum, Risk Management in Scrum, Cost Management in Scrum.	15 Hrs	

10	Books and References: <ol style="list-style-type: none"> 1. "Agile Scrum", Rama Bedarkar, Wiley, 1st, 2020 2. "Mastering Professional Scrum: A Practitioner's Guide to Overcoming Challenges and Maximizing the Benefits of Agility" by Stephanie Ockerman and Simon Reindl, Addison-Wesley Professional, 1st edition (2019). 3. "Scrum: A Pocket Guide" by Gunther Verheyen, Van Haren Publishing, 2nd edition (2019). 4. "Software in 30 Days" by Ken Schwaber and Jeff Sutherland, Wiley, 1st edition (2012). 5. "Scrum Insights for Practitioners: The Scrum Guide Companion" by Hiren Doshi, PracticeAgile Solutions, 1st edition (2016). 6. "A Scrum Book: The Spirit of the Game" by Jeff Sutherland and James O. Coplien, Pragmatic Bookshelf, 1st edition (2019). 7. "The Scrum Fieldbook: A Master Class on Accelerating Performance, Getting Results, and Defining the Future" by J.J. Sutherland, Random House Business, 1st edition (2019). 	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	Continuous Evaluation through: Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	Format of Question Paper: External Examination (30 Marks)– 1 hr duration
14	Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour) Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks) Or Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)	

Title of Paper: Computer Networks

Sr.No.	Heading	Particulars
1	Description the course : Including but Not limited to:	A course on Computer Networks typically focuses on the fundamental principles, technologies, and protocols that enable communication and data exchange between devices in various network environments.
2	Vertical :	Major
3	Type :	Theory
4	Credits :	2 credits (1 credit = 15 Hours for Theory in a semester, Total 30 hours)
5	Hours Allotted :	30
6	Marks Allotted:	50
7	Course Objectives(CO): 1. To understand the basic concepts in OSI Model,distinguishing Factors in TCP/IP ,IP addressing Schemes 2. Understand How the communication happens across the network 3. Understanding of various Routing protocol and their implementation	
8	Course Outcomes (OC): CO 1.Understanding the Transport layer protocols and their utilities CO 2.Various application layer protocols and their implementation CO3:Mailing Services and web services implementation	
9	Modules:- Module 1: 1. Introduction: OSI Model, TCP/IP Protocol Suite, IPV 4 Addresses and Protocol and IPV6 Addresses and Protocol 2. Address Resolution Protocol (ARP), Internet Control 3. Message Protocol Version 4 (ICMPv4), Mobile IP, 4. Unicast Routing Protocols (RIP, OSPF and BGP)	15 Hrs
	Module 2: 8. User Datagram Protocol (UDP), Transmission Control Protocol (TCP) 9. Host Configuration: DHCP, Domain Name System (DNS) 10. Remote Login: TELNET and SSH, File Transfer: FTP and TFTP ; World Wide Web and HTTP, 11. Electronic Mail: SMTP, POP, IMAP and MIME	15 Hrs
10	Books and References: TCP/IP Protocol Suite, Behrouz A. Forouzan, 4th Edition, Tata McGrawHill (Chapter 2, 5, 7, 26, 27, Chapter 8, 9, 10, 11, Chapter 14,15, Chapter 16, 18, 19, Chapter 20, 21, 22, Chapter 23, 25)	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	Continuous Evaluation through: Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	Format of Question Paper: External Examination (30 Marks)– 1 hr duration

14

Format of Question Paper: (Semester End Examination : 30 Marks. Duration:1 hour)

Q1: Attempt any two (out of four) from Module 1 (15 marks)

Q2: Attempt any two (out of four) from Module 2 (15 marks)

Or

Q1: Attempt any three (out of five) from Module 1 (15 marks)

Q2: Attempt any three (out of five) from Module 2 (15 marks)

Title of Paper: Major Practical 4

Sr.No.	Heading	Particulars
1	Description the course : Including but Not limited to:	<p>Computer Networking Practical course focuses on providing hands-on experience with various networking concepts and techniques. Students typically practice configuring, troubleshooting, and testing network protocols and hardware in real-world scenarios. The practical component of this course emphasizes network setup, monitoring, and management skills Wireless Networks and Mobile Communications</p> <p>A Java Programming Practical course typically provides hands-on experience in writing, debugging, and executing Java programs. The goal is to help students become proficient in Java programming and apply theoretical concepts to solve real-world problems. The practical sessions in this course usually focus on programming skills and the application of Java principles in various scenario</p>
2	Vertical :	Major
3	Type :	Practical
4	Credits :	2 credits (30 Hours of Practical work in a semester)
5	Hours Allotted :	30
6	Marks Allotted:	50 Marks
7	Course Objectives(CO):	<ol style="list-style-type: none">1. Understand core Java programming concepts, including data types, control structures, and object-oriented programming principles.2. Develop the ability to implement inheritance, polymorphism, interfaces, and abstract classes effectively.3. Gain hands-on experience with exception handling, multithreading, and dynamic initialization.4. Learn to apply Java programming to solve real-world problems, such as matrix operations and finding areas/volumes.5. Enhance debugging and problem-solving skills using Java's rich standard libraries and features.6. Basic foundation of LAN7. various command line utilities to be tested8. Practical implementation of IP Subnetting9. Testing of various Routing Protocols
8	Course Outcomes (OC):	<p>CO 1. Write efficient Java programs to perform arithmetic operations, manage control flow, and manipulate strings.</p> <p>CO 2. Demonstrate knowledge of object-oriented concepts by implementing inheritance, polymorphism, and interfaces.</p> <p>CO 3. Apply exception handling mechanisms to create robust Java applications.</p> <p>CO 4.1 Implement multithreading and explore dynamic initialization for advanced Java programming.</p>

CO 5. Solve computational problems, such as matrix operations and factorial calculation, using packages and Java constructs.
 CO 6. Implementation of utility protocols
 CO 7 Understanding Basic Security features
 CO 8 Network Traffic and Packet Analysis
 CO 9 Basic Understanding of Wireless Network

9

Module 1

30 Hrs

1. Write a program
 - a. in Java to demonstrate Boolean value.
 - b. Print a string 10 times using a for loop.
 - c. Write a program in Java to evaluate $a+b*c\%d$.
2. Write a program
 - a. in Java to find the biggest element among three numbers using if else.
 - b. Write a program in Java to find the biggest element among three numbers using the ternary operator.
 - c. Write a program in Java to check the grade of marks using a switch case.
3. Write a program
 - a. in Java to demonstrate dynamic initialization.
 - b. Write a program in Java to create a class and access all data members and methods using the object and compute the area and perimeter of a circle.
 - c. Write a program in Java to access member variables using the constructor.
4. Write a program
 - a. in Java to multiply two matrices.
 - b. Write a program in Java to calculate the area of a rectangle using single inheritance.
 - c. Write a program in Java to demonstrate multilevel inheritance.
5. Write a program
 - a. in Java to demonstrate hierarchical inheritance.
 - b. Write a program in Java to find the area and perimeter of a circle using an abstract class.
 - c. Write a program in Java to show that a private member of a class cannot be inherited.
6. Write a program
 - a. in Java to find the volume of a box using this keyword.
 - b. Write a program in Java to find the average of three numbers using the method overloading
 - c. Write a program in Java to find average of three numbers using method overriding.
 - d. Create a class figure. Create two subclasses rectangle and triangle. Find the area of a rectangle and half the area of the rectangle using the reference of the figure.
7. Write a program
 - a. Create an interface area. Find the area of a circle.
 - b. Write a program in Java to find the sum and average of three numbers using the super keyword.
12. Write a program

	<ul style="list-style-type: none"> a. in Java to find the volume of a box using constructor overloading. b. Write a program in Java to demonstrate exception handling in case of variable/constant divided by zero. <p>13. Write a program in Java</p> <ul style="list-style-type: none"> a. to implement multiple inheritance using the interface. b. Write a program in Java to check if a given string is palindrome or not. <p>14. Write a program in Java</p> <ul style="list-style-type: none"> a. for sorting a given list of strings in ascending order. b. Write a program in Java to find the factorial of a number using the package. <p>15. Write a program in</p> <ul style="list-style-type: none"> a. Java to import the package. b. Write a program in Java to implement thread. c. Write program to implement Flow, Grid and Border Layout using swing. d. Write program to demonstrate following events Action Mouse Key 	
	Module 2	30 Hrs
	<ul style="list-style-type: none"> 1. Configuring LAN setup <ul style="list-style-type: none"> a. Planning and Setting IP networks b. Configuring subnet c. Using, linux-terminal or Windows-cmd, execute following networking commands and note the output: ping, traceroute, netstat, arp, ipconfig, Getmac, hostname, NSLookUp, pathping, SystemInfo 2. IPv4 Addressing and Subnetting <ul style="list-style-type: none"> a. Given an IP address and network mask, determine other information about the IP address such as: <ul style="list-style-type: none"> a. Network address • Network broadcast address • Total b. number of host bits • Number of hosts b. Given an IP address and network mask, determine other information about the IP address such as: c. The subnet address of this subnet • d. The broadcast address of this subnet • e. The range of host addresses for this subnet • f. The maximum number of subnets for this subnet mask • g. The number of hosts for each subnet • h. The number of subnet bits •The number of this subnet 3. Configure Static IP routing using . 4. Configure IP routing using RIP. 5. Configuring Simple and multi-area OSPF 6. Configuring BGP protocol (Multi-Autonomous) 7. Configuring server and client. <ul style="list-style-type: none"> a. Configure DHCP b. Configure DNS c. Configure HTTP d. Configure Telnet e. Configure FTP 8. Configure basic security features for networks 9. Using Wireshark, network analyzer, set the filter for ICMP, TCP, HTTP, UDP, FTP and perform respective protocol transactions to show/prove that the 	

	network analyzer is working 10.create a wireless network of multiple PCs using appropriate access point. 11.IPV6 Addressing Basics	
10 & 11	Text Books& References Books :	
	1. Java: The Complete Reference Herbert Schildt MC-Graw HILL 12th EDITION 2022 2. Core Java, Volume I: Fundamentals Hortsman Pearson 9th 2013 3. Core Java, Volume II: Advanced Features Gary Cornell and Hortsman Pearson 8th 2008 4. Cisco CCNA 200-301 Official Cert Guide	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	Continuous Evaluation through: Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totaling to 50 marks and can be converted to 20 marks.	30 marks practical exam of 2 hours duration
14	Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks	

Vertical - 4

VSC

Syllabus

B. Sc. (Information Technology)

(Sem.- III)

Title of Paper APPLIED MATHEMATICS

Sr.No.	Heading	Particulars
1	Description the course : Including but Not limited to:	This course is designed for developing competency of the students in the applications of various mathematical concepts. It is equipped with Complex numbers, Laplace transform, Inverse Laplace transform, Differential equations of first order with first degree and higher degree. This course introduces basic concepts of Algebra and prepares students to study further courses in linear and abstract algebra.
2	Vertical :	Vocational Skill Course
3	Type :	Theory
4	Credits :	2 credits (1 credit = 15 Hours for Theory in a semester, Total 30 hours)
5	Hours Allotted :	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives(CO): CO1: Ability to interpret the mathematical results in physical or practical terms for complex numbers. CO2: Know and to understand various types of methods to solve Laplace transform. CO3: Apply the knowledge of Laplace Transforms to solve the problems. CO4: Know and to understand various types of methods to solve differential equation. CO5: Apply the knowledge of differential equations to solve the problems. CO6: Inculcate the habit of Mathematical Thinking through Indeterminate forms.	
8	Course Outcomes (OC): OC 1. Familiar with the various forms and operations of a complex number. OC 2: Find the Laplace transform of a function of using definition. OC 3: Find the Inverse Laplace transform of a function of using definition. OC 4: Solve Differential equations of first degree and first order. OC 5: Solve Differential equations of first degree and higher order.	
9	Modules:- Module 1: 1.1 Complex Numbers: Complex number, Equality of complex numbers, Graphical representation of complex number (Argand's Diagram), Polar form of complex numbers. Polar form of $x+iy$ for different signs of x,y , Exponential form of complex numbers, Mathematical operation with complex numbers and their representation on Argand's Diagram, Circular functions of complex angles, Definition of hyperbolic function. Relations between circular and hyperbolic functions, Inverse hyperbolic functions. 1.2 The Laplace Transform: Introduction. Definition of the Laplace Transform, Table of Elementary Laplace Transforms. Theorems on Important Properties of	15 Hrs

	Laplace Transformation, First Shifting Theorem, Second Shifting Theorem, Convolution Theorem, Laplace Transform of Derivatives. 1.3 Inverse Laplace Transform: Shifting Theorem, Partial fractions Methods, Use of Convolution Theorem, Solution of Ordinary Linear Differential Equations with Constant Coefficients, Laplace Transformation of Special Function, Periodic Functions, Heaviside Unit Step Function, Dirac-delta Function (Unit Impulse Function).	
	Module 2:	
	2.1 Equation of the first order and of the first degree: Separation of variables, Equations homogeneous in x and y, Non-homogeneous linear equations, Exact differential Equation, Integrating Factor, Linear Equation and equation reducible to this form, Method of substitution. 2.2 Differential equation of the first order of a degree higher than the first: Introduction, Solvable for p (or the method of factors), Solve for y, Solve for x, Clairaut's form of the equation, Method of Substitution. 2.3 Linear Differential Equations with Constant Coefficients: Introduction, The Differential Operator, Linear Differential Equation $f(D) y = 0$, Different cases depending on the nature of the root of the equation $f(D) = 0$, Linear differential equation $f(D) y = X$, The complimentary Function, The inverse operator $1/f(D)$ and the symbolic expression for the particular integral,	15 Hrs
10	Books and References: 1. A text book of Applied Mathematics Vol I, P. N. Wartikar and J. N. Wartikar, Pune Vidyathi Griha, 7 th , 1995 2. A text book of Applied Mathematics Vol II, P. N. Wartikar and J. N. Wartikar, Pune Vidyathi Griha, 7 th , 1995 3. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publications.	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	Continuous Evaluation through: Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	Format of Question Paper: External Examination (30 Marks)– 1 hr duration
14	Format of Question Paper: (Semester End Examination : 30 Marks. Duration:1 hour) Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks) Or Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)	

SEC

Syllabus

B. Sc. (Information Technology)

(Sem.- IV)

Title of Paper: Computer Graphics

Sr.No	Heading	Particulars
1	Description the course : Including but Not limited to:	Computer Graphics Practical is a hands-on course designed to introduce students to the foundational principles of computer graphics, including 2D transformations, graphical modelling, and basic animations. The course focuses on applying mathematical concepts like translation, rotation, scaling, and shearing to create and manipulate graphical objects. Students will learn to use programming tools such as Python (Matplotlib, Pygame, OpenCV) or C/C++ libraries to implement these concepts. Through practical assignments, they will develop the skills to create simple 2D animations, simulate real-world objects, and design graphical scenes. The course bridges the gap between theoretical concepts and real-world applications, fostering creativity and problem-solving in visual computing.
2	Vertical :	Skill Enhancement Course
3	Type :	Practical
4	Credits :	2 credits (30 Hours of Practical work in a semester)
5	Hours Allotted :	30
6	Marks Allotted:	50 Marks
7	Course Objectives(CO):	<p>CO1: Introduce foundational concepts of 2D transformations, geometric modelling, and rendering techniques in computer graphics.</p> <p>CO2: Develop skills to apply 2D transformations (translation, rotation, scaling, shearing, reflection) and basic animations.</p> <p>CO3: Enable students to simulate real-world objects and create simple animations.</p> <p>CO4: Equip students to understand graphics pipelines, coordinate systems, and basic rendering principles.</p> <p>CO5: Foster creativity and logical thinking by implementing graphical scenes and animations.</p>
8	Course Outcomes (OC):	<p>OC1: Understand and apply 2D transformation matrices to graphical objects.</p> <p>OC2: Implement simple graphics primitives and manipulate them using transformations.</p> <p>OC3: Create basic 2D animations (e.g., bouncing ball, rotating shapes).</p> <p>OC4: Understand and utilize color models, coordinate systems, and graphical libraries.</p> <p>OC5: Develop basic graphical applications using lightweight tools and programming languages.</p>

9	Module 1	30 Hrs
	<p>Module 1: Basic Setup and 2D Graphics Fundamentals</p> <ol style="list-style-type: none"> 1. Installing Required Software <ul style="list-style-type: none"> • Objective: Install and configure Python, Matplotlib, OpenCV, or Pygame for computer graphics. • Task: Verify the installation and create a "Hello, Graphics!" window. 2. Drawing Basic Shapes <ul style="list-style-type: none"> • Objective: Draw lines, circles, rectangles, and polygons using graphical primitives. • Tool: Python with Matplotlib or OpenCV. 3. Line Drawing Algorithms <ul style="list-style-type: none"> • Objective: Implement the DDA (Digital Differential Analyzer) algorithm. • Tool: Python or C++. 4. Bresenham's Line Drawing Algorithm <ul style="list-style-type: none"> • Objective: Implement Bresenham's line drawing algorithm. • Tool: Python or C++. 5. Circle Drawing Algorithms <ul style="list-style-type: none"> • Objective: Implement the Midpoint Circle algorithm. • Tool: Python or C++. 6. Polygon Filling <ul style="list-style-type: none"> • Objective: Implement the boundary-fill and flood-fill algorithms. • Tool: Python or C++. 7. Translation Transformation <ul style="list-style-type: none"> • Objective: Shift a 2D object using translation matrices. • Tool: Python with Matplotlib. 8. Rotation Transformation <ul style="list-style-type: none"> • Objective: Rotate a 2D object about a fixed point or origin. • Tool: Python with Matplotlib. 9. Scaling Transformation <ul style="list-style-type: none"> • Objective: Scale a 2D object up or down using scaling matrices. • Tool: Python with Matplotlib. 10. Reflection Transformation <ul style="list-style-type: none"> • Objective: Reflect a 2D object across x-axis, y-axis, and diagonal. • Tool: Python with Matplotlib. 11. Shearing Transformation <ul style="list-style-type: none"> • Objective: Apply x-axis and y-axis shearing to a 2D object. • Tool: Python with Matplotlib. 12. Composite Transformations <ul style="list-style-type: none"> • Objective: Combine translation, rotation, and scaling on a 2D object. • Tool: Python with Matplotlib. 13. Clipping Algorithms <ul style="list-style-type: none"> • Objective: Implement the Cohen-Sutherland line clipping algorithm. 	

	<ul style="list-style-type: none"> • Tool: Python or C++. <p>14. Window-to-Viewport Transformation</p> <ul style="list-style-type: none"> • Objective: Map a 2D object from a window to a viewport. • Tool: Python or C++. <p>15. Basic Interactive Graphics</p> <ul style="list-style-type: none"> • Objective: Create a simple interactive graphics program (e.g., moving a rectangle with arrow keys). • Tool: Python with Pygame. 	
Module 2		30 Hrs
	<p>1. Simple Animation</p> <ul style="list-style-type: none"> • Objective: Animate a moving ball across the screen. • Tool: Python with Pygame. <p>2. Bouncing Ball Animation</p> <ul style="list-style-type: none"> • Objective: Create a bouncing ball with collision detection. • Tool: Python with Pygame. <p>3. Rotating Object Animation</p> <ul style="list-style-type: none"> • Objective: Animate a rotating triangle or square. • Tool: Python with Pygame or Matplotlib. <p>4. Scaling Animation</p> <ul style="list-style-type: none"> • Objective: Create an animation showing pulsating objects (grow/shrink). • Tool: Python with Matplotlib. <p>5. Multiple Object Animation</p> <ul style="list-style-type: none"> • Objective: Animate multiple objects moving independently. • Tool: Python with Pygame. <p>6. Color Models</p> <ul style="list-style-type: none"> • Objective: Experiment with RGB and HSI color models. • Tool: Python with OpenCV. <p>7. Bezier Curves</p> <ul style="list-style-type: none"> • Objective: Draw and animate a Bezier curve. • Tool: Python with Matplotlib. <p>8. 2D Game Development Basics</p> <ul style="list-style-type: none"> • Objective: Create a simple 2D game (e.g., a ball avoiding obstacles). • Tool: Python with Pygame. <p>9. Scene Creation</p> <ul style="list-style-type: none"> • Objective: Design a basic 2D scene (e.g., a house, tree, and sun). • Tool: Python with Matplotlib. <p>10. Parallax Scrolling Animation</p> <ul style="list-style-type: none"> • Objective: Implement parallax scrolling for a background in 2D graphics. • Tool: Python with Pygame. <p>11. Path Animation</p> <ul style="list-style-type: none"> • Objective: Animate an object moving along a predefined path. 	

	<ul style="list-style-type: none"> • Tool: Python with Matplotlib. <p>12. Collision Detection</p> <ul style="list-style-type: none"> • Objective: Implement collision detection between 2D objects. • Tool: Python with Pygame. <p>13. Interactive Graphics with Mouse Input</p> <ul style="list-style-type: none"> • Objective: Create an interactive program where shapes follow mouse clicks. • Tool: Python with Pygame. <p>14. Text Rendering</p> <ul style="list-style-type: none"> • Objective: Render and animate text in a 2D graphical environment. • Tool: Python with Pygame. <p>15. Final Project</p> <ul style="list-style-type: none"> • Objective: Combine multiple concepts to create a complete animated 2D scene. • Example: A car moving on a road with a rising sun and trees. <p>Tool: Python with Matplotlib or Pygame</p>	
10 & 11	Reference and Text Books: <ol style="list-style-type: none"> 1. Python Graphics: A Reference for Creating 2D and 3D Images, Bernard Korites, Apress, 2nd Edition 2023. 2. Computer Graphics from Scratch: A programmer's Introduction to 3D Rendering, Gabriel Gambetta, no starch press, 2021 3. 2D Computer Graphics: Modern C++ and Standard Library, Hakan Blomqvist, 2023 	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	Continuous Evaluation through: Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totaling to 50 marks and can be converted to 20 marks.	30 marks practical exam of 2 hours duration
14	Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks	

Syllabus B. Sc. (Information Technology) (Sem.- IV)

Title of Paper Mobile Programming

Sr.No	Heading	Particulars
1	Description the course : Including but Not limited to:	This course introduces the fundamentals of Flutter and Dart for building cross-platform mobile applications. Students will learn to create responsive user interfaces, manage app state, handle user inputs, and implement navigation and animations. The course also covers integrating APIs, working with databases, and deploying functional mobile apps for Android and iOS.
2	Vertical :	Skill Enhancement Course
3	Type :	Practical
4	Credits :	2 credits (30 Hours of Practical work in a semester)
5	Hours Allotted :	30
6	Marks Allotted:	50 Marks
7	Course Objectives(CO):	<p>CO1: Understand the fundamentals of Flutter and Dart programming for mobile app development.</p> <p>CO2: Learn how to set up the Flutter SDK and development environment.</p> <p>CO3: Develop skills to create basic Flutter applications using widgets like Text, Row, and Column.</p> <p>CO4: Explore the use of StatelessWidget and StatefulWidget for managing app states.</p> <p>CO5: Master the implementation of responsive UIs using MediaQuery and layouts.</p> <p>CO6: Gain knowledge of form creation, input handling, and validation in Flutter apps.</p> <p>CO7: Learn to navigate between screens and implement app navigation features like drawers.</p> <p>CO8: Understand how to use Flutter animations, including AnimatedContainer and FadeTransition.</p> <p>CO9: Explore database integration with APIs using packages like http and FutureBuilder.</p> <p>CO10: Build apps with themes, user interactions (e.g., taps and long presses), and custom styling.</p>

8	<p>Course Outcomes (OC):</p> <p>OC1: Demonstrate the ability to configure Flutter and build a functional development environment.</p> <p>OC2: Create and run basic Flutter apps with appropriate UI components.</p> <p>OC3: Develop responsive and adaptive UIs for multiple screen sizes.</p> <p>OC4: Implement interactive features like counters, sliders, and switches in Flutter apps.</p> <p>OC5: Design and validate user input forms using TextFormField.</p> <p>OC6: Develop navigation flows between screens and integrate drawers for better usability.</p> <p>OC7: Create animations for smooth transitions and enhanced user experiences.</p> <p>OC8: Build applications that fetch and display data from public APIs asynchronously.</p> <p>OC9: Apply effective state management strategies to handle app states efficiently.</p> <p>OC10: Demonstrate the ability to debug, test, and optimize Flutter apps for deployment.</p>	
9	Module 1	30 Hrs
	<ol style="list-style-type: none"> 1. Install Flutter SDK on your computer and run the flutter doctor command to check your setup. 2. Create a "Hello, World!" Flutter application and run it on an emulator. 3. Modify the app's title and primary color in the MaterialApp widget. 4. Create a StatelessWidget that displays a greeting message. 5. Write a Dart program to calculate the sum of two numbers entered by the user. 6. Implement a Dart program that uses if-else statements to determine if a number is odd or even. 7. Demonstrate the use of a switch-case statement in Dart. 8. Write a program to print a multiplication table using a for loop. 9. Create a Flutter app with a Text widget that displays your name. 10. Build an app with a Column widget to arrange multiple Text widgets vertically. 11. Use a Row widget to arrange three buttons horizontally. 12. Create a Flutter app using Scaffold with an AppBar, Body, and a FloatingActionButton. 13. Create a simple counter app using StatefulWidget to increment and display a number. 14. Implement a TextField widget to accept user input and display it using a Text widget. 15. Design a Flutter app with a Container widget and customize its padding, margin, and color. <p>Use the Stack widget to overlay a Text widget on an Image.</p>	
	Module 2	30 Hrs
	<ol style="list-style-type: none"> 1. Build a responsive UI using MediaQuery to adapt to different screen sizes. 2. Create a Flutter form with TextFormField widgets to accept a username and password. 3. Implement form validation to ensure the fields are not empty. 4. Add navigation between two screens in Flutter using the Navigator class. 	

	<ol style="list-style-type: none"> 5. Create a Drawer widget for app navigation with three menu options. 6. Display a list of items in a ListView widget. 7. Use the GridView widget to display a grid of images. 8. Add a GestureDetector to detect taps and display a message in the console. 9. Implement a LongPress event to change the color of a container. 10. Create a basic animation using the AnimatedContainer widget. 11. Implement a FadeTransition to animate the opacity of a widget. 12. Use a Slider widget to select a value between 0 and 100 and display the value. 13. Create a Switch widget to toggle between two themes (light and dark). 14. Use the http package to fetch and display data from a public API. <p>Create a FutureBuilder widget to display data asynchronously.</p>	
10 & 11	<p>Reference and Text Books:</p> <ol style="list-style-type: none"> 1. Mastering Flutter: A Beginner’s Guide, by Sufyan bin Uzayr, CRC Press, 1st, 2023 2. Flutter for Beginners, by Alessandro Biessek, Packt Publishing, 1st edition (2019). 3. Flutter Cookbook, by Simone Alessandria, Packt Publishing, 2nd Edition, 2023 4. Beginning App Development with Flutter, by Rap Payne, Apress, 1st edition (2019). 5. Flutter Apprentice, by Michael Katz, Kevin David Moore, and Vincent Ngo, Kodeco, 1st edition (2021). 6. Flutter Complete Reference 2.0, by Alberto Miola, Independently published, 2nd edition (2023). 7. Flutter in Action, by Eric Windmill, Manning Publications, 1st edition (2020). 8. Programming Flutter, by Carmine Zaccagnino, O'Reilly Media, 1st edition (2020). 	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	<p>Continuous Evaluation through:</p> <p>Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totaling to 50 marks and can be converted to 20 marks.</p>	30 marks practical exam of 2 hours duration
14	<p>Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination</p> <p>Practical Slip:</p> <p>Q1. From Module 1 13 marks</p>	

	Q2. From Module 2 12marks
	Q3. Journal and Viva 05 marks

QUESTION PAPER PATTERN (External and Internal)

Internal Continuous Assessment: 40%	Semester End Examination: 60%
Continuous Evaluation through: Class test of 1 of 15 marks Class test of 2 of 15 marks Average of the two: 15 marks Quizzes/ Presentations/ Assignments: 5 marks Total: 20 marks	Format of Question Paper: External Examination (30 Marks)– 1 hr duration
Format of Question Paper: (Semester End Examination: 30 Marks. Duration:1 hour) Q1: Attempt any two (out of four) from Module 1 (15 marks) Q2: Attempt any two (out of four) from Module 2 (15 marks) Or Q1: Attempt any three (out of five) from Module 1 (15 marks) Q2: Attempt any three (out of five) from Module 2 (15 marks)	

Practical Examination

Internal Continuous Assessment: 40%	Semester End Examination: 60%
Continuous Evaluation through: Students are expected to attend each practical and submit the written practical of the previous session. Performing Practical and writeup submission will be continuous internal evaluation. 2.5 marks can be awarded for each practical performance and writeup submission totaling to 50 marks and can be converted to 20 marks.	30 marks practical exam of 2 hours duration
Format of Question Paper: Duration 2 hours. Certified copy of Journal is compulsory to appear for the practical examination Practical Slip: Q1. From Module 1 13 marks Q2. From Module 2 12marks Q3. Journal and Viva 05 marks	

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 - 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

**Sd/-
Sign of the BOS
Chairman
Dr. Srivaramangai R
BOS in Information
Technology**

**Sd/-
Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology**

**Sd/-
Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology**

AC-20/05/2025

Item No.- 5.45 (N)

Sem-IV 5(a)

As Per NEP 2020

University of Mumbai



Syllabus for Basket of AEC	
Board of Studies in English	
UG First Year B.sc Programme	
Semester	IV
Title of Paper	Credits
Introduction to Communication Skills in English II	2
From the Academic Year	2025-2026

Sr. No.	Heading	Particulars
1	Description of the course: Including but Not limited to:	Introduction to Communication Skills in English II Effective academic communication skills are essential for success in scholarly pursuits. In the academic realm, proficiency extends beyond verbal articulation to encompass precise and coherent written expression. Students are not only required to engage in thoughtful discussions and articulate complex ideas verbally but must also demonstrate their understanding through well-crafted written assignments, and presentations. Academic communication involves the mastery of scholarly conventions, such as adherence to academic writing styles, and the ability to engage in dialogue with peers and scholars. It encompasses the skillful navigation of academic discourse, fostering an environment where ideas are shared, challenged, and refined. Developing strong academic communication skills empower individuals to contribute meaningfully to intellectual conversations, enriching both their academic journey and the broader scholarly community. This course with its 30:20 pattern will also help in accomplishing this goal. The course is aimed at honing their cognitive, analytical, linguistic and creative skills. It is hoped that by the end of the academic year, the learners will have developed confidence in using the English language both for oral and written communication as well as develop interest in enhancing these skills later on.
2	Vertical:	AEC (Ability Enhancement Course)
3	Type:	Theory
4	Credit:	2 credits (1credit=15Hours for Theory in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives:	<ol style="list-style-type: none"> 1. To cultivate a comprehensive understanding of English Usage in Communication 2. To enhance reading proficiency with a diverse range of written texts with different genres and styles of written communication. 3. To help learners with better comprehension of a variety of oral texts by inculcating listening skills through practical exercises. 4. To train learners in group discussion and interview skills 5. To provide practical experience in formal and creative writing.

8 Course Outcomes:

At the end of the course the learner is able to:

- Demonstrate an understanding of English Usage in Communication
- Exhibit the ability to Read a variety of written text using subskills such as analyzing and interpreting text.
- Show competence in comprehending a variety of oral texts.
- Actively participate in group discussion, and research and prepare for the interview effectively
- Display advanced formal (email writing, report writing) and creative writing skills.

9 Modules: -

Module1:(15 Lectures)

A) English Usage in Communication

- Appropriacy in the Use of English
- Distinction between American English and British English
- Indianism and Indian English
- Elevator Pitch
- Modes and Types of Interview

B) Enhancing Reading Competencies:

- Augmenting active vocabulary
- Understanding relations between parts of a text
- Understanding concepts and arguments,
- Developing skills in analysis and interpretation
- Rewriting a passage from a defined perspective
- Reading critically (presenting a reasoned argument that evaluates and analyses what you have read)

A variety of passages of 200-250 words may be taken such as extracts from academic texts literary texts, magazines, newspapers, reports, documents. The passages should have complex text type, function and lexis. The learners may be encouraged to gather meaning contextually or by referring to offline and online sources such as dictionary, thesaurus, and encyclopedia.

C) Listening Skills

- Predicting content and guessing meaning
- Making inferences from the audio-visual text
- Listening for opinion/argument/counter-arguments etc.

- Taking notes

A variety of relevant audio/visual texts as samples may be drawn from various sources. Listening skills in English should be developed through various activities along with the practice done while teaching in the class.

Module2: (15 Lectures)

A. Group Discussion

- Formal and informal discussion
- Elements of group discussion
- Using appropriate language: Initiating, seeking and giving opinions, suggesting, responding to a suggestion, agreeing, disagreeing, interrupting, requesting, clarifying, summing up
- Types of discussion: Giving and sharing opinions of a given topic, making decisions, problem solving (case study)

B. Interview Skills

- Attending an Interview (Job/Entrance): Researching the organization, reviewing career-profile and your bio-data, preparing for standard questions, Responding to questions
- Analyzing Interviews

Students can be tested on forming actual interview frameworks including questions. Teachers must form the groups and conduct actual interviews involving full strength of students.

C. Writing Skills:

- Emails: applying for admission, accepting and joining (academic institution), Cancelling admission, registering a complaint
- Report Writing: Activity/Event report, Academic Report
- Creative Writing: Personal Essay, Memoir, Short Speech on the given occasion/ event, Story writing

10 **Text Books: N.A.**

11 **References:**

- Bellare, Nirmala. *Reading & Study Strategies*. Books. 1 and 2. Oxford University Press, 1997, 1998
- Bellare, Nirmala. *Easy Steps to Summary Writing and Note-Making*. Amazon Kindle Edition, 2020
- Comfort, Jeremy, et al. *Speaking Effectively: Developing Speaking Skills for Business English*. Cambridge University Press, 1994.

- Das, Bikram K., et. al. *An Introduction to Professional English and Soft Skills*. Cambridge University Press India Pvt. Ltd., 2010
- Das, Yadjnaseni & R. Saha (eds.) *English for Careers*. Pearson Education India, 2012.
- Dimond-Bayir, Stephanie. *Unlock Level 2 Listening and Speaking Skills Student's Book and Online Workbook: Listening and Speaking Skills Student's Book+ Online Workbook*. Cambridge University Press, 2014.
- Doff, Adrian and Christopher Jones. *Language in Use* (Intermediate and Upper Intermediate). CUP, 2004.
- Glendinning, Eric H. and Beverley Holmstrom. Second edition. *Study Reading: A Course in Reading Skills for Academic Purposes*. CUP, 2004
- Goodale, Malcolm. *Professional Presentations Video Pack: A Video Based Course*. Cambridge University Press, 1998.
- Grellet, F. *Developing Reading Skills*. Cambridge: Cambridge University Press, 1981
- Grussendorf, Marion. *English for Presentations*. Oxford University Press, 2007.
- Hamp- Lyons, Liz and Ben Heasley. Second edition. *Study Writing: A Course in Writing Skills for Academic Purposes*. CUP, 2006
- Labade, Sachin, Katre Deepa et al. *Communication Skills in English*. Orient Blackswan, Pvt Ltd, 2021.
- Lewis, N. *How to Read Better & Faster*. New Delhi, Goyal Publishers & Distributors Pvt. Ltd, 2006.
- McCarthy, Michael and Felicity O'Dell. *English Vocabulary in Use*. Cambridge: Cambridge University Press, 2001.
- Mohan, RC Sharma Krishna. *Business Correspondence and Report Writing*. Third edition. Tata McGraw-Hill Education, 2002.
- Murphy, Raymond, et al. *Grammar in use: Intermediate*. Cambridge University Press, 2000
- Raman, Meenakshi, and Singh, Prakash. *Business Communication*. India, Oxford University Press, 2006.
- Richards, Jack C., and Chuck Sandy. *Passages Level 2 Student's Book*. Cambridge University Press, 2014.
- Sadanand, Kamlesh & S. Punitha. *Spoken English: A Foundation Course*. (Part 1 & 2). Orient Blackswan. 2009.
- Sasikumar, V., et al. *A Course in Listening & Speaking I*. 2005. Cambridge University Press India Pvt. Ltd. (under the Foundation Books Imprint), 2010
- Savage, Alice, et al *Effective Academic Writing*. Oxford: OUP, 2005
- Sethi, J. *Standard English and Indian usage: Vocabulary and grammar*. PHI Learning Pvt. Ltd., 2011.
- Taylor, Grant. *English Conversation Practice*. 1967. Tata McGraw-Hill, 2013
- Turton, Nigel D. *A B C of Common Grammatical Errors*. 1995. Macmillan India Ltd., 1996
- Vas, Gratian. *English Grammar for Everyone*. Mumbai, Shree Book Centre, 2015
- Watson, T. *Reading Comprehension Skills and Strategies: Level 6*. Saddleback Educational Publishing, 2002

Web link Resources:

1. A rendezvous with Simi Garewal: Ratan Tata:
<https://www.youtube.com/watch?v=ozetTgOHu78&t=510s> Here Ratan Tata discusses his personal life, his expectations, his experience as a CEO of Tata and sons.
2. A rendezvous with Simi Garewal: Kiran Bedi: <https://youtu.be/vX2NyKvEAXQ> In this video, Kiran Bedi shares her daring adventures, her field, her passion for career with Simi Garewal.
3. In Conversation: Rajiv Mehrotra with J.R.D.Tata: <https://youtu.be/68otfg601HI> J. R. D. Tata discloses his dream of India, his experiences with Pandit Nehru, Mahatma Gandhi, Sardar Patel and his contribution to modern India.
4. The Tharoor Guide To Indian English: <https://youtu.be/NsyI9LIXbFM> Shashi Tharoor talks of new words like “defenstrate”, “brinjol”; talks about Indian English, ethnicity and so on.
5. Dr. A.P.J Abdul Kalam on Discovery, invention and innovation: <https://youtu.be/9CKCfiX3u00> Dr. Kalam addresses IIT Delhi students.
6. Malala Yousafzai’s speech on the occasion of her Nobel Peace Prize (2014) on education: <https://youtu.be/c2DHzkUI6s>
7. Kailash Satyarthi’s speech on the occasion of Nobel Peace Prize(2014) on the innocence of children; he gives voice to voiceless in his speech: https://youtu.be/wt0LSCeuc_M
8. Speech by Mr. Ratan Tata: <https://youtu.be/m7-tKX7aZXM>
9. “I Have a Dream” speech by Martin Luther King Jr. HD (subtitled)
<https://www.youtube.com/watch?v=vP4iY1TtS3s> “I Have a Dream” is a public speech that was delivered by American civil rights activist Martin Luther King Jr. during the March on Washington for Jobs and Freedom on August 28, 1963, in which he called for civil and economic rights and an end to racism in the United States.
10. Speech by Emma Watson on Gender Equality : <https://youtu.be/nIwU-9ZTTJc> 11. Imaginative science video: Could humans live in underwater cities?
<https://youtu.be/GUGtU7Ii1yk>
12. A conversation about household appliances: <https://youtu.be/rAPI0fSborU> 13. Video on psychology: Why do we dream? <https://youtu.be/2W85Dwxx218>
14. Video on space: Solar system 101: <https://youtu.be/libKVRa01L8>
15. Video on evolution: How Apocalypses paved the way for Humans
<https://youtu.be/libKVRa01L8> 16. Video on biology: Why Bats Aren't as Scary as You Think https://youtu.be/D6e_qh3YRPs
17. Video on social media: What is a social media influencer?
<https://youtu.be/39A3og7enz8>
18. Tips on communication (TED Talk): The Secrets of Learning a New Language https://youtu.be/o_XVt5rdpFY

	<p>19. Expressing opinions: If Cinderella Were a Guy: https://youtu.be/p4OyCNctKXg</p> <p>20. Telling stories without words: Partly Cloudy https://youtu.be/ix13P9NqBjo</p> <p>21. Telling stories without words: Tree of Unity https://youtu.be/sAo41Gyl6hY 17</p> <p>22. Bonding over the Radio: A special storytelling series by the much loved author Ruskin Bond: akashvaniair https://youtu.be/oxf60BIR2Q4 https://youtu.be/ISX7rUOJOms https://youtu.be/rrC_s0XPXKI https://youtu.be/FUML3q1ncF0 https://youtu.be/3by_ninqRzg</p> <p>23. Video on the English language: Where did English come from? https://youtu.be/YEaSxhcns7Y</p> <p>24. Video on biology: The science of skin colour: https://youtu.be/r4c2NT4naQ</p> <p>25. Video on advertising: The Science of Persuasion https://youtu.be/cFdCzN7RYbw</p> <p>26. "The Happy Prince" Oscar Wilde Michael Mills Classic Animated Short 1974 https://www.youtube.com/watch?v=q3RZh1yaqxM Learners may be encouraged to watch animated stories such as this one and questions asked later on.</p>	
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%
13	<p>Continuous Evaluation through:</p> <ul style="list-style-type: none"> • Performance in activities on Module 2 A & B during lectures: (10 marks) The class may be divided into batches to participate in Group Discussion and mock interview by creating formal schedule for the same before the semester End Examination. • Participation in classes during lectures: (05 marks) (Learners' response during the teaching and the tasks involving Listening skills (Module 1 C) will be assessed) • Overall attendance in lectures (05 marks) (Percentage of learners' attendance in class to be considered) 	
14	<p>Format of Question Paper: for the final examination</p> <p>Q.1. Short Notes on Module 1 A (2 out of 4) 10 Marks</p> <p>Q.2. Unseen Passage (200-250 words) (Module 1 B) 10 Marks</p> <p>Q.3 Writing Skills on Module 2 C – Writing an email or a Report or Creative Writing 10 Marks</p>	

Sd/-
Sign of BOS Chairman
Dr. Sachin Labade
Board of Studies in
English

Sd/-
Sign of the Offg.
Associate Dean
Dr. Suchitra Naik
Faculty of
Humanities

Sd/-
Sign of the Offg.
Associate Dean
Dr. Manisha Karne
Faculty of
Humanities

Sd/-
Sign of the Dean
Prof. Dr. Anil Singh
Faculty of
Humanities

AC – 20/05/2025
Item No. – 5.45 (N) Sem-III 2(a)

As Per NEP 2020

University of Mumbai



Syllabus for Marathi - AEC	
Board of Studies in Marathi	
UG Second Year Programme	
Semester	III
Title of Paper	लेखन कौशल्ये -२ (महाजालावरील लेखन)
Credits	2
From the Academic Year	2025-26

Syllabus
B.A. (Marathi AEC)
(Semester - III)

Title of Paper : लेखन कौशल्ये - २ (महाजालावरील लेखन)

Sr. No.	Heading	Particulars
1.	अभ्यासक्रमाचे वर्णन : (Description of the Course)	<p>राष्ट्रीय शैक्षणिक धोरण - २०२० विद्यार्थ्यांच्या सर्वांगीण विकासावर (Wholistic Development) भर देते. या धोरणात सर्वांगीण विकासाचा भाग म्हणून क्षमता वर्धन अभ्यासक्रम (Ability Enhancement Course) या स्तंभांतर्गत भाषिक कौशल्य अभ्यासक्रमाचा समावेश करण्यात आला आहे. कला, वाणिज्य व विज्ञान या विद्याशाखांमध्ये अध्ययन करणाऱ्या विद्यार्थ्यांना तिसऱ्या सत्रामध्ये 'आधुनिक भारतीय भाषां'चे अध्ययन अनिवार्य करण्यात आले आहे. सदर क्षमता वर्धन अभ्यासक्रमाचे स्वरूप प्रामुख्याने भाषाकेंद्री असावे, असेही राष्ट्रीय शैक्षणिक धोरणात नमूद करण्यात आले आहे. विद्यार्थ्यांना विविध प्रकारच्या भाषिक कौशल्यांचा तपशीलवार परिचय करून देणे, तसेच ती कौशल्ये आत्मसात करण्याची संधी विद्यार्थ्यांना उपलब्ध करून देणे, ही या अभ्यासक्रमाची महत्त्वाची उद्दिष्टे आहेत. ही उद्दिष्टे लक्षात घेऊन 'लेखन कौशल्ये - २ (महाजालावरील लेखन)' (श्रेयांकने २) या अभ्यासपत्रिकेची आखणी करण्यात आली आहे.</p> <p>आंतरमहाजाल हे एकविसाव्या शतकातील अत्यंत प्रभावी साधन आहे. जगभरातील संगणक एकमेकांशी जोडले जाऊन त्यांचे जाळे तयार झाले आहे. विविध सामाजिक माध्यमस्थळांवर स्वतःचे खाते (अकाउंट) तयार करणे आणि त्यावर मराठी भाषा व देवनागरी लिपीतून लिहिणे, ही समकालीन संपर्क व्यवहारातील आवश्यक बाब झाली आहे. यास अनुसरून आपल्या अभिव्यक्तीला व्यासपीठ मिळवून देणारी अनुदिनी (ब्लॉग) तयार करणे, विकिपीडियावर भोवतालातील भाषा, साहित्य, संस्कृतीशी निगडित माहितीपर व विश्लेषणात्मक नोंदी लिहिणे, सामाजिक माध्यमस्थळांवरील आपल्या खात्यावर सातत्याने अभ्यासपूर्ण लेखन करणे, स्वक्षमतेशी निगडित समाजगट / आभासी कट्टे (कम्युनिटी ग्रुप) तयार करणे, या बाबींसाठी आवश्यक सामाजिक माध्यमस्थळ साक्षरता आणि मराठी भाषा व देवनागरी लिपीतून लिहिण्याची क्षमता 'लेखन कौशल्ये - २ (महाजालावरील लेखन)' (श्रेयांकने २) या अभ्यासपत्रिकेच्या अध्ययनातून विद्यार्थ्यांमध्ये निर्माण होईल.</p>

2.	Vertical	Ability Enhancement Course
3.	Type	Theory
4.	Credit	2 Credits (1 Credit = 15 Hours for Theory or 30 Hours of Practical Work in a Semester)
5.	Hours Allotted	30 Hours (AEC या स्तंभांतर्गत शिकविल्या जाणाऱ्या अभ्यासपत्रिकांच्या कार्यभारासंबंधी मुंबई विद्यापीठाच्या दिनांक २३ जुलै, २०२४ च्या NO.AAMS_UGS/ICC/2024-25/19 या परिपत्रकाचा आधार घ्यावा.)
6.	Marks Allotted	50 Marks
7.	अभ्यासक्रम उद्दिष्टे (Course Objectives) : १. महाजालावरील लेखन कौशल्याचे स्वरूप समजावून सांगणे. २. महाजालावर प्रभावी लेखन करण्यासाठी आवश्यक असणाऱ्या तंत्रांचा परिचय करून देणे. ३. नेहमीच्या पठडीतील लेखन व महाजालावरील लेखन यांमधील साम्य-भेद स्पष्ट करणे. ४. विविध सामाजिक माध्यमस्थळांवर लेखन करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित करणे.	
8.	अभ्यासक्रम निष्पत्ती (Course Outcomes) : १. विद्यार्थ्यांना महाजालावरील लेखन कौशल्याचे स्वरूप समजेल. २. विद्यार्थ्यांना महाजालावर प्रभावी लेखन करण्यासाठी आवश्यक तंत्रांचा परिचय होईल. ३. विद्यार्थ्यांना नेहमीच्या पठडीतील लेखन व महाजालावरील लेखन यांमधील साम्य-भेद स्पष्ट होईल. ४. विद्यार्थ्यांमध्ये विविध सामाजिक माध्यमस्थळांवर लेखन करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित होतील.	
9.	अभ्यासघटक (Module) :	
	घटक - १ : सामाजिक माध्यमस्थळांवर मराठी भाषा व देवनागरीतून लेखन (भाग - १)	
	अ) अनुदिनी (ब्लॉग) लेखन आ) विकिपीडियावरील लेखन (६० मिनिटांच्या १५ तासिका, श्रेयांकन १) (सूचना : विद्यार्थ्यांमध्ये उपरोक्त सामाजिक माध्यमस्थळांवर लेखन करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित होतील या दृष्टीने शिक्षकांनी सराव करून घ्यावा.)	

घटक -२ : सामाजिक माध्यमस्थळांवर मराठी भाषा व देवनागरीतून लेखन (भाग - २)	
<p>अ) फेसबुक, इन्स्टाग्राम, एक्स यांवरील लेखन आ) समाज गट (कम्युनिटी ग्रुप), आभासी कट्टे यांवरील लेखन (६० मिनिटांच्या १५ तासिका, श्रेयांकन-१)</p> <p>(सूचना : विद्यार्थ्यांमध्ये उपरोक्त सामाजिक माध्यमस्थळांवर लेखन करण्यासाठी आवश्यक कौशल्ये व क्षमता विकसित होतील या दृष्टीने शिक्षकांनी सराव करून घ्यावा.)</p>	
10.	पाठ्य ग्रंथ (Text books) : N. A.
11.	<p>संदर्भ ग्रंथ (Reference Books) :</p> <p>१. मराठी व्याकरण आणि लेखन, विनायक गंधे व मीरा जोशी, निराली प्रकाशन, पुणे, २०१२. २. उपयोजित मराठी, (संपा.) केतकी मोडक व अन्य, पद्मगंधा प्रकाशन, पुणे, २०१२. ३. मराठी भाषिक कौशल्य विकास, (संपा.) पृथ्वीराज तौर, अथर्व पब्लिकेशन्स, धुळे, २०१८. ४. व्यावहारिक मराठी, ल. रा. नसिराबादकर, भाषा विकास संशोधन संस्था, कोल्हापूर, २०२३. ५. <i>Aayushi International Interdisciplinary Research Journal</i> (ISSN 2349-638x) Peer Reviewed Journal www.aiirjournal.com</p>
12.	<p>Internal Continuous Assessment : 40%</p> <p>External, Semester End Examination : 60% Individual Passing in Internal and External Examination</p>
13.	<p>अंतर्गत सातत्यपूर्ण मूल्यांकन (Internal Continuous Assessment) : २० गुण</p> <p>अंतर्गत मूल्यांकनाचे स्वरूप (Format of Internal Assessment) :</p> <p>चाचणी परीक्षा / मौखिक परीक्षा / प्रकल्पलेखन / नियतकार्य (Assignment) / सादरीकरण / प्रश्नमंजूषा यांपैकी कोणत्याही पद्धतींचा अवलंब करून अंतर्गत मूल्यमापन करता येईल. (प्रत्यक्ष उपस्थिती किंवा ऑनलाईन)</p>

14. बहिरगत परीक्षा (External Examination) : ३० गुण (वेळ : एक तास)

बहिरगत परीक्षेच्या प्रश्नपत्रिकेचे स्वरूप (Format of Question Paper) :

१. प्रत्येकी १५ गुणांचे एकूण तीन प्रश्न विचारावेत. त्यांपैकी विद्यार्थ्यांनी कोणतेही दोन प्रश्न सोडवावेत.
२. पहिले दोन प्रश्न दीर्घोत्तरी स्वरूपाचे असावेत. दोन्ही घटकांवर आधारित १५ गुणांचे अंतर्गत पर्याय असलेले दोन प्रश्न विचारावेत.
३. तिसरा प्रश्न हा घटक क्रमांक एक व दोनवर आधारित १५ गुणांचा वस्तुनिष्ठ स्वरूपाचा असावा. प्रत्येक घटकावर दहा याप्रमाणे एकूण वीस प्रश्न विचारावेत. विद्यार्थ्यांनी कोणतेही पंधरा प्रश्न सोडवावेत.

Sd /-

Sign of the BOS
Chairman
Prof. Dr. Satish
Kamat
Board of Studies in
Marathi

Sd/-

Sign of the
Offg. Associate Dean
Dr. Suchitra Naik
Faculty of
Humanities

Sd/-

Sign of the
Offg. Associate Dean
Prof. Manisha
Karne
Faculty of Humanities

Sd/-

Sign of the
Offg. Dean
Prof. Anil Singh
Faculty of
Humanities

As Per NEP 2020

University of Mumbai



Syllabus for Basket of OE Vertical 3

Syllabus for Basket of OE Vertical 3	
Faculty of Science	
Board of Studies in Statistics	
UG Second Year Programme	
Semester	IV
Title of Paper	Credits 2
I) Introduction to Basic Statistics-II	2 credit
From the Academic Year	2025-26

Open Elective-I		
Introduction to Basic Statistics-II		
Sr. No.		Particulars
1	Description the course : Including but Not limited to :	<p>Introduction:</p> <p>Introduction to Basic Statistics-II course is focuses on to equip students with basic theory of probability and standard discrete distributions. Student will learn basic elementary probability theory, discrete random variables and continuous random variables. Also students will be acquiring knowledge about correlation and predictive analysis.</p> <p>This course will be useful for science, humanity and commerce faculty. This course will be offered other than science faculty students which will be very useful to gain knowledge about basic statistics in their field. This course will be applicable to various field to analyze their basic data structure.</p> <p>This course is focuses practical as well as theoretical aspects of basic statistics along with subjects from psychology, Economics, sociology, commerce, Computers , Mathematics , IT etc.</p> <p>There is growing demand for highly skilled statisticians in the 21st century in many fields including government, banking sector, health sciences, veterinary sciences, agricultural sciences, business, and social sciences etc</p>
2	Vertical :	Open Elective
3	Type :	Theory
4	Credit:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted :	30 Hours
6	Marks Allotted:	50 Marks

7	<p>Course Objectives: : Students will be able to,</p> <ol style="list-style-type: none"> 1. Understand difference between random and non-random experiment. 2. Understand the concept of probability and its applications 3. Understand the meaning of continuous and discrete random variable. 4. Understand discrete distributions and their properties. 5. Solve the examples on probability and probability distributions. 						
8	<p>Course Outcomes: On successful completion of this course Students Should be able to,</p> <ol style="list-style-type: none"> 1. Identify the types of events 2. Calculate probabilities and conditional probabilities. 3. Apply the concept of probability in real-life situations. 4. Compute the expectation of the uni-variate discrete random variable. 5. Write probability mass functions (p.m.f.) of various discrete distribution and their real-life applications. 6. Understand the concept and difference between correlation and regression 						
9	<table border="1"> <thead> <tr> <th>Modules:-</th> <th>Lect ures</th> </tr> </thead> <tbody> <tr> <td>Module 1: Elementary Probability Theory</td> <td></td> </tr> <tr> <td> <ul style="list-style-type: none"> • Definitions: Trial, random and non-random experiment, sample point and sample space. • Definition of an event and different types of events: complementary event, equally likely events, certain event, impossible event, independent events, mutually exclusive and exhaustive events. • Different definitions of Probability: Classical (Mathematical), Empirical(Statistical) and Axiomatic definitions of Probability. • Conditional probability. • Theorems (without proof) and their applications: <ol style="list-style-type: none"> i. Addition theorem on probability for two and three events ii. Multiplication theorem on probability for two events. iii. Bayes' theorem. <p>Simple examples based on all concepts.</p> <ul style="list-style-type: none"> • Random variable: discrete and continuous random variables. Definition and properties of probability mass function . </td> <td>15</td> </tr> </tbody> </table>	Modules:-	Lect ures	Module 1: Elementary Probability Theory		<ul style="list-style-type: none"> • Definitions: Trial, random and non-random experiment, sample point and sample space. • Definition of an event and different types of events: complementary event, equally likely events, certain event, impossible event, independent events, mutually exclusive and exhaustive events. • Different definitions of Probability: Classical (Mathematical), Empirical(Statistical) and Axiomatic definitions of Probability. • Conditional probability. • Theorems (without proof) and their applications: <ol style="list-style-type: none"> i. Addition theorem on probability for two and three events ii. Multiplication theorem on probability for two events. iii. Bayes' theorem. <p>Simple examples based on all concepts.</p> <ul style="list-style-type: none"> • Random variable: discrete and continuous random variables. Definition and properties of probability mass function . 	15
Modules:-	Lect ures						
Module 1: Elementary Probability Theory							
<ul style="list-style-type: none"> • Definitions: Trial, random and non-random experiment, sample point and sample space. • Definition of an event and different types of events: complementary event, equally likely events, certain event, impossible event, independent events, mutually exclusive and exhaustive events. • Different definitions of Probability: Classical (Mathematical), Empirical(Statistical) and Axiomatic definitions of Probability. • Conditional probability. • Theorems (without proof) and their applications: <ol style="list-style-type: none"> i. Addition theorem on probability for two and three events ii. Multiplication theorem on probability for two events. iii. Bayes' theorem. <p>Simple examples based on all concepts.</p> <ul style="list-style-type: none"> • Random variable: discrete and continuous random variables. Definition and properties of probability mass function . 	15						

<p>cumulative distribution function.</p> <ul style="list-style-type: none"> • Expectation and variance of a random variable. Theorems and properties on Expectation and variance of random variables without proof. • Raw and Central moments (definition only) and their relationship. (up to order four). • Joint probability mass function of two discrete random variables. Covariance 	
<p>Module 2: Correlation and Regression Analysis.</p>	<p>15</p>
<ul style="list-style-type: none"> • Correlation analysis: Meaning, types of correlation • Scatter Diagram, product moment or Karl Pearson's correlation coefficient and its properties. • Spearman's Rank correlation (With and without ties) • Concept of linear regression, Principle of least squares, fitting of regression lines by method of least squares. • Properties of regression equations. • Relation between regression coefficients and correlation coefficient. • Concept and use of coefficient of determination (R^2). • Introduction of discrete distributions- Discrete Uniform distribution, Binomial distribution, Poisson distribution and their characteristics (without proof) formulae) and their interpretation 	
<p>Reference Books</p> <ul style="list-style-type: none"> • David S. : Elementary Probability, Cambridge University Press. • Hoel P.G. : Introduction to Mathematical Statistics, Asia Publishing House. • Hogg R.V. and Tannis E.P. : Probability and Statistical Inference. McMillan Publishing Co. Co. Inc. • Pitan Jim : Probability, Narosa Publishing House. • Goon A.M., Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II :The World Press Private Limited, Calcutta. • Mukhopadhyay P. An Introduction to the Theory of 	

Probability, World Scientific Publishing Company,
2011.

- Grewal P. S, Methods of Statistical Analysis, Sterling Publishers, 1990
- S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons

Format of Question Paper:

Internal Continuous Assessment: (20 marks)

Assignment/viva Quizzes, Class Tests, presentation, project, assignment etc	Class Test	Total
05	15	20

Semester End Examination: (30 marks)

Semester End Examination will be of 30 marks of 01 hour duration covering entire syllabus of the semester. All questions are Compulsory.

Theory Question Paper Pattern:

Q 1	Attempt any one question out of two questions (Module I and II)	Max. marks: 10
Q 2	Attempt any two questions out of three questions (Module I)	Max. marks: 10
Q 3	Attempt any two questions out of three questions (Module II)	Max. marks: 10

Sd/-

**Sign of the BOS Chairman
Dr. Santosh Gite
Board of Studies in
Statistics**

Sd/-

**Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology**

Sd/-

**Sign of the
Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology**

As Per NEP 2020

University of Mumbai



Syllabus for Basket of OE Vertical 3	
Faculty of Science	
Board of Studies in Statistics	
UG Second Year Programme	
Semester	III
Title of Paper	Credits 2
I) Introduction to Basic Statistics-I	2 credit
From the Academic Year	2025-26

Semester-III

Open Electives-I

Name of the course: Introduction to Basic Statistics-I

Sr. No .	Heading	Particulars
------------------------	----------------	--------------------

1	<p>Description the course :</p> <p>Including but Not limited to :</p>	<p>Introduction:</p> <p>Introduction to Basic statistics-I course is focuses on basic statistics such as collection of data and how to measure variables on different scale. Student will equip with to identify the scale of measurement and analyze elementary statistical analysis through graphical presentation. Also student will learn to identify nature of the data through statistical methods. This course mainly emphasizes the method of collecting data, summarizing and presenting data, and drawing inferences from the data.</p> <p>This course will be useful for science, humanity and commerce faculty. This course will be offered other than science faculty students which will be very useful to gain knowledge about basic statistics in their field. This course will be applicable to various field to analyze their basic data structure.</p> <p>This course is focuses practical as well as theoretical aspects of basic statistics along with subjects from psychology, Economics, sociology, commerce, Computers , Mathematics , IT etc.</p> <p>There is growing demand for highly skilled statisticians in the 21st century in many fields including government, banking sector, health sciences, veterinary sciences, agricultural sciences, business, and social sciences etc</p>
2	Vertical :	Open Elective
3	Type :	Theory
4	Credit:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted :	30 Hours
6	Marks Allotted:	50 Marks

7	<p>Course Objectives:</p> <p>Students will be able to,</p> <ol style="list-style-type: none"> 1. Understand the meaning of Statistics and scope of Statistics. 2. Understand techniques of data collection and its presentation. 3. Compute various measures of central tendencies to know the entire data by a centralized single value. 4. Understand spread and variation of data using various techniques of measure of dispersion. 5. Understand the behavior of data using skewness and kurtosis and study the nature of probability curve.
8	<p>Course Outcomes:</p> <p>: on successful completion of the course Students Should be able to,</p> <ol style="list-style-type: none"> 1. Calculate arithmetic mean and its applicability 2. Differentiate between qualitative and quantitative data through scale of measurement. 3. Construct graphs and diagrams from data and interpret the result. 4. Compute Skewness and Kurtosis of the data to describe nature of data distribution.

9	Modules:-	Lect ures
	Module 1: Classification, Tabulation and Presentation of data.	
	<ul style="list-style-type: none"> • Definition and scope of Statistics • Types of data: Qualitative and Quantitative data, Geographical data, Time series data and Crosssection data • Measurement of scales: Nominal, Ordinal, Interval and Ratio. • Primary data and Secondary data • Classification and Tabulation (One way and Two way). • Frequency distributions: Uni-variate and Bi-variate • Diagrammatic representation of data Simple bar diagram, Multiple bar diagram, Subdivided bar diagram and Pie-chart • Graphical representation of data Histogram, Frequency Polygon, Frequency Curve, Cumulative frequency curve (Less than and more than type). 	15

<p>Module 2: Measures of central tendency and Measures of Dispersion</p> <p>Measures of central tendency</p> <ul style="list-style-type: none"> • Concept and Requirements of good measures of central tendency. • Arithmetic mean (Simple, weighted mean, combined mean)for grouped and un-grouped data, Merits, demerits and its applicability • Positional averages: Median, Mode, and Quartiles (for grouped and un-grouped data) Merits, demerits and its applicability • Graphical representation of mode, median and Quartiles. • Empirical relation between mean, median and mode (Only statement) <p>Measures of Dispersion</p> <ul style="list-style-type: none"> • Concept and requirements of good measures of dispersion. • Absolute and Relative measures of dispersion: Range, Quartile Deviation , Mean absolute deviation, Variance and Standard deviation (for grouped and un-grouped data) Merits, demerits and its applicability • Raw moments and central moments , relation between them upto order four (only statement). • Measures of Skewness and Kurtosis: Karl Pearson's measure of Skewness , <ul style="list-style-type: none"> • Measures of skewness and kurtosis based on moments.(Only formulae) and their interpretation 	<p>15</p>
<p>Reference Books</p> <ul style="list-style-type: none"> • David S. : Elementary Probability, Cambridge University Press. • Hoel P.G. : Introduction to Mathematical Statistics, Asia Publishing House. • Hogg R.V. and Tannis E.P. : Probability and Statistical Inference.McMillan Publishing Co. Inc. • Pitan Jim : Probability, Narosa Publishing House. • Goon A.M., Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II :The World Press Private Limited, Calcutta. • Mukhopadhyay P. An Introduction to the Theory of 	

Probability, World Scientific Publishing Company,
2011.

- Grewal P. S, Methods of Statistical Analysis,
Sterling Publishers, 1990
- S.C. Gupta and V.K. Kapoor, Fundamentals of
Mathematical Statistics, Sultan Chand and Sons

Format of Question Paper:**Internal Continuous Assessment: (20 marks)**

Assignment/viva Quizzes, Class Tests, presentation, project, assignment etc	Class Test	Total
05	15	20

Semester End Examination: (30 marks)

Semester End Examination will be of 30 marks of 01 hour duration covering entire syllabus of the semester. All questions are Compulsory.

Theory Question Paper Pattern:

Q 1	Attempt any one question out of two questions (Module I and II)	Max. marks: 10
Q 2	Attempt any two questions out of three questions (Module I)	Max. marks: 10
Q 3	Attempt any two questions out of three questions (Module II)	Max. marks: 10

Sd/-

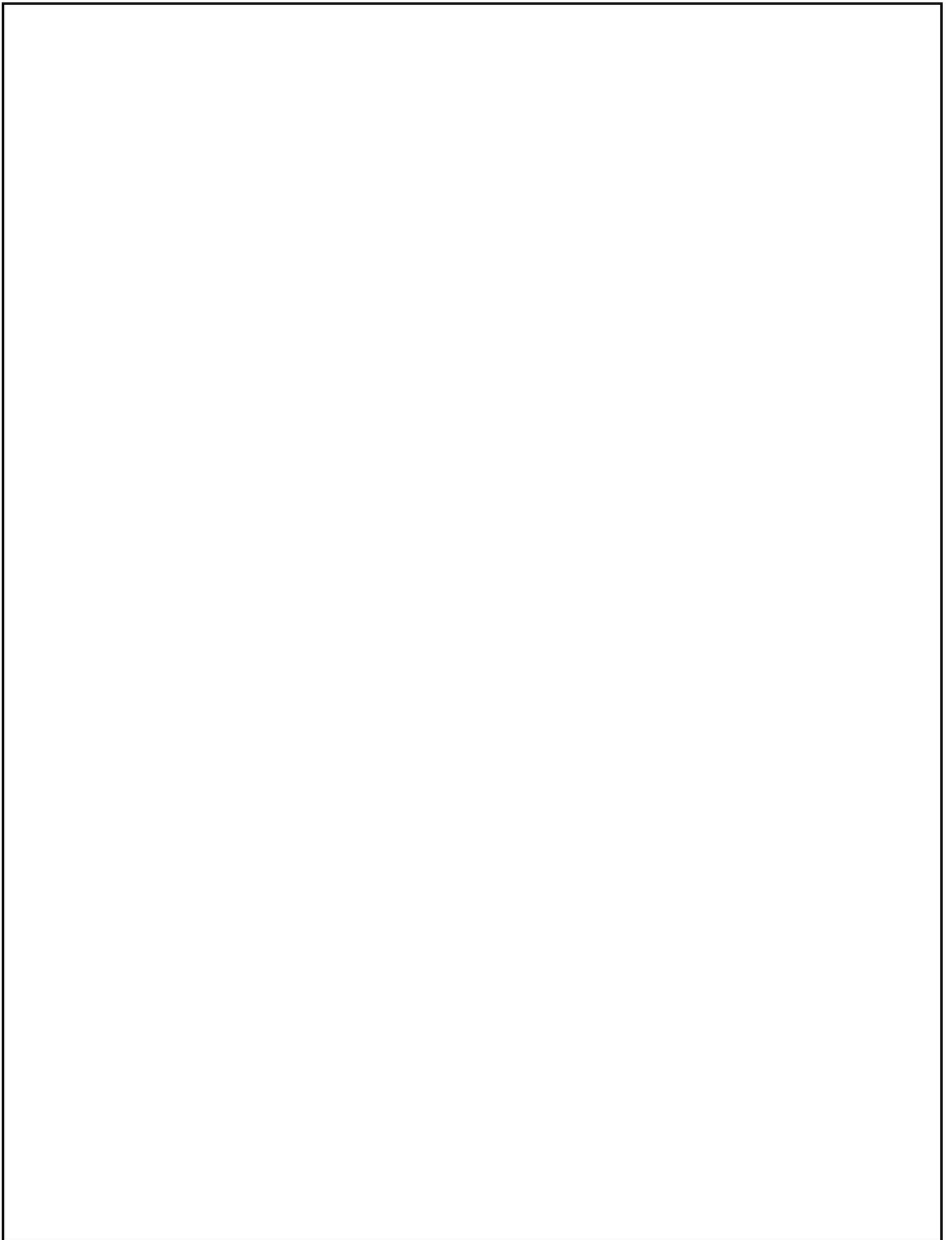
**Sign of the BOS Chairman
Dr. Santosh Gite
Board of Studies in
Statistics**

Sd/-

**Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology**

Sd/-

**Sign of the
Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology**



AC – 28/03/2025

Item No. – 6.3 (N) (1ab) Sem. III & IV

As Per NEP 2020**University of Mumbai**

Syllabus for Minor Vertical 2 (Scheme – I and III)

Faculty of Science			
Board of Studies in Mathematics			
Second Year Programme in Minor (Mathematics)			
Semester		III & IV	
Title of Paper		Sem. III	Total Credits 4
Choose any one of the following:			
1	a) Calculus- III	III	2
	b) PM-3A Calculus III	III	2
OR			
2	a) Vector Spaces	III	2
	b) PM-3B Vector Spaces	III	2
OR			
3	a) Basic Mathematics in Real Life II	III	2
	b) PM-3C Basic Mathematics in Real Life II	III	2
Title of Paper		Sem. IV	Total Credits 4
Choose any one of the following:			
1	a) Calculus IV	IV	2
	b) PM-4A Calculus IV	IV	2
OR			
2	a) Linear Algebra	IV	2
	b) PM-4B Linear Algebra	IV	2
OR			
3	a) Basic Mathematics in Real Life III	IV	2
	b) PM-4C Basic Mathematics in Real Life III	IV	2
From the Academic Year			2025-26

Sem. - III

Syllabus
B.Sc. (Mathematics)
(Sem.- III)

Name of the Course: Calculus III (Minor I)

Sr. No	Heading	Particulars
1	Description the course: Including but not limited to:	Calculus finds extensive applications in diverse fields such as Physics, Chemistry, Biotechnology, Engineering, among others. This course aims to instill a deep understanding of Mathematical Analysis as it forms a rigorous foundation for Calculus. Learners will explore properties of Real Numbers, delve into concepts like Series and Riemann integration of functions. To provide practical context, the course incorporates applications of integration, offering students a broader perspective on the diverse uses of acquired knowledge.
2	Vertical:	Minor
3	Type:	Theory
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives (CO):	<p>This course provides an introduction to advanced concepts in analysis with a strong emphasis on rigor. It aims to prepare students for more advanced courses in abstract analysis. The focus of the course is on developing formal proof skills, which not only deepens comprehension of the subject but also extends to broader applications in mathematics.</p> <p>CO1: Provide a solid understanding of fundamental principles and methods, equipping students with the skills to apply mathematical ideas and tools through modeling, solving, and interpretation.</p> <p>CO2: Illustrate the expansive nature of the subject by fostering the acquisition of essential mathematical tools for continued studies across various scientific fields.</p> <p>CO3: Foster students' comprehensive development by placing emphasis on problem-solving skills, nurturing creative talents, and enhancing communication abilities, all of which are vital for a range of employment opportunities.</p> <p>CO4: Ensure exposure to both global and local issues within the realm of Mathematical Sciences, allowing learners to explore diverse aspects of the discipline.</p>
8	Course Outcomes (OC):	

	<p>After completion of the course, students will be able to</p> <p>OC1 Understand and remember the concepts such as convergence/ divergence of series, Riemann Integration, beta-gamma functions and related results.</p> <p>OC2: Apply the formulae and concepts to solve the examples related to series, Riemann Integral, area between two curves etc.</p> <p>OC3: Analyse the convergence and divergence of series and integrability of given function.</p> <p>OC4: Justify/ check the integrability of function, absolute and conditional convergence of series.</p> <p>OC5: Construct counter examples related to absolutely convergent/ divergent series, non-integrable functions etc.</p>
9	<p>Modules: -</p> <p>Module 1: Infinite Series (15 Lectures)</p> <p>1. Infinite series in \mathbb{R}. Definition of convergence and divergence. Basic examples including geometric series. Elementary results such as if $\sum_{n=1}^{\infty} a_n$ is convergent then $a_n \rightarrow 0$ but converse is not true. Cauchy Criterion, Algebra of convergent series and related examples.</p> <p>2. Tests for convergence: Comparison Test, Limit Comparison Test (without proof), Ratio Test (without proof), Root Test (without proof), Examples, p- series test.</p> <p>3. Alternating series. Leibnitz's Test. Examples. Absolute convergence, absolute convergence implies convergence but not conversely. Conditional Convergence.</p> <p>Module 2: Riemann Integration and Applications (15 Lectures)</p> <p>1. Idea of approximating the area under a curve by inscribed and circumscribed rectangles. Partitions of an interval. Refinement of a partition. Upper and Lower Riemann sums for a bounded real valued function defined on a closed and bounded interval in \mathbb{R}. Definition of Riemann integral.</p> <p>2. Criterion for Riemann integrability, Characterization of the Riemann integral as the limit of a sum. (without proof). Examples.</p> <p>3. Algebra of Riemann integrable functions and basic results such as if (i) $f:[a,b] \rightarrow \mathbb{R}$ is integrable, then $\int_a^b f(x)dx = \int_a^c f(x)dx + \int_c^b f(x)dx$ (without proof) (ii) f is integrable and $\left \int_a^b f(x)dx \right \leq \int_a^b f (x)dx$ (iii) If $f(x) \geq 0$ for all $x \in [a,b]$ then $\int_a^b f(x)dx \geq 0$</p> <p>4. Riemann integrability of a continuous function. Integrability of a bounded function whose set of discontinuities has only finitely many points (without proof). Riemann integrability of monotone functions.</p> <p>5. First and Second Fundamental Theorems of Calculus.</p> <p>6. Area between the two curves. Lengths of plane curves. Surface area of surfaces of revolution.</p> <p>7. Gamma and Beta functions and their properties. Relationship between them (without proof).</p>
10	<p>Recommended Reference Books:</p> <p>1. Sudhir Ghorpade, Balmohan Limaye; A Course in Calculus and Real Analysis (second edition); Springer.</p> <p>2. R.R. Goldberg; Methods of Real Analysis; Oxford and IBH Pub. Co., New Delhi, 1970.</p> <p>3. Calculus and Analytic Geometry (Ninth Edition); Thomas and Finney; Addison-Wesley, Reading Mass., 1998.</p> <p>4. T. Apostol; Calculus Vol. 2; John Wiley.</p>
11	<p>Additional Reference Books</p> <p>1. Ajit Kumar, S.Kumaresan; A Basic Course in Real Analysis; CRC Press, 2014</p>

2. D. Somasundaram and B. Choudhary; A First Course in Mathematical Analysis, Narosa, New Delhi, 1996.
 3. K. Stewart; Calculus, Booke/Cole Publishing Co, 1994.
 4. J. E. Marsden, A.J. Tromba and A. Weinstein; Basic Multivariable Calculus; Springer.
 5. R.G. Bartle and D. R. Sherbert; Introduction to Real Analysis Second Ed.; John Wiley, New Yorm, 1992.
 6. M. H. Protter; Basic Elements of Real Analysis; Springer-Verlag, New York, 1998.

Scheme of the Examination

The performance of the learners shall be evaluated in two parts.

- Internal Continuous Assessment of 20 marks.
- Semester End Examination of 30 marks.
- A separate head of passing is required for internal and semester-end examinations.

12 Internal Continuous Assessment: 40% Semester End Examination: 60%

13 Continuous Evaluation through: Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc. (at least 3)

Sr. No.	Particulars	Marks
1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10
2	Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.	05
3	Seminar/ group presentation on any one topic related to the syllabus.	05

Paper pattern of the Test (Offline Mode with One hour duration):

Q1: Definitions/Fill in the blanks/ True or False with Justification. (04 Marks: 4 x 1).

Q2: Attempt any 2 from 3 descriptive questions. (06 marks: 2 x 3)

14 Format of Question Paper:
 The semester-end examination will be of 30 marks marks of one hour duration covering the entiresyllabus of the semester.

Note: Attempt any TWO questions out of THREE.

Q.No.1	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks
Q.No.2	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks
Q.No.3	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks

Name of the Course: PM-3A Calculus III (Minor I)

Sr. No.	Heading	Particulars												
1	Description the course: Including but not limited to:	Problem-solving is a fundamental aspect of any Mathematics course. While advanced courses often emphasize the theoretical nature of the subject, engaging in problem-solving reinforces concepts and enhances learners' ability to analyze existing problems and devise solutions. This activity not only motivates learners but also empowers them to formulate new results, propose conjectures, and develop innovative theories.												
2	Vertical:	Minor												
3	Type:	Practical												
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)												
5	Hours Allotted:	30 Hours												
6	Marks Allotted:	50 Marks												
7	Course Objectives (CO):	<p>This course emphasizes on problem solving and motivates to think on the basic concepts of Algebra and Analysis with rigour and prepares students to study further courses.</p> <p>CO1. To give sufficient knowledge of fundamental principles, methods and a clear perception of numerous powers of mathematical ideas and tools and the skills to use them by modelling, solving and interpreting.</p> <p>CO2. To reflect the broad nature of the subject and develop mathematical tools for continuing further study in various fields of sciences.</p> <p>CO3. To enhance students' overall development, problem solving skills, creative talent, and power of communication. These are necessary for various kinds of employment.</p> <p>CO4. To give adequate exposure to global and local concerns that would help learners explore many aspects of Mathematical Sciences.</p>												
8	Course Outcomes (OC):	<p>After completion of the course, students will be able to</p> <p>OC1: Apply the formulae and concepts to solve the examples related to series, Riemann Integral, area between two curves etc.</p> <p>OC2: Analyze the convergence and divergence of series and integrability of given function.</p> <p>OC3: Justify/ check the integrability of function, absolute and conditional convergence of series.</p> <p>OC4: Construct counter examples related to absolutely convergent/ divergent series, non-integrable functions etc.</p>												
9	Modules: - Practical for Calculus III (30 Hours)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 5%; text-align: center;">1.</td> <td>Convergent and divergent series and algebra of convergent series.</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Comparison and limit comparison test.</td> </tr> <tr> <td style="text-align: center;">3.</td> <td>Ratio test and root test.</td> </tr> <tr> <td style="text-align: center;">4.</td> <td>Alternating Series and p-series test.</td> </tr> <tr> <td style="text-align: center;">5.</td> <td>Absolute and conditional convergence.</td> </tr> <tr> <td style="text-align: center;">6.</td> <td>Upper sum and lower sum.</td> </tr> </tbody> </table>	1.	Convergent and divergent series and algebra of convergent series.	2.	Comparison and limit comparison test.	3.	Ratio test and root test.	4.	Alternating Series and p-series test.	5.	Absolute and conditional convergence.	6.	Upper sum and lower sum.
1.	Convergent and divergent series and algebra of convergent series.													
2.	Comparison and limit comparison test.													
3.	Ratio test and root test.													
4.	Alternating Series and p-series test.													
5.	Absolute and conditional convergence.													
6.	Upper sum and lower sum.													

7.	Riemann integral and its properties.
8.	Fundamental Theorems of Calculus.
9.	Area between two curves, lengths of plane curves and surface area of surfaces of revolution.
10.	Beta and Gamma functions.

10 Recommended Reference Books:

1. Sudhir Ghorpade, Balmohan Limaye; A Course in Calculus and Real Analysis (second edition); Springer.
2. R.R. Goldberg; Methods of Real Analysis; Oxford and IBH Pub. Co., New Delhi, 1970.
3. Calculus and Analytic Geometry (Ninth Edition); Thomas and Finney; Addison-Wesley, Reading Mass., 1998.
4. T. Apostol; Calculus Vol. 2; John Wiley.

11 Additional Reference Books

1. Ajit Kumar, S.Kumaresan; A Basic Course in Real Analysis; CRC Press, 2014
2. D. Somasundaram and B. Choudhary; A First Course in Mathematical Analysis, Narosa, New Delhi, 1996.
3. K. Stewart; Calculus, Booke/Cole Publishing Co, 1994.
4. J. E. Marsden, A.J. Tromba and A. Weinstein; Basic Multivariable Calculus; Springer.
5. R.G. Bartle and D. R. Sherbert; Introduction to Real Analysis Second Ed. ; John Wiley, New York, 1992.
6. M. H. Protter; Basic Elements of Real Analysis; Springer-Verlag, New York, 1998.

Scheme of the Examination

12 Internal Continuous Assessment: 40%

Semester End Examination: 60%

13 Continuous Evaluation through:
Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc.
(at least 3)

Sr. No.	Particulars	Marks
1	Objective question test	10
2	Overall performance	05
3	Viva	05

Paper pattern of the Test (Offline Mode):

Q1: (Attempt any 5 from 8) Multiple choice questions. (10 marks: 5×2)

Duration: 1Hrs

While setting question paper

four MCQ on module 1 and
four MCQ on module 2 both.

14 **Format of Question Paper:**

Scheme of examination:

At the end of the Semester III, Practical examinations of three hours duration and 30 marks shall be conducted based on both the modules.

Paper pattern: The question paper shall have two questions.

Q. No. 1	Five out of Eight multiple choice questions (four from module 1 and four from module 2) (OC1 to OC3)	Marks (3 × 5 = 15 Marks)
Q. No.2	Attempt any Two out of Four (two from module 1 and two from module 2). (OC3 and OC4)	(5 × 2 = 10 Marks)

Marks for Journals:

For both Module 1 and Module 2

1. Journal: 5 marks (2.5 marks for each module 1 & module 2)

The students are required to perform 75% of the Practical for the journal to be duly certified. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

Name of the Course: Vector Spaces (Minor II)

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course covers fundamental concepts in linear algebra, concepts in mathematics with applications across various fields including physics, engineering, computer science, and economics. Learners will learn about subspaces, spanning sets, linear independence, and basis vectors, crucial concepts that form the building blocks of vector space theory.
2	Vertical:	Minor
3	Type:	Theory
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives (CO):	<p>This course gives an introduction to vector spaces and system of linear equations and its solutions. Also, it deals with the basics of vector spaces, covering different examples and dealing with finite-dimensional vector spaces.</p> <p>CO1. To give sufficient knowledge of fundamental principles, methods, and a clear perception of numerous powers of mathematical ideas and tools and the skills to use them by modelling, solving, and interpreting.</p> <p>CO2. To reflect the broad nature of the subject and develop mathematical tools for continuing further study in various fields of sciences.</p> <p>CO3. To enhance students' overall development, problem-solving skills, creative talent, and power of communication are necessary for various kinds of employment.</p> <p>CO4. To give adequate exposure to global and local concerns that would help learners explore many aspects of Mathematical Sciences.</p>
8	Course Outcomes (OC):	<p>After completion of the course, students will be able to</p> <p>OC1: Understand, remember the concepts and properties vector spaces.</p> <p>OC2: Apply the formulas and the concepts to solve examples subspaces, sum and intersection of subspaces.</p> <p>OC3: To analyse the properties of vector spaces, row space and column space of a matrix</p> <p>OC4: Justify or check a set to be a vector space.</p> <p>OC5: Construct counterexamples related to vector spaces and subspaces.</p>
9	Modules: - Module 1: Vector spaces and subspaces (15 Hours)	<p>(a) Definition of a vector space over R. Examples such as:</p> <p>(i) Euclidean space R^n.</p> <p>(ii) The space of $m \times n$ matrices over R.</p> <p>(iii) The space of polynomials with real coefficients.</p>

	<p>(b) Subspaces: definition, criterion for a nonempty subset to be a subspace of a vector space. Examples, including:</p> <p>(i) Lines in R^2, Lines and planes in R^3.</p> <p>(ii) The solutions of a homogeneous system of linear equations.</p> <p>(iii) The spaces of symmetric, skew-symmetric, upper triangular, lower triangular, and diagonal matrices.</p> <p>(iv) The space of polynomials with real coefficients of degree $\leq n$.</p> <p>(c) The sum, union and intersection of subspaces, direct sum of vector spaces. Cosets, Introduction to quotient space.</p>										
	<p>Module 2: System of linear equations, Linear combination, Basis of vector spaces (15 Hours)</p>										
	<p>(a) (i) Introduction to linear systems, Matrix representation of the system of homogeneous and non-homogeneous linear equations, row echelon form, Gauss Elimination.</p> <p>(ii) Linear combination of vectors.</p> <p>(iii) Linear span of a subset of a vector space.</p> <p>(iv) Linear dependence and independence of a set.</p> <p>(b) Basis of a vector space, Dimension of a vector space. The discussion of these concepts is for finitely generated vector spaces only.</p> <p>(c) (i) Row space, column space of a $m \times n$ matrix over R and row rank, column rank of a matrix.</p> <p>(ii) Equivalence of row rank and column rank, computing the rank of a matrix by row reduction.</p>										
10	<p>Text Books</p> <ol style="list-style-type: none"> 1. Kenneth Hoffman and Ray Kunze, Linear Algebra, 2nd edition, Pearson. 2. Howard Anton, Chris Rorres, Elementary Linear Algebra, Wiley Student Edition). 3. Serge Lang, Introduction to Linear Algebra, Springer. 4. S Kumaresan, Linear Algebra: A Geometric Approach, PHI Learning. 										
11	<p>Reference Books</p> <ol style="list-style-type: none"> 1. Sheldon Axler, Linear Algebra done right, Springer. 2. Gareth Williams, Linear Algebra with Applications, Jones and Bartlett Publishers. 3. David W. Lewis, Matrix theory. 										
	<p><u>Scheme of the Examination</u></p>										
	<p>The performance of the learners shall be evaluated in two parts.</p> <ul style="list-style-type: none"> ● Internal Continuous Assessment of 20 marks. ● Semester examination of 30 marks. ● A separate head of passing is required for internal and semester-end examinations. 										
12	<p>Internal Continuous Assessment: 40%</p>	<p>Semester End Examination: 60%</p>									
13	<p>Continuous Evaluation through: Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments, etc. (at least 3)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Sr. No.</th> <th style="width: 70%;">Particulars</th> <th style="width: 20%;">Marks</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td>A class test of 10 marks is to be conducted during each semester in an Offline mode.</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: center;">2</td> <td>Project on any one topic</td> <td style="text-align: center;">05</td> </tr> </tbody> </table>		Sr. No.	Particulars	Marks	1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10	2	Project on any one topic	05
Sr. No.	Particulars	Marks									
1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10									
2	Project on any one topic	05									

		related to the syllabus or a quiz (offline/online) on one of the modules.		
	3	Seminar/group presentation on any one topic related to the syllabus.	05	
<p>Paper pattern of the Test (Offline Mode with One-Hour Duration): Q1: Definitions/Fill in the blanks/ True or False with Justification. (04 Marks: 4 x 1). Q2: Attempt any 2 from 3 descriptive questions. (06 marks: 2 x 3)</p>				
14	<p>Format of Question Paper: The semester-end examination will be of 30 marks of one-hour duration, covering the entire syllabus of the semester.</p>			
Note: Attempt any TWO questions out of THREE.				
	Q.No.1	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks
	Q.No.2	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks
	Q.No.3	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks

Name of the Course: PM-3B Vector Spaces (Minor II)

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	This course covers fundamental concepts in linear algebra, concepts in mathematics with applications across various fields including physics, engineering, computer science, and economics. Learners will learn about subspaces, spanning sets, linear independence, and basis vectors, crucial concepts that form the building blocks of vector space theory.
2	Vertical:	Minor
3	Type:	Practical
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives (CO):	<p>This course gives an introduction to vector spaces and system of linear equations and its solutions. Also, it deals with the basics of vector spaces, covering different examples and dealing with finite-dimensional vector spaces.</p> <p>CO1. To give sufficient knowledge of fundamental principles, methods, and a clear perception of numerous powers of mathematical ideas and tools and the skills to use them by modelling, solving, and interpreting.</p> <p>CO2. To reflect the broad nature of the subject and develop mathematical tools for continuing further study in various fields of sciences.</p> <p>CO3. To enhance students' overall development, problem-solving skills, creative talent, and the power of communication are necessary for various kinds of employment.</p> <p>CO4. To give adequate exposure to global and local concerns that would help learners explore many aspects of Mathematical Sciences.</p>
8	Course Outcomes (OC):	<p>After completion of the course, students will be able to</p> <p>OC1: Apply the formulas and the concepts to solve examples related to vector spaces.</p> <p>OC2: To analyse and test the property of vector subspaces on sets.</p> <p>OC3: To check linear independence, and dependence of vectors.</p> <p>OC4: Construct basis and counter-examples related to vector spaces and subspaces.</p>
9	Modules: -	
	Module 1: Vector spaces and subspaces (30 Hours)	
	1.	Vector spaces-I (Examples)
	2.	Vector spaces-II (To check which of the given sets are vector spaces)
	3.	Subspaces of Euclidean space
	4.	Subspaces of Polynomial space
	5.	Subspaces of Matrix space
	6.	Sum of subspaces
	7.	Intersection of subspaces
	8.	Union of subspaces

	<table border="1"> <tr> <td>9.</td> <td>Direct sum of subspaces</td> </tr> <tr> <td>10.</td> <td>Cosets, Quotient spaces</td> </tr> </table>	9.	Direct sum of subspaces	10.	Cosets, Quotient spaces																	
9.	Direct sum of subspaces																					
10.	Cosets, Quotient spaces																					
Module 2: System of linear equations, Linear combination, Basis of vector spaces (30 Hours)																						
	<table border="1"> <tr> <td>1.</td> <td>System of linear equations</td> </tr> <tr> <td>2.</td> <td>Linear combination of vectors</td> </tr> <tr> <td>3.</td> <td>Linear span of vectors in vector spaces</td> </tr> <tr> <td>4.</td> <td>Linear dependence.</td> </tr> <tr> <td>5.</td> <td>Linear independence.</td> </tr> <tr> <td>6.</td> <td>Standard Basis of vector spaces.</td> </tr> <tr> <td>7.</td> <td>Basis of vector spaces</td> </tr> <tr> <td>8.</td> <td>Dimension of vector spaces.</td> </tr> <tr> <td>9.</td> <td>Row rank and column rank of the matrix.</td> </tr> <tr> <td>10.</td> <td>Computing rank of matrix by row reduction.</td> </tr> </table>	1.	System of linear equations	2.	Linear combination of vectors	3.	Linear span of vectors in vector spaces	4.	Linear dependence.	5.	Linear independence.	6.	Standard Basis of vector spaces.	7.	Basis of vector spaces	8.	Dimension of vector spaces.	9.	Row rank and column rank of the matrix.	10.	Computing rank of matrix by row reduction.	
1.	System of linear equations																					
2.	Linear combination of vectors																					
3.	Linear span of vectors in vector spaces																					
4.	Linear dependence.																					
5.	Linear independence.																					
6.	Standard Basis of vector spaces.																					
7.	Basis of vector spaces																					
8.	Dimension of vector spaces.																					
9.	Row rank and column rank of the matrix.																					
10.	Computing rank of matrix by row reduction.																					
10	Text Books <ol style="list-style-type: none"> 1. Kenneth Hoffman and Ray Kunze, Linear Algebra, 2nd edition, Pearson. 2. Howard Anton, Chris Rorres, Elementary Linear Algebra, Wiley Student Edition. 3. Serge Lang, Introduction to Linear Algebra, Springer. 4. S Kumaresan, Linear Algebra: A Geometric Approach, PHI Learning. 																					
11	Reference Books <ol style="list-style-type: none"> 1. Sheldon Axler, Linear Algebra done right, Springer. 2. Gareth Williams, Linear Algebra with Applications, Jones and Bartlett Publishers. 3. David W. Lewis, Matrix theory. 																					
<u>Scheme of the Examination</u>																						
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%																				
13	Continuous Evaluation through: Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments, etc. (at least 3) <table border="1" style="margin-top: 10px;"> <thead> <tr> <th>Sr. No.</th> <th>Particulars</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Objective question test</td> <td>10</td> </tr> <tr> <td>2</td> <td>Overall performance</td> <td>05</td> </tr> <tr> <td>3</td> <td>Viva</td> <td>05</td> </tr> </tbody> </table> <p style="margin-top: 10px;">Paper pattern of the Test (Offline Mode): Q1: (Attempt any 5 from 8) Multiple-choice questions. (10 marks: 5×2)</p>	Sr. No.	Particulars	Marks	1	Objective question test	10	2	Overall performance	05	3	Viva	05									
Sr. No.	Particulars	Marks																				
1	Objective question test	10																				
2	Overall performance	05																				
3	Viva	05																				

Duration: 1Hrs
While setting the question paper, four MCQs on module 1 and four MCQs on module 2 both.

14 **Format of Question Paper:**
Scheme of examination:

At the end of Semester III, Practical examinations of three hours duration and 30 marks shall be conducted based on both modules.

Paper pattern: The question paper shall have two questions.

Q. No. 1	Five out of Eight multiple-choice questions (four from module 1 and four from module 2) (OC1 to OC3)	Marks (3 × 5 = 15 Marks)
Q. No.2	Attempt any Two out of Four (two from module 1 and two from module 2). (OC3 and OC4)	(5 × 2 = 10 Marks)

Marks for Journals:

For both Module 1 and Module 2,

Journal: 5 marks (2.5 marks for each module 1 & module 2)

The students are required to perform 75% of the practical for the journal to be duly certified. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

**Name of the Course: Basic Mathematics in Real Life-II
(Minor III)**

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	To demonstrate the importance of mathematics in real life by considering interdisciplinary applications of basic concepts in real life.
2	Vertical:	Minor
3	Type:	Theory
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives (CO):	This course is a balanced mixture of the basic concepts of mathematics, which highlights the crucial role of mathematics in other sciences. In this course, students from various science streams will be able to see mathematics being applied in their area of interest and learn CO1: To develop methods for polynomial interpolation. CO2: To identify row echelon form and row reduced echelon form for matrices. CO3: To associate mathematical notation for solving real-life problems like those related to forest management. CO4: To recognize the role of geometry (in particular Platonic solids) in science streams.
8	Course Outcomes (OC):	After completion of the course, students will be able to OC1: Understand and remember the polynomials, polynomial graphs, Fibonacci sequence, platonic solids and Matrices OC2: Apply the formulas and concepts to solve problems and examples related to quadratic equations recurrence relations, matrices and platonic solids OC3: Examine and investigate the growth matrices, echelon form of matrices, and Kirchhoff's Law using matrices. OC4: Justify and check the inverse of matrices and applications of the golden ratio. OC5: Design and construct circuits using Kirchhoff's Laws
9	Modules: - Module 1: Polynomials and interpolation (15 Hours)	1. Solving a quadratic equation: conditions for repeated roots, discriminant 2. Plotting a polynomial graph for degree two when roots are real. Example: (monic; not monic) 3. Relation between roots and coefficients of a polynomial (degree two), plotting polynomial of degree three (some specific examples). 4. Fibonacci numbers: motivation and recurrence relation. Simple examples of recurrence. 5. Sunflower and Golden ratio. 6. Polynomial interpolation: Statement of the problem and motivation; calculation in degree two. 7. Matrices (not necessarily square) and multiplication formula for two matrices under suitable conditions; examples. 8. Forest management—I: introduction to growth matrix.

	<p>9. Forest management II: Statements and notations for optimal sustainable yield. 10. Forest management III : Computation of solution 11. Row echelon and Row reduced echelon form: Definition and computation in 2 by 2 matrices. 12. Row echelon and row reduced echelon form: computation in 3 by 3 matrices. 13. Definition of the inverse of a matrix, Elementary matrices and calculation of inverse in particular examples (size 2,3) 14. Polynomial interpolation in degree three: simple examples. 15. Vander monde matrix and computation of its determinant (by stating properties of determinant).</p>	
	<p>Module 2: Applications of linear systems and introduction to platonic solids (15 Hours)</p>	
	<p>1. Kirchoff's laws recall and setting up notation. 2. Kirchoff's laws and determination of current in a circuit (setting up a linear system of equations). 3. Kirchoff's laws and explicit examples. 4. Cofactor, Adjoint of a Matrix: Definitions. 5. Computation of cofactor and adjoint of two-by-two matrices. 6. Computation of cofactor and adjoint of three-by-three matrices. 7. Formula stating the relation between a matrix, adjoint, and inverse. 8. Computation of adjoint and inverse for higher-size matrices. 9. Relation between invertibility and uniqueness of solution to a linear system of equations (only statement) and examples. 10. Counting edges, faces, and vertices in planar and non-coplanar figures. Statement of Euler's formula. 11. Platonic solids: introducing five platonic solids with names, verifying Euler's formula. 12. Proof of the existence of only five platonic solids. 13. Duals of platonic solids, the existence of molecules in the shape of platonic solids, and the impossibility of certain crystal shapes. 14. George Mendel and his experiment and introduction to The hardy-Weinberg principle in population genetics 15. Punnett square and associated binomial expansions.</p>	
10	<p>Text Books:</p> <ol style="list-style-type: none"> Hermann Weyl, Symmetry, Princeton University Press, 1952. Elementary Linear Algebra Application Version, H. Anton, C. Rorres, Wiley, Tenth Edition. 	
11	<p>Reference Books:</p> <ol style="list-style-type: none"> Contemporary Abstract Algebra, J. A. Gallian, Narosa publishing house. Tipler, Paul (2004). Physics for Scientists and Engineers: Electricity, Magnetism, Light, and Elementary Modern Physics (5th ed.). W. H. Freeman. 	
	<p><u>Scheme of the Examination</u></p>	
	<p>The performance of the learners shall be evaluated in two parts.</p> <ul style="list-style-type: none"> ● Internal Continuous Assessment of 20 marks. ● Semester-end examination of 30 marks. ● A separate head of passing is required for internal and semester-end examinations. 	
12	<p>Internal Continuous Assessment: 40%</p>	<p>Semester End Examination: 60%</p>

13 **Continuous Evaluation through:** Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments, etc.
(at least 3)

Sr. No.	Particulars	Marks
1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10
2	Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.	05
3	Seminar/group presentation on any one topic related to the syllabus.	05

Paper pattern of the Test (Offline Mode with One Hour Duration):

Q1: Definitions/Fill in the blanks/ True or False with Justification.

(04 Marks: 4 x 1).

Q2: Attempt any 2 from 3 descriptive questions. (06 marks: 2 x 3)

14 **Format of Question Paper:**

The semester-end examination will be of 30 marks of one hour duration, covering the entire syllabus of the semester.

Note: Attempt any TWO questions out of THREE.

Q.No.1	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks
Q.No.2	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks
Q.No.3	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks

**Name of the Course: PM-3C Basic Mathematics in Real Life-II
(Minor III)**

Sr. No.	Heading	Particulars																				
1	Description of the course: Including but not limited to:	To demonstrate the importance of mathematics in real life by considering interdisciplinary applications of basic concepts in real life.																				
2	Vertical:	Minor																				
3	Type:	Practical																				
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)																				
5	Hours Allotted:	30 Hours																				
6	Marks Allotted:	50 Marks																				
7	Course Objectives (CO):	<p>This course is a balanced mixture of the basic concepts of mathematics, which highlights the crucial role of mathematics in other sciences. In this course, students from various science streams will be able to see mathematics being applied in their area of interest and learn</p> <p>CO1: To develop methods for polynomial interpolation. CO2: To identify row echelon form and row reduced echelon form for matrices. CO3: To associate mathematical notation for solving real-life problems like those related to forest management. CO4: To recognise the role of geometry (in particular Platonic solids) in science streams.</p>																				
8	Course Outcomes (OC):	<p>After completion of the course, students will be able to</p> <p>OC1: Apply the formulas and concepts to solve interpolation problems, problems, and examples related to polynomials up to degree three, equations of recurrence relations. OC2: analyse the solutions of the system of linear equations and graphs OC3: Check the relation between non-planar graphs and Euler's formula and verify the Hardy-Weinberg principle. OC4: Construct the recurrence relations and design circuits based on Kirchhoff's Law</p>																				
9	Modules: - Module 1: Practicals for Polynomials and Interpolation (30 Hours)	<table border="1"> <tbody> <tr> <td>1.</td> <td>Computing roots for quadratic equations.</td> </tr> <tr> <td>2.</td> <td>Plotting polynomials of degree at most three.</td> </tr> <tr> <td>3.</td> <td>Setting up Recurrence Relations.</td> </tr> <tr> <td>4.</td> <td>Polynomial Interpolation with Examples.</td> </tr> <tr> <td>5.</td> <td>Multiplication of matrices of arbitrary sizes.</td> </tr> <tr> <td>6.</td> <td>Computation of Row-Echelon Form in 2 by 2 and 3 by 3 matrices.</td> </tr> <tr> <td>7.</td> <td>Computation of Row-Reduced-Echelon Form in 2 by 2 and 3 by 3 matrices.</td> </tr> <tr> <td>8.</td> <td>Calculating inverses of 2 by 2 matrices and 3 by 3 matrices.</td> </tr> <tr> <td>9.</td> <td>Polynomial Interpolation in Degree Three.</td> </tr> <tr> <td>10.</td> <td>Vandermonde Determinant and Invertibility.</td> </tr> </tbody> </table>	1.	Computing roots for quadratic equations.	2.	Plotting polynomials of degree at most three.	3.	Setting up Recurrence Relations.	4.	Polynomial Interpolation with Examples.	5.	Multiplication of matrices of arbitrary sizes.	6.	Computation of Row-Echelon Form in 2 by 2 and 3 by 3 matrices.	7.	Computation of Row-Reduced-Echelon Form in 2 by 2 and 3 by 3 matrices.	8.	Calculating inverses of 2 by 2 matrices and 3 by 3 matrices.	9.	Polynomial Interpolation in Degree Three.	10.	Vandermonde Determinant and Invertibility.
1.	Computing roots for quadratic equations.																					
2.	Plotting polynomials of degree at most three.																					
3.	Setting up Recurrence Relations.																					
4.	Polynomial Interpolation with Examples.																					
5.	Multiplication of matrices of arbitrary sizes.																					
6.	Computation of Row-Echelon Form in 2 by 2 and 3 by 3 matrices.																					
7.	Computation of Row-Reduced-Echelon Form in 2 by 2 and 3 by 3 matrices.																					
8.	Calculating inverses of 2 by 2 matrices and 3 by 3 matrices.																					
9.	Polynomial Interpolation in Degree Three.																					
10.	Vandermonde Determinant and Invertibility.																					

Module 2: Practicals for Applications of linear systems and introduction to Platonic solids (30 Hours)

1.	Kirchhoff's Law in Computing Current in given examples.
2.	Computing cofactors of 2 by 2 and 3 by 3 matrices.
3.	Computing adjoint and inverse of 2 by 2 matrices.
4.	Computing the adjoint and inverse of 3 by 3 matrices.
5.	Determining solutions to linear systems of equations using matrices.
6.	Examples in n by n matrices to System of Linear Equations.
7.	Euler's Formula via Examples.
8.	Planar Figures and Graphs, Definition and Examples.
9.	Non-Planar Figures and Relation to Euler's Formula.
10.	Problems based on the Hardy-Weinberg principle.

- 10 Text Books:**
1. Artin, Algebra, Pearson, Second Edition.
 2. Elementary Linear Algebra Application Version, H. Anton, C. Rorres, Wiley, Tenth Edition.

- 11 Reference Books:**
1. Contemporary Abstract Algebra, J. A. Gallian, Narosa publishing house.
 2. Tipler, Paul (2004). Physics for Scientists and Engineers: Electricity, Magnetism, Light, and Elementary Modern Physics (5th ed.). W. H. Freeman.

Scheme of the Examination

12 Internal Continuous Assessment: 40% Semester End Examination: 60%

13 Continuous Evaluation through:
Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments, etc.
(at least 3)

Sr. No.	Particulars	Marks
1	Objective question test	10
2	Overall performance	05
3	Viva	05

Paper pattern of the Test (Offline Mode):

Q1: (Attempt any 5 from 8) Multiple-choice questions. (10 marks: 5×2)

Duration: 1Hrs

While setting the question paper, four MCQs on module 1 and four MCQs on module 2

	both.							
14	<p>Format of Question Paper: Scheme of examination:</p> <p>At the end of the Semester III, Practical examinations of three hours duration and 30 marks shall be conducted based on both the modules. Paper pattern: The question paper shall have two questions.</p> <table border="1"> <tr> <td>Q. No. 1</td> <td>Five out of Eight multiple-choice questions (four from module 1 and four from module 2) (OC1 to OC3)</td> <td>Marks (3 × 5 = 15 Marks)</td> </tr> <tr> <td>Q. No.2</td> <td>Attempt any Two out of Four (two from module 1 and two from module 2). (OC3 and OC4)</td> <td>(5 × 2 = 10 Marks)</td> </tr> </table> <p>Marks for Journals:</p> <p>For both Module 1 and Module 2, Journal: 5 marks (2.5 marks for each module 1 & module 2)</p> <p>The students are required to perform 75% of the practical for the journal to be duly certified. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.</p>		Q. No. 1	Five out of Eight multiple-choice questions (four from module 1 and four from module 2) (OC1 to OC3)	Marks (3 × 5 = 15 Marks)	Q. No.2	Attempt any Two out of Four (two from module 1 and two from module 2). (OC3 and OC4)	(5 × 2 = 10 Marks)
Q. No. 1	Five out of Eight multiple-choice questions (four from module 1 and four from module 2) (OC1 to OC3)	Marks (3 × 5 = 15 Marks)						
Q. No.2	Attempt any Two out of Four (two from module 1 and two from module 2). (OC3 and OC4)	(5 × 2 = 10 Marks)						

Sem. – IV

Name of the Course: Calculus IV (Minor I)

Sr. No.	Heading	Particulars
1	Description the course: Including but not limited to:	Calculus finds extensive applications in diverse fields such as Physics, Chemistry, Biotechnology, Engineering, and more. This course seeks to provide learners with a comprehensive understanding of Multivariable Calculus, building upon a rigorous foundation laid by Mathematical Analysis. Through the exploration of various properties of derivatives of scalar fields and vector fields. Students will gain valuable insights into the analytical aspects of Multivariable Calculus. To enhance practical understanding, the course incorporates real-world applications of differentiation in multiple dimensions, allowing learners to grasp the diverse uses of the acquired knowledge.
2	Vertical:	Minor
3	Type:	Theory
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives (CO):	<p>This course aims to equip students with a comprehensive understanding of functions of several variables and the principles of differentiation for scalar and vector fields in multivariable calculus.</p> <p>CO1: To develop the understanding of vectors in \mathbb{R}^n focusing on \mathbb{R}^2 and \mathbb{R}^3 and acquire proficiency in working with real-valued functions of several variables.</p> <p>CO2: To demonstrate competence in analyzing neighbourhoods in \mathbb{R}^n and applying concepts of limits and continuity to scalar fields.</p> <p>CO3: To define and compute partial and directional derivatives of scalar fields, focusing on \mathbb{R}^2 and \mathbb{R}^3, and understand the Mean Value Theorem for scalar fields.</p> <p>CO4: To explore the basic properties of differentiability, such as continuity at a point, existence of partial derivatives, and differentiability when partial derivatives exist and are continuous.</p> <p>CO5: To utilize concept of differentiation for practical applications, including the understanding of tangent planes and maxima-minima.</p> <p>CO6: To understand higher-order partial derivatives and their applications, including the Mixed Partial Derivatives Theorem, Taylor's Theorem for twice continuously differentiable functions, the Method of Lagrange Multipliers and the Second Derivative Test for functions of two variables.</p>
8	Course Outcomes (OC):	<p>After completion of the course, students will be able</p> <p>OC1: understand and remember the concepts such as Euclidean spaces, norm, inner product, limit, continuity, derivatives of scalar fields etc.</p> <p>OC2: apply first and second derivative tests to find extreme values of scalar fields.</p> <p>OC3: verify the relationship between Differentiability and Continuity, directional derivative and continuity etc.</p>

	<p>OC4: check differentiability and continuity of scalar and vector fields.</p> <p>OC5: create counter examples related to continuity and differentiability, directional derivative and continuity, partial derivatives and total derivative etc.</p>
9	<p>Modules: -</p> <p>Module 1: Functions of Several Variables (15 Lectures)</p> <ol style="list-style-type: none"> 1 Review of vectors in \mathbb{R}^n [with emphasis on \mathbb{R}^2 and \mathbb{R}^3] and basic notions such as addition and scalar multiplication, inner product, length (norm) and distance between two points. 2 Real-valued functions of several variables (Scalar fields). Graph of a function. Level sets (level curves, level surfaces, etc). Examples. Vector valued functions of several variables (Vector fields). Component functions. Examples. 3 Sequence in \mathbb{R}^n [with emphasis on \mathbb{R}^2 and \mathbb{R}^3] and their limits. Neighbourhoods in \mathbb{R}^n. Limits and continuity of scalar fields. Sequential characterizations (without proof), Composition of continuous functions. Algebra of limits and continuity (Results with proofs). Iterated and simultaneous limits of scalar fields. Limits and continuity of vector fields. Algebra of limits and continuity of vector fields. (without proofs). 4 Partial derivatives, directional derivatives and gradient of scalar fields (with emphasis on \mathbb{R}^2 and \mathbb{R}^3). Existence of directional derivative implies continuity. Mean Value Theorem for scalar fields. 5 Differentiability of scalar fields (in terms of linear transformation). Concept of total derivative and its uniqueness, basic results such as (i) continuity at a point of differentiability, (ii)existence of partial derivatives at a point of differentiability and (iii) differentiability when the partial derivatives exist and are continuous. <p>Module 2: Applications of Differentiability (15 Lectures)</p> <ol style="list-style-type: none"> 1 Relation between total derivative and gradient of a function. Chain rule (without proof). Geometric properties of gradient. Tangent planes. 2 Euler's Theorem, Higher order partial derivatives. Mixed Partial Derivatives Theorem (n=2). 3 Taylor's Theorem for twice continuously differentiable functions (without proof). 4 The maximum and minimum rate of change of scalar fields. Notions of local maxima, local minima and saddle points. First Derivative Test. Examples. Hessian matrix. Second Derivative Test for functions of two variables (statement only). Examples. Method of Lagrange Multipliers.
10	<p>Recommended Reference Books:</p> <ol style="list-style-type: none"> 1. T. Apostol; Calculus, Vol. 2 (Second Edition); John Wiley. 2. Sudhir Ghorpade, Balmohan Limaye; A Course in Multivariable Calculus and Analysis (Second Edition); Springer. 3. Walter Rudin; Principles of Mathematical Analysis; McGraw-Hill, Inc. 4. J. E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus; Springer. 5. D. Somasundaram and B. Choudhary; A First Course in Mathematical Analysis, Narosa New Delhi, 1996. 6. K. Stewart; Calculus; Booke/Cole Publishing Co, 1994.
11	<p>Additional Reference Books</p> <ol style="list-style-type: none"> 1. Calculus and Analytic Geometry, G.B. Thomas and R. L. Finney, (Ninth Edition); Addison-

	<p>Wesley, 1998.</p> <p>2. Howard Anton; Calculus- A new Horizon, (Sixth Edition); John Wiley and Sons Inc, 1999.</p> <p>3. Shabanov, Sergei; Concepts in Calculus, III: Multivariable Calculus; University Press of Florida, 2012.</p> <p>4. S C Malik and Savita Arora; Mathematical Analysis; New Age International Publishers.</p>														
	<u>Scheme of the Examination</u>														
	<p>The performance of the learners shall be evaluated in two parts.</p> <ul style="list-style-type: none"> • Internal Continuous Assessment of 20 marks. • Semester End Examination of 30 marks. • A separate head of passing is required for internal and semester-end examinations. 														
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%													
13	<p>Continuous Evaluation through: Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc. (at least 3)</p> <table border="1"> <thead> <tr> <th>Sr. No.</th> <th>Particulars</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>A class test of 10 marks is to be conducted during each semester in an Offline mode.</td> <td>10</td> </tr> <tr> <td>2</td> <td>Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.</td> <td>05</td> </tr> <tr> <td>3</td> <td>Seminar/ group presentation on any one topic related to the syllabus.</td> <td>05</td> </tr> </tbody> </table> <p>Paper pattern of the Test (Offline Mode with One hour duration): Q1: Definitions/Fill in the blanks/ True or False with Justification. (04 Marks: 4 x 1). Q2: Attempt any 2 from 3 descriptive questions. (06 marks: 2 × 3)</p>			Sr. No.	Particulars	Marks	1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10	2	Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.	05	3	Seminar/ group presentation on any one topic related to the syllabus.	05
Sr. No.	Particulars	Marks													
1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10													
2	Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.	05													
3	Seminar/ group presentation on any one topic related to the syllabus.	05													
14	<p>Format of Question Paper:</p> <p>The semester-end examination will be of 30 marks of one hour duration covering the entire syllabus of the semester.</p> <table border="1" style="width: 100%;"> <tr> <td colspan="4" style="text-align: center;">Note: Attempt any TWO questions out of THREE.</td> </tr> <tr> <td style="width: 15%;">Q.No.1</td> <td style="width: 15%;">Module 1 and 2</td> <td style="width: 55%;">Attempt any THREE out of FOUR. (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5</td> <td style="width: 15%;">15 Marks</td> </tr> </table>			Note: Attempt any TWO questions out of THREE.				Q.No.1	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks				
Note: Attempt any TWO questions out of THREE.															
Q.No.1	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks												

Q.No.2	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks
Q.No.3	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks

Name of the Course: PM-4A Calculus IV (Minor I)

Sr. No.	Heading	Particulars								
1	Description the course: Including but not limited to:	Problem solving forms one of the basic aspects of any course in Mathematics. Higher courses in Mathematics focus mainly on the theoretical nature of the subject, nevertheless, the problem- solving activity strengthens the concepts and helps the learners develop their ability to think over the existing problems in the subject, and also to create and crack new problems! This way a learner is not just motivated, but elevated also, to formulate new results, suggest new postulates (usually known as conjectures), and design new theories.								
2	Vertical:	Minor								
3	Type:	Practical								
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)								
5	Hours Allotted:	30 Hours								
6	Marks Allotted:	50 Marks								
7	Course Objectives (CO):	<p>This course introduces basic concepts of Calculus, Linear Algebra and differential equation with rigour and prepares students to study further courses.</p> <p>CO1. To give sufficient knowledge of fundamental principles, methods, and a clear perception of numerous powers of mathematical ideas and tools and the skills to use them by modelling, solving and interpreting.</p> <p>CO2. To reflect the broad nature of the subject and develop mathematical tools for continuing further study in various fields of sciences.</p> <p>CO3. To enhance students' overall development, problem solving skills, creative talent, and power of communication, which are necessary for various kinds of employment.</p> <p>CO4. To give adequate exposure to global and local concerns that would help learners explore many aspects of Mathematical Sciences.</p>								
8	Course Outcomes (OC):	<p>After completion of the course, students will be able</p> <p>OC1: apply first and second derivative tests to find extreme values of scalar fields.</p> <p>OC2: verify the relationship between Differentiability and Continuity, directional derivative and continuity etc.</p> <p>OC3: check differentiability and continuity of scalar and vector fields.</p> <p>OC4: create counter examples related to continuity and differentiability, directional derivative and continuity, partial derivatives and total derivative etc.</p>								
9	Modules: - Practical for Calculus IV (30 Hours)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="text-align: center;">1.</td> <td>Limits and continuity of scalar fields, using "definition and otherwise", iterated limits.</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>Directional derivatives, partial derivatives and mean value theorem of scalar fields.</td> </tr> <tr> <td style="text-align: center;">3.</td> <td>Differentiability of scalar field and Total derivative.</td> </tr> <tr> <td style="text-align: center;">4.</td> <td>Gradient, level sets and tangent planes.</td> </tr> </tbody> </table>	1.	Limits and continuity of scalar fields, using "definition and otherwise", iterated limits.	2.	Directional derivatives, partial derivatives and mean value theorem of scalar fields.	3.	Differentiability of scalar field and Total derivative.	4.	Gradient, level sets and tangent planes.
1.	Limits and continuity of scalar fields, using "definition and otherwise", iterated limits.									
2.	Directional derivatives, partial derivatives and mean value theorem of scalar fields.									
3.	Differentiability of scalar field and Total derivative.									
4.	Gradient, level sets and tangent planes.									

	5.	Chain rule, higher order partial derivatives and mixed partial derivatives of scalar fields.												
	6.	Maximum and minimum rate of change of scalar fields. Finding Hessian/Jacobian matrix.												
	7.	Taylor's Theorem.												
	8.	Finding maxima, minima and saddle points. Second derivative test for extrema of functions of two variables and method of Lagrange multipliers.												
	9.	Wronskian and linear independence of solutions.												
	10.	Higher order homogeneous linear differential equations with constant coefficients.												
10	Text Books	<ol style="list-style-type: none"> 1. Apostol; Calculus, Vol. 2 (Second Edition); John Wiley. 2. Sudhir Ghorpade, Balmohan Limaye; A Course in Multivariable Calculus and Analysis (Second Edition); Springer. 3. Walter Rudin; Principles of Mathematical Analysis; McGraw-Hill, Inc. 4. J. E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus; Springer. 5. D. Somasundaram and B.Choudhary; A First Course in Mathematical Analysis, Narosa New Delhi, 1996. 6. K. Stewart; Calculus; Booke/Cole Publishing Co, 1994. 												
11	Reference Books	<ol style="list-style-type: none"> 1. Calculus and Analytic Geometry, G.B. Thomas and R. L. Finney, (Ninth Edition); Addison-Wesley, 1998. 2. Howard Anton; Calculus- A new Horizon, (Sixth Edition); John Wiley and Sons Inc, 1999. 3. S L Gupta and Nisha Rani; Principles of Real Analysis; Vikas Publishing house PVT LTD. 4. Shabanov, Sergei; Concepts in Calculus, III: Multivariable Calculus; University Press of Florida, 2012. 5. S C Malik and Savita Arora; Mathematical Analysis; New Age International Publishers. 												
	<u>Scheme of the Examination</u>													
12	Internal Continuous Assessment: 40% Semester End Examination: 60%	Semester End Examination: 60%												
13	Continuous Evaluation through: Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc. (at least 3)													
	<table border="1"> <thead> <tr> <th>Sr. No.</th> <th>Particulars</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Objective question test</td> <td>10</td> </tr> <tr> <td>2</td> <td>Overall performance</td> <td>05</td> </tr> <tr> <td>3</td> <td>Viva</td> <td>05</td> </tr> </tbody> </table>	Sr. No.	Particulars	Marks	1	Objective question test	10	2	Overall performance	05	3	Viva	05	
Sr. No.	Particulars	Marks												
1	Objective question test	10												
2	Overall performance	05												
3	Viva	05												

	<p>Paper pattern of the Test (Offline Mode): Q1: (Attempt any 5 from 8) Multiple choice questions. (10 marks: 5 × 2)</p> <p>Duration: 1Hrs While setting question paper four MCQ on module 1 and four MCQ on module 2 both.</p>	
--	--	--

14

Format of Question Paper:

Scheme of examination:

At the end of the Semester IV, Practical examinations of three hours duration and 30 marks shall be conducted based on both the modules.

Paper pattern: The question paper shall have two questions.

Q. No. 1	Five out of Eight multiple choice questions (four from module 1 and four from module 2) (OC1 to OC3)	Marks (3 × 5 = 15 Marks)
Q. No.2	Attempt any Two out of Four (two from module 1 and two from module 2). (OC3 and OC4)	(5 × 2 = 10 Marks)

Marks for Journals:

For both Module 1 and Module 2

1. Journal: 5 marks (2.5 marks for each module 1 & module 2)

The students are required to perform 75% of the Practical for the journal to be duly certified. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

Name of the Course: Linear Algebra (Minor II)

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	The system of linear equations arises naturally in other science courses. This course provides a sound knowledge of Matrix theory, starting with the basic requirement of its study in the form of solving a system of equations. Also, it advances the discussion of vector space dealing with linear transformations, developing its connection with matrix theory.
2	Vertical:	Minor
3	Type:	Theory
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives (CO):	<p>This course gives an introduction to linear transformations with an understanding of its geometry. Also, it covers a brief amount of matrix theory.</p> <p>CO1. To give sufficient knowledge of fundamental principles and methods, as well as a clear perception of numerous powers of mathematical ideas and tools and the skills to use them by modelling, solving, and interpreting.</p> <p>CO2. To reflect the broad nature of the subject and develop mathematical tools for continuing further study in various fields of sciences.</p> <p>CO3. To enhance students' overall development, problem-solving skills, creative talent and power of communication are necessary for various kinds of employment.</p> <p>CO4. To give adequate exposure to global and local concerns that would help learners explore many aspects of Mathematical Sciences.</p>
8	Course Outcomes (OC):	<p>After completion of the course, students will be able to</p> <p>OC1: Remember and understand the concept of a system of linear equations, matrices and linear transformations</p> <p>OC2: Calculate and find the solutions to a system of equations using various methods, finding the inverse of matrices</p> <p>OC3: Analyse the linear transformation and its various aspects</p> <p>OC4: Verify the Rank Nullity theorem</p> <p>OC5: Construct counterexamples related to linear transformations</p>
9	Modules: - Module 1: Matrices (15 Hours)	<p>(a) Systems of homogeneous and non-homogeneous linear equations, Simple examples of finding solutions of such systems. Geometric and algebraic understanding of the solutions. Algebra of solutions of systems of homogeneous linear equations. A system of homogeneous linear equations with a number of unknowns greater than the number of equations has infinitely many solutions.</p> <p>(b) Equivalence of statements (in which A denotes an $n \times n$ matrix) such</p>

	<p>as the following.(without proof)</p> <p>(i) The system $Ax = b$ of non-homogeneous linear equations has a unique solution.</p> <p>(ii) The system $Ax = 0$ of homogeneous linear equations has no nontrivial solution.</p> <p>(iii) A is invertible.</p> <p>(iv) $\det A \neq 0$.</p> <p>(v) $\text{rank}(A) = n$.</p> <p>Examples.</p> <p>(c) Elementary matrices. Relation of elementary row operations with elementary matrices. Invertibility of elementary matrices. Consequences such as (i) a square matrix is invertible if and only if its row echelon form is invertible. (ii) Invertible matrices are products of elementary matrices. Examples of the computation of the inverse of a matrix using the Gauss elimination method.</p>
	<p>Module 2: Linear Transformation (15 Hours)</p> <p>(a) Definition of a linear transformation of vector spaces; elementary properties. Examples. Sums and scalar multiples of linear transformations. Composites of linear transformations. A Linear transformation of $V \rightarrow W$; where V, W are vector spaces over R and V is a finite-dimensional vector space is completely determined by its action on an ordered basis of V.</p> <p>(b) Null space (kernel) and the image (range) of a linear transformation. Nullity and rank of a linear transformation. Rank-Nullity Theorem (without proof).</p> <p>(c) Matrix associated with linear transformation of $V \rightarrow W$ where V and W are finite dimensional vector spaces over R. Matrix of the composite of two linear transformations. Invertible linear transformations (isomorphisms), Linear operator, Effect of change of bases on matrices of linear operator.</p> <p>(d) Equivalence of the rank of a matrix and the rank of the associated linear transformation. Similar matrices.</p>
10	<p>Text Books:</p> <ol style="list-style-type: none"> 1. Kenneth Hoffman and Ray Kunze, Linear Algebra, 2nd edition, Pearson. 2. Howard Anton, Chris Rorres, Elementary Linear Algebra, Wiley Student Edition). 3. Serge Lang, Introduction to Linear Algebra, Springer. 4. S Kumaresan, Linear Algebra: A Geometric Approach, PHI Learning. 5. Sheldon Axler, Linear Algebra done right, Springer. 6. Gareth Williams, Linear Algebra with Applications, Jones and Bartlett Publishers. 7. David W. Lewis, Matrix theory.
11	<p>Reference Books</p> <ol style="list-style-type: none"> 1. Matrix Analysis and its Applications, Carl D. Mayor, SIAM publications. 2. Linear Algebra, Kenneth Hoffman & Ray Kunze, Prentice-Hall Inc.
	<p style="text-align: center;"><u>Scheme of the Examination</u></p>
	<p>The performance of the learners shall be evaluated in two parts.</p> <ul style="list-style-type: none"> ● Internal Continuous Assessment of 20 marks. ● Semester-end examination of 30 marks. ● A separate head of passing is required for internal and semester-end examinations.

12	Internal Continuous Assessment: 40%	Semester End Examination: 60%																
13	<p>Continuous Evaluation through:</p> <p>Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments, etc. (at least 3)</p> <table border="1"> <thead> <tr> <th>Sr. No.</th> <th>Particulars</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>A class test of 10 marks is to be conducted during each semester in an Offline mode.</td> <td>10</td> </tr> <tr> <td>2</td> <td>Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.</td> <td>05</td> </tr> <tr> <td>3</td> <td>Seminar/group presentation on any one topic related to the syllabus.</td> <td>05</td> </tr> </tbody> </table> <p>Paper pattern of the test (offline mode with one-hour duration):</p> <p>Q1: Definitions/Fill in the blanks/ True or False with Justification. (04 Marks: 4 x 1).</p> <p>Q2: Attempt any two of the three descriptive questions. (06 marks: 2 × 3)</p>	Sr. No.	Particulars	Marks	1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10	2	Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.	05	3	Seminar/group presentation on any one topic related to the syllabus.	05					
Sr. No.	Particulars	Marks																
1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10																
2	Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.	05																
3	Seminar/group presentation on any one topic related to the syllabus.	05																
14	<p>Format of Question Paper:</p> <p>The semester-end examination will be of 30 marks of one-hour duration, covering the entire syllabus of the semester.</p> <table border="1"> <thead> <tr> <th colspan="4">Note: Attempt any TWO questions out of THREE.</th> </tr> </thead> <tbody> <tr> <td>Q.No.1</td> <td>Module 1 and 2</td> <td>Attempt any THREE out of FOUR. (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5</td> <td>15 Marks</td> </tr> <tr> <td>Q.No.2</td> <td>Module 1 and 2</td> <td>Attempt any THREE out of FOUR. (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5</td> <td>15 Marks</td> </tr> <tr> <td>Q.No.3</td> <td>Module 1 and 2</td> <td>Attempt any THREE out of FOUR. (Each question of 5 marks)</td> <td>15 Marks</td> </tr> </tbody> </table>		Note: Attempt any TWO questions out of THREE.				Q.No.1	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks	Q.No.2	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks	Q.No.3	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks)	15 Marks
Note: Attempt any TWO questions out of THREE.																		
Q.No.1	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks															
Q.No.2	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks															
Q.No.3	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks)	15 Marks															

			(a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5		
--	--	--	--	--	--

Name of the Course: PM-4B Linear Algebra (Minor II)

Sr. No.	Heading	Particulars																
1	Description of the course: Including but not limited to:	The system of linear equations arises naturally in other science courses. This course provides a sound knowledge of Matrix theory, starting with the basic requirement of its study in the form of solving a system of equations. Also, it advances the discussion of vector space dealing with linear transformations, developing its connection with matrix theory.																
2	Vertical:	Minor																
3	Type:	Practical																
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)																
5	Hours Allotted:	30 Hours																
6	Marks Allotted:	50 Marks																
7	Course Objectives (CO):	<p>This course deepens the understanding of system of linear equations with an understanding of the geometry of its solutions. Also, it covers a brief amount of matrix theory and the theory of linear transformations.</p> <p>CO1. To give sufficient knowledge of fundamental principles and methods, as well as a clear perception of numerous powers of mathematical ideas and tools and the skills to use them by modelling, solving, and interpreting.</p> <p>CO2. To reflect the broad nature of the subject and develop mathematical tools for continuing further study in various fields of sciences.</p> <p>CO3. To enhance students' overall development, problem-solving skills, creative talent, and the power of communication are necessary for various kinds of employment.</p> <p>CO4. To give adequate exposure to global and local concerns that would help learners explore many aspects of Mathematical Sciences.</p>																
8	Course Outcomes (OC):	<p>After completion of the course, students will be able to</p> <p>OC1: Calculate solutions to a system of equations using various methods, and the inverse of matrices</p> <p>OC2: Analyse the null space and rank space related to the linear transformation.</p> <p>OC3: Verify the Rank Nullity theorem</p> <p>OC4: Construct and design counterexamples related to linear transformations</p>																
9	Modules: - Module 1: Practical for Matrices (30 Hours)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td style="width: 5%; text-align: center;">1.</td> <td>System of linear equations with examples.</td> </tr> <tr> <td style="text-align: center;">2.</td> <td>The geometry of solutions of a system of linear equations.</td> </tr> <tr> <td style="text-align: center;">3.</td> <td>Matrix representation of a system of linear equations.</td> </tr> <tr> <td style="text-align: center;">4.</td> <td>Algebra of solutions of a system of homogenous linear equations.</td> </tr> <tr> <td style="text-align: center;">5.</td> <td>Elementary row operations on matrices.</td> </tr> <tr> <td style="text-align: center;">6.</td> <td>Determinants and rank of a matrix.</td> </tr> <tr> <td style="text-align: center;">7.</td> <td>Solving a system of linear equations using determinants.</td> </tr> <tr> <td style="text-align: center;">8.</td> <td>Elementary matrices and their relations with elementary operations on matrices.</td> </tr> </tbody> </table>	1.	System of linear equations with examples.	2.	The geometry of solutions of a system of linear equations.	3.	Matrix representation of a system of linear equations.	4.	Algebra of solutions of a system of homogenous linear equations.	5.	Elementary row operations on matrices.	6.	Determinants and rank of a matrix.	7.	Solving a system of linear equations using determinants.	8.	Elementary matrices and their relations with elementary operations on matrices.
1.	System of linear equations with examples.																	
2.	The geometry of solutions of a system of linear equations.																	
3.	Matrix representation of a system of linear equations.																	
4.	Algebra of solutions of a system of homogenous linear equations.																	
5.	Elementary row operations on matrices.																	
6.	Determinants and rank of a matrix.																	
7.	Solving a system of linear equations using determinants.																	
8.	Elementary matrices and their relations with elementary operations on matrices.																	

	9.	Invertibility of elementary matrices.												
	10.	Computing the inverse of a matrix by the Gauss elimination method.												
Module 2: Practical for Linear Transformation (30 Hours)														
	1.	Linear transformations and their elementary properties.												
	2.	Composite of linear transformations.												
	3.	Determining linear transformation by knowing its action on basis vectors.												
	4.	Null space and image space of linear transformation.												
	5.	Rank and nullity of a linear transformation with verification of rank-nullity theorem.												
	6.	Computing matrix associated with a linear transformation.												
	7.	Matrix associated with a composite of two linear transformations.												
	8.	Effect on change of basis on linear transformation.												
	9.	Similar matrices.												
	10.	Equivalence of rank of a matrix with the associated linear transformation.												
10	Text Books: <ol style="list-style-type: none"> 1. Kenneth Hoffman and Ray Kunze, Linear Algebra, 2nd edition, Pearson. 2. Howard Anton, Chris Rorres, Elementary Linear Algebra, Wiley Student Edition. 3. Serge Lang, Introduction to Linear Algebra, Springer. 4. S Kumaresan, Linear Algebra - A Geometric Approach, PHI Learning. 5. Sheldon Axler, Linear Algebra done right, Springer. 6. Gareth Williams, Linear Algebra with Applications, Jones and Bartlett Publishers. 7. David W. Lewis, Matrix theory. 													
11	Reference Books <ol style="list-style-type: none"> 1. Matrix Analysis and its Applications, Carl D. Mayor, SIAM publications. 2. Linear Algebra, Kenneth Hoffman & Ray Kunze, Prentice-Hall Inc. 													
<u>Scheme of the Examination</u>														
12	Internal Continuous Assessment: 40%	Semester End Examination: 60%												
13	<p>Continuous Evaluation through: Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc. (at least 3)</p> <table border="1"> <thead> <tr> <th>Sr. No.</th> <th>Particulars</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Objective question test</td> <td>10</td> </tr> <tr> <td>2</td> <td>Overall performance</td> <td>05</td> </tr> <tr> <td>3</td> <td>Viva</td> <td>05</td> </tr> </tbody> </table> <p>Paper pattern of the Test (Offline Mode): Q1: (Attempt any 5 from 8) Multiple-</p>		Sr. No.	Particulars	Marks	1	Objective question test	10	2	Overall performance	05	3	Viva	05
Sr. No.	Particulars	Marks												
1	Objective question test	10												
2	Overall performance	05												
3	Viva	05												

	choice questions. (10 marks: 5×2) Duration: 1Hrs While setting the question paper, four MCQs on module 1 and four MCQs on module 2.							
14	<p>Format of Question Paper:</p> <p>Scheme of examination:</p> <p>At the end of Semester IV, Practical examinations of three hours duration and 30 marks shall be conducted based on both modules.</p> <p>Paper pattern: The question paper shall have two questions.</p> <table border="1"> <tr> <td>Q. No. 1</td> <td>Five out of Eight multiple-choice questions (four from module 1 and four from module 2) (OC1 to OC3)</td> <td>Marks ($3 \times 5 = 15$ Marks)</td> </tr> <tr> <td>Q. No.2</td> <td>Attempt any Two out of Four (two from module 1 and two from module 2). (OC3 and OC4)</td> <td>($5 \times 2 = 10$ Marks)</td> </tr> </table> <p>Marks for Journals:</p> <p>For both Module 1 and Module 2</p> <p>1. Journal: 5 marks (2.5 marks for each module 1 & module 2)</p> <p>The students are required to perform 75% of the Practical for the journal to be duly certified. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.</p>		Q. No. 1	Five out of Eight multiple-choice questions (four from module 1 and four from module 2) (OC1 to OC3)	Marks ($3 \times 5 = 15$ Marks)	Q. No.2	Attempt any Two out of Four (two from module 1 and two from module 2). (OC3 and OC4)	($5 \times 2 = 10$ Marks)
Q. No. 1	Five out of Eight multiple-choice questions (four from module 1 and four from module 2) (OC1 to OC3)	Marks ($3 \times 5 = 15$ Marks)						
Q. No.2	Attempt any Two out of Four (two from module 1 and two from module 2). (OC3 and OC4)	($5 \times 2 = 10$ Marks)						

**Name of the Course: Basic Mathematics in Real Life-III
(Minor IV)**

Sr. No.	Heading	Particulars
1	Description of the course: Including but not limited to:	To underline the importance of concepts in mathematics that have physical interpretation, especially in other sciences like physics and chemistry.
2	Vertical:	Minor
3	Type:	Theory
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted:	30 Hours
6	Marks Allotted:	50 Marks
7	Course Objectives (CO):	This course emphasizes the concepts of mathematics applicable, especially in physics and chemistry. In this course, students from various science streams will be introduced to fundamental concepts from mathematics relevant to daily life and learn CO1: To identify eigenvalues and eigenvectors. CO2: To develop insight into the cross-product of vectors. CO3: To associate counting with real-life puzzles and games to make it easy to understand. CO4: recognizes symmetries in existing objects.
8	Course Outcomes (OC):	OC1: Remember and understand the concept of inner product spaces OC2: Calculate and find the inner products, moments, Eigenvalues Eigenvectors and orthogonal vectors OC3: Analyse the Cauchy-Schwarz inequality and the symmetries of triangles OC4: Verify the Cauchy-Schwarz inequality. OC5: Construct counterexamples related to inner product spaces
9	Modules: - Module 1: Linear dependence, independence and inner product spaces (15 Hours)	<ol style="list-style-type: none"> 1. Linear dependence and independence in two and three dimensions over reals, definitions, and simple examples. 2. Further examples of dependence and independence. 3. Linear dependence and independence of vectors and relation to determinants. 4. Cross products of vectors in R^3 basic properties like the angle between two vectors. 5. Cross product on R^3 and Jacobi identity; characterization of cross product is zero. 6. Use of cross product to calculate moment about a point: definition and formula 7. Moment of a force about a point: examples. 8. Problems involving angle bars and estimates on the magnitude of the moment about a point. 9. Inner product spaces definitions, examples, and properties. 10. Arithmetic mean—geometric mean inequality: statement, proof (for two numbers only) and applications (for two or more).

	<p>11. Cauchy-Schwarz inequality (real numbers) statement and proof, norm of a vector.</p> <p>12. Problems based on Cauchy-Schwarz inequality, like finding the maximum possible value of a dot product.</p> <p>13. Inner product spaces with complex coefficients.</p> <p>14. Proof of Cauchy-Schwarz inequality for complex numbers.</p> <p>15. Hermitian and unitary matrices and their examples.</p>	
	<p>Module 2: Eigenvalues and eigenvector orthonormalization and symmetry (15 Hours)</p>	
	<p>1. Definition of eigenvector and eigenvalue.</p> <p>2. Examples of eigenvector and eigenvalue in 2 by 2 matrices.</p> <p>3. Examples of eigenvectors and eigenvalues in 3 by three matrices.</p> <p>4. Gram-Schmidt orthogonalization process: formula.</p> <p>5. Gram-Schmidt orthogonalization process with examples.</p> <p>6. Playing cards and counting permutations (ordered arrangements)</p> <p>7. Further problems on cards.</p> <p>8. Set game: introduction, counting: Calculation of total number of cards, calculation of the number of sets, calculation of cards with certain properties.</p> <p>9. Permutations of an equilateral triangle.</p> <p>10. Writing composition tables for symmetries (group) of equilateral triangles.</p> <p>11. Permutation on four symbols.</p> <p>12. Rule for composition of above permutations.</p> <p>13. Symmetries of the square.</p> <p>14. Writing a composition table for symmetries of a square.</p> <p>15. Introduction to quaternions and their composition table.</p>	
10	<p>Text Books:</p> <ol style="list-style-type: none"> Halliday and Resnick's Principles of Physics, Wiley, Eleventh Edition. Hoffman and Kunze, Linear Algebra, Second Edition, Pearson. 	
11	<p>Reference Books:</p> <ol style="list-style-type: none"> Shaeffer, R.E. <i>Elementary Structures for Architects and Builders</i>. Elementary Linear Algebra Application Version, H. Anton, C. Rorres, Wiley & Sons. 	
	<p><u>Scheme of the Examination</u></p>	
	<p>The performance of the learners shall be evaluated in two parts.</p> <ul style="list-style-type: none"> Internal Continuous Assessment of 20 marks. Semester-end examination of 30 marks. A separate head of passing is required for internal and semester-end examinations. 	
12	<p>Internal Continuous Assessment: 40%</p>	<p>Semester End Examination: 60%</p>

13 **Continuous Evaluation through Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments, etc.**
(at least 3)

Sr. No.	Particulars	Marks
1	A class test of 10 marks is to be conducted during each semester in an Offline mode.	10
2	Project on any one topic related to the syllabus or a quiz (offline/online) on one of the modules.	05
3	Seminar/ group presentation on any one topic related to the syllabus.	05

Paper pattern of the test (offline mode with one-hour duration):

Q1: Definitions/Fill in the blanks/
True or False with Justification.
(04 Marks: 4 x 1).

Q2: Attempt two of 3 descriptive questions. (06 marks: 2 x 3)

14 **Format of Question Paper:**
The semester-end examination will be of 30 marks for one hour, duration covering the entire syllabus of the semester.

Note: Attempt any TWO questions out of THREE.

Q.No.1	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks
Q.No.2	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks
Q.No.3	Module 1 and 2	Attempt any THREE out of FOUR . (Each question of 5 marks) (a) Question based on OC1 (b) Question based on OC2 (c) Question based on OC3 (d) Question based on OC4/OC5	15 Marks

**Name of the Course: PM-4C Basic Mathematics in Real Life-III
(Minor IV)**

Sr. No.	Heading	Particulars																				
1	Description of the course: Including but not limited to:	To underline the importance of concepts in mathematics that have physical interpretation, especially in other sciences like physics and chemistry.																				
2	Vertical:	Minor																				
3	Type:	Practical																				
4	Credits:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)																				
5	Hours Allotted:	30 Hours																				
6	Marks Allotted:	50 Marks																				
7	Course Objectives (CO):	This course emphasizes the concepts of mathematics applicable, especially in physics and chemistry. In this course, students from various science streams will be introduced to fundamental concepts from mathematics relevant to daily life and learn CO1: To identify eigenvalues and eigenvectors. CO2: To develop insight into the cross-product of vectors. CO3: To associate counting with real-life puzzles and games to make it easy to understand. CO4: recognizes symmetries in existing objects.																				
8	Course Outcomes (OC):	After completion of the course, students will be able to OC1: Calculate and find the cross product, inner product, Norm, moments of force, Eigenvalues Eigenvectors and orthogonal vectors OC2: Analyse the Vector Spaces, Cauchy-Schwarz inequality and the symmetries of triangles OC3: Verify the Cauchy-Schwarz inequality and permutations as a function. OC4: Construct counterexamples related to inner product spaces.																				
9	Modules: -																					
	Module 1: Practical for linear dependence, independence and inner product spaces (30 Hours)																					
		<table border="1"> <tbody> <tr> <td>1.</td> <td>Checking Linear dependence and independence.</td> </tr> <tr> <td>2.</td> <td>Definition of Linear Span of Vectors and Examples of Finding the Span.</td> </tr> <tr> <td>3.</td> <td>Calculations based on cross product.</td> </tr> <tr> <td>4.</td> <td>Examples based on a moment about a point.</td> </tr> <tr> <td>5.</td> <td>Further computations based on cross-product.</td> </tr> <tr> <td>6.</td> <td>Verification of inner product via examples for real vector spaces.</td> </tr> <tr> <td>7.</td> <td>Norms in inner product spaces, examples and properties.</td> </tr> <tr> <td>8.</td> <td>Definition of vector space over real and complex numbers, Examples.</td> </tr> <tr> <td>9.</td> <td>Inner product spaces over complex numbers, Definition and Examples.</td> </tr> <tr> <td>10.</td> <td>Eigenvalues and Eigenvectors with basic calculations.</td> </tr> </tbody> </table>	1.	Checking Linear dependence and independence.	2.	Definition of Linear Span of Vectors and Examples of Finding the Span.	3.	Calculations based on cross product.	4.	Examples based on a moment about a point.	5.	Further computations based on cross-product.	6.	Verification of inner product via examples for real vector spaces.	7.	Norms in inner product spaces, examples and properties.	8.	Definition of vector space over real and complex numbers, Examples.	9.	Inner product spaces over complex numbers, Definition and Examples.	10.	Eigenvalues and Eigenvectors with basic calculations.
1.	Checking Linear dependence and independence.																					
2.	Definition of Linear Span of Vectors and Examples of Finding the Span.																					
3.	Calculations based on cross product.																					
4.	Examples based on a moment about a point.																					
5.	Further computations based on cross-product.																					
6.	Verification of inner product via examples for real vector spaces.																					
7.	Norms in inner product spaces, examples and properties.																					
8.	Definition of vector space over real and complex numbers, Examples.																					
9.	Inner product spaces over complex numbers, Definition and Examples.																					
10.	Eigenvalues and Eigenvectors with basic calculations.																					
	Module 2: Practical for eigenvalues and eigenvector orthonormalisation and symmetry (30 Hours)																					

	<table border="1"> <tbody> <tr><td>1.</td><td>Eigenvectors and Linear Independence.</td></tr> <tr><td>2.</td><td>Orthogonalization Formula and Examples.</td></tr> <tr><td>3.</td><td>Gram-Schmidt process with examples only of the real plane.</td></tr> <tr><td>4.</td><td>Gram-Schmidt process with examples in three dimensions.</td></tr> <tr><td>5.</td><td>Problems based on permutations and their composition, Examples.</td></tr> <tr><td>6.</td><td>Problems based on the formula for permutations with possible constraints.</td></tr> <tr><td>7.</td><td>Problems based on the set game.</td></tr> <tr><td>8.</td><td>Composition of two permutations and further properties.</td></tr> <tr><td>9.</td><td>Symmetries of rectangles and pentagons and other figures.</td></tr> <tr><td>10.</td><td>Symmetries of letters of the alphabet of Indian languages and English.</td></tr> </tbody> </table>	1.	Eigenvectors and Linear Independence.	2.	Orthogonalization Formula and Examples.	3.	Gram-Schmidt process with examples only of the real plane.	4.	Gram-Schmidt process with examples in three dimensions.	5.	Problems based on permutations and their composition, Examples.	6.	Problems based on the formula for permutations with possible constraints.	7.	Problems based on the set game.	8.	Composition of two permutations and further properties.	9.	Symmetries of rectangles and pentagons and other figures.	10.	Symmetries of letters of the alphabet of Indian languages and English.
1.	Eigenvectors and Linear Independence.																				
2.	Orthogonalization Formula and Examples.																				
3.	Gram-Schmidt process with examples only of the real plane.																				
4.	Gram-Schmidt process with examples in three dimensions.																				
5.	Problems based on permutations and their composition, Examples.																				
6.	Problems based on the formula for permutations with possible constraints.																				
7.	Problems based on the set game.																				
8.	Composition of two permutations and further properties.																				
9.	Symmetries of rectangles and pentagons and other figures.																				
10.	Symmetries of letters of the alphabet of Indian languages and English.																				
10	<p>Text Books:</p> <ol style="list-style-type: none"> Halliday and Resnick's Principles of Physics, Wiley, Eleventh Edition. Hoffman and Kunze, Linear Algebra, Second Edition, Pearson. 																				
11	<p>Reference Books:</p> <ol style="list-style-type: none"> Shaeffer, R.E. <i>Elementary Structures for Architects and Builders</i>. Elementary Linear Algebra Application Version, H. Anton, C. Rorres, Wiley & Sons. 																				
<u>Scheme of the Examination</u>																					
12	<p>Internal Continuous Assessment: 40%</p>	<p>Semester End Examination: 60%</p>																			
13	<p>Continuous Evaluation through: Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments, etc. (at least 3)</p> <table border="1"> <thead> <tr> <th>Sr. No.</th> <th>Particulars</th> <th>Marks</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Objective question test</td> <td>10</td> </tr> <tr> <td>2</td> <td>Overall performance</td> <td>05</td> </tr> <tr> <td>3</td> <td>Viva</td> <td>05</td> </tr> </tbody> </table> <p>Paper pattern of the Test (Offline Mode): Q1: (Attempt any 5 from 8) Multiple-choice questions. (10 marks: 5 × 2)</p> <p>Duration: 1Hrs While setting the question paper, four MCQs in module 1 and MCQs in module 2.</p>	Sr. No.	Particulars	Marks	1	Objective question test	10	2	Overall performance	05	3	Viva	05								
Sr. No.	Particulars	Marks																			
1	Objective question test	10																			
2	Overall performance	05																			
3	Viva	05																			
14	<p>Format of Question Paper: Scheme of examination:</p> <p>At the end of Semester IV, Practical examinations of three hours duration</p>																				

and 30 marks shall be conducted based on the modules.
Paper pattern: The question paper shall have two questions.

Q. No. 1	Five out of Eight multiple-choice questions (four from module 1 and four from module 2) (OC1, OC2 and OC 3)	Marks (3 × 5 = 15 Marks)
Q. No.2	Attempt any Two out of Four (two from module 1 and two from module 2). (OC3 and OC4)	(5 × 2 = 10 Marks)

Marks for Journals:

For both Module 1 and Module 2

2. Journal: 5 marks (2.5 marks for each module 1 & module 2)

The students are required to perform 75% of the Practical for the journal to be duly certified. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

Sd/-
Sign of the BOS
Chairman
Prof. B.S. Desale.
BOS in
Mathematics

Sd/-
Sign of the
Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science &
Technology

Sd/-
Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology

As Per NEP 2020

University of Mumbai



Syllabus for Minor Vertical 2 (Scheme-III)

Faculty of Science.

Board of Studies in Statistics.

B.A. Second Year Programme Minor - Statistics

Semester	III & IV	
Title of Paper	Sem.	Total Credits 4
I) Statistical Methods-I	III	2
II) Practical based on statistical Methods-I		2
Title of Paper		Credits
I) Statistical Methods-II	IV	2
II) Practical based on Statistical Methods-II		2
From the Academic Year		2025-26

Semester-III

Minor-I

Name of the course: Statistical Methods -I

Sr. No.	Heading	Particulars
1	Description the course : Including but Not limited to :	Introduction: Statistical Methods-I paper covers basic concept of probability and probability distribution which is useful to gain in-depth knowledge of probability and standard discrete distributions of other than statistics students of same faculty.
2	Vertical :	Minor
3	Type :	Theory
4	Credit:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted :	30 Hours
6	Marks Allotted:	50 Marks

Credit:2	MINOR SUBJECT STATISTICAL METHODS-I	No. of Hours: 30
	<p>CO2: Students will be able to,</p> <ol style="list-style-type: none"> 1. Understand the concept of probability and its applications. 2. Differentiate between random and non-random experiment. 3. Understand the meaning of continuous and discrete random variable. 4. Understand discrete distributions and their properties. 5. Solve the examples of probability <p>OC2: On successful completion of this course Students Should be able to,</p> <ol style="list-style-type: none"> 1. Calculate probabilities and conditional probabilities. 2. Identify the types of events. 3. Compute the expectation of the univariate discrete random variable. 4. Write probability mass functions (pmf) of various discrete distribution and their real-life applications. 5. Apply the concept of probability in real-life situations. 	
Unit	Elementary Probability Theory	Lectures

I	<ul style="list-style-type: none"> • Definitions: Trial, random experiment, sample point and sample space. • Definition of an event and different types of events: compound event, complementary event, equally likely events, certain event, impossible event, mutually exclusive and exhaustive events. • Different definitions of Probability: Classical (Mathematical), Empirical(Statistical) and Axiomatic definitions of Probability. Properties of probability • Conditional probability. • Independence of events, pairwise and mutual independence of three events. • Theorems (with proof)and their applications: <ul style="list-style-type: none"> i. Addition theorem on probability for two and three events ii. Multiplication theorem on probability for two events. iii. Bayes' theorem. 	10
Unit	Discrete random variables	Lectures
II	<ul style="list-style-type: none"> • Random variable: discrete and continuous random variables. Definition and properties of probability mass function . cumulative distribution function. • Raw and Central moments (definition only) and their relationship. (up to order four). • Concepts of Skewness and Kurtosis and their uses for random variables. • Expectation and variance of a random variable. Theorems and properties on Expectation and variance of random variables with proof. • Joint probability mass function of two discrete random variables. • Marginal and conditional distributions. • Covariance and Coefficient of Correlation. Independence of two random variables. 	10
Unit	Standard Discrete Probability Distributions	Lectures
III	<ol style="list-style-type: none"> 1. Definition and derivation of mean and variance of the following distributions: 2. Discrete Uniform distribution 3. Bernoulli and Binomial distributions 4. Poisson distribution 5. Hypergeometric distribution 6. Geometric distribution. 	10

	<p>7. Recurrence relation for probabilities of Binomial and Poisson distributions.</p> <p>8. Poisson approximation to Binomial distribution (only statement) and its applications.</p>	
--	--	--

Reference Books

1. David S. : Elementary Probability, Cambridge University Press.
2. Hoel P.G. : Introduction to Mathematical Statistics, Asia Publishing House.
3. Hogg R.V. and Tannis E.P. : Probability and Statistical Inference. McMillan Publishing Co. Inc.
4. Pitan Jim : Probability, Narosa Publishing House.
5. Goon A.M., Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II : The World Press Private Limited, Calcutta.
6. Mukhopadhyay P. An Introduction to the Theory of Probability, World Scientific Publishing Company, 2011.
7. Grewal P. S, Methods of Statistical Analysis, Sterling Publishers, 1990
8. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons

Format of Question Paper:

Internal Continuous Assessment: (20 marks)

5Assignment/viva Quizzes, Class Tests, presentation, project, assignment etc	Class Test	Total
05	15	20

Semester End Examination: (30 marks)

Semester End Examination will be of 30 marks of 01 hour duration covering entire syllabus of the semester. Examiners should frame sub questions for Q.1, Q2 and Q3. Each question carrying 15 marks. Attempt any two out of three questions.

Theory Question Paper Pattern:

Q 1	Max. marks: 15	Attempts any two questions out of Three.
Q 2	Max. marks: 15	
Q 3	Max. marks: 15	

Semester-III**Minor-I****Name of the course: Practical based on Statistical Methods -I**

Sr. No.	Heading	Particulars
1	Description the course : Including but Not limited to :	Introduction: Statistical Methods-I paper covers basic concept of probability and probability distribution which is useful to gain in-depth knowledge of probability and standard discrete distributions of other than statistics students of same faculty.
2	Vertical :	Minor
3	Type :	Practical
4	Credit:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted :	60 Hours
6	Marks Allotted:	50 Marks

Credit: 2	Minor Practical Paper- I	No. of Hours: 60
	List of Practical on Statistical Methods-I	
	<ol style="list-style-type: none">1. Probability 12. Probability 23. Univariate Discrete random variable4. Bivariate Discrete random variable5. Binomial Distribution6. Poisson Distribution7. Hypergeometric Distribution8. Geometric distribution. Practicals using EXCEL	

Reference Books

1. Medhi J. : Statistical Methods, An Introductory Text, Second Edition, New Age International Ltd.
2. Agarwal B.L. : Basic Statistics, New Age International Ltd.
3. Spiegel M.R. : Theory and Problems of Statistics, Schaum' s Publications series. Tata McGraw-Hill.
4. Kothari C.R. : Research Methodology, Wiley Eastern Limited.
5. David S. : Elementary Probability, Cambridge University Press.
6. Hoel P.G. : Introduction to Mathematical Statistics, Asia Publishing House.
7. Hogg R.V. and Tannis E.P. : Probability and Statistical Inference. McMillan Publishing Co. Inc.
8. Pitan Jim : Probability, Narosa Publishing House.
9. Goon A.M., Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II :The World Press Private Limited, Calcutta.
10. Elhance D. N, Elhance V, Aggarwal B. M, Fundamentals of Statistics, Kitab Mahal Daryaganaj New Delhi, 2018.
11. Mukhopadhyay P. An Introduction to the Theory of Probability, World Scientific Publishing Company, 2011.
12. Grewal P. S, Methods of Statistical Analysis, Sterling Publishers, 1990
13. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
14. Schaum Series book in O.R. Richard Bronson. 2nd edition Tata McGraw Hill Publishing Company Ltd.
15. Operations Research: Methods and Problems: Maurice Sasiemi, Arthur Yaspan and Lawrence Friedman, (1959), John Wiley & Sons.
16. Mathematical Models in Operations Research : J K Sharma, (1989), Tata McGraw Hill Publishing Company Ltd.
17. Principles of Operations Research with Applications to Management Decisions: Harvey M. Wagner, 2nd Edition, Prentice Hall of India Ltd.
18. Operations Research: S.D.Sharma. 11th edition, KedarNath Ram Nath & Company.
19. Operations Research: H. A.Taha. 6th edition, Prentice

Format of Practical Question Paper:**Internal Practical Continuous Assessment: (20 marks)**

Journal	Assignment/Viva	Total
05	15	20

Semester End Practical Examination: (30 marks)

Semester End practical Examination will be of 30 marks of 01 hour duration covering all practical listed above of the semester. Examiners should frame questions for Q.1, Q.2 and Q.3. Each question carrying 10 marks. All questions are compulsory to solve.

Practical Question Paper Pattern:

Q 1	Max. marks: 10	All questions are compulsory.
Q 2	Max. marks: 10	
Q 3	Max. marks: 10	

A student must have a certified journal before appearing for the practical examination.

In case a student does not possess a certified journal, he/she is not qualified for journal 5 marks

For each paper minimum 75% of the practical must be completed to the journal certified.

Semester-IV
Minor
Statistical Method-II

Sr. No.	Heading	Particulars
1	Description the course : Including but Not limited to :	Introduction: Statistical Methods-II paper covers basic concept of probability and probability distribution which is useful to gain in-depth knowledge of probability and standard discrete distributions of other than statistics students of same faculty.
2	Vertical :	Minor
3	Type :	Theory
4	Credit:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted :	30 Hours
6	Marks Allotted:	50 Marks

Credit:2	MINOR SUBJECT STATISTICAL METHODS-II	No. of Hours:30
	<p>CO2: Students will be able to,</p> <ol style="list-style-type: none"> 1. Understand the fundamental concepts of continuous probability distributions. 2. Study the concept of estimate and estimator. 3. Understand the concept of testing of hypothesis and large sample test. <p>OC2: Students Should be able to,</p> <ol style="list-style-type: none"> 1. Explain the continuous probability distributions such as Uniform, Exponential, Normal distributions and apply to real life applications. 2. Compute mean, variance and standard deviations for continuous probability distributions. 3. Apply testing of hypothesis technique to solve statistical problems. 	
Unit	Continuous Probability Distributions	Lectures

I	<ul style="list-style-type: none"> • Concept of continuous random variable, probability density function and its properties. Cumulative distribution functions of continuous random variables and its properties. • Definition and derivation of mean, variance and median of Uniform and Exponential distributions. Memory less property of Exponential distribution. • Normal distribution. Properties of Normal distribution (without proof). Normal approximation to Binomial and Poisson distribution (statement only). Properties of Normal curve. Use of normal tables. 	10
Unit	Estimation	Lectures
II	<ul style="list-style-type: none"> • Sampling from a distribution: Concept of a statistic, parameter, estimate and estimator, sampling distribution of statistic. • Concept of bias and standard error of an estimator. • Central Limit theorem (statement only). 	10
	<ul style="list-style-type: none"> • Sampling distribution of sample mean and sample proportion. (For large sample only) • Standard errors of sample mean and sample proportion. • Point and Interval estimate of single mean, single proportion from sample of large size. • Point and interval estimate of difference between two means and proportions. 	
Unit	Testing of Hypothesis and Large Sample Test	Lectures
III	<p>Testing of hypothesis:</p> <ul style="list-style-type: none"> • Concept of hypothesis • Simple and composite hypothesis • Null and alternate hypothesis • Test statistic, Critical region, Types of error, Level of significance and power of the test. <p>Large sample tests:</p> <ul style="list-style-type: none"> • For testing specific value of population mean • For testing specific value in difference of two means • For testing specific value of population proportion • For testing specific value of difference of population proportion (development of critical region is not expected) 	10

Reference Books

1. Agarwal B. L, Basic Statistics, New Age International P Ltd. Delhi, 2015
2. Saxena S., Kapoor J. N., Mathematical Statistics, Sultan Chand & Sons, Delhi, 2010
3. Gupta S. P, Statistical Methods, Sultan Chand and Sons, New Delhi, 2002
4. Kapoor V. K, Gupta S. C, Fundamental of Mathematical Statistics, S Chand & Sons, Delhi, 2008
5. Grewal P. S. Methods of Statistical Analysis, Sterling Publishers, 1990
6. Mukhopadyay P., An Introduction to the theory of Probability, World Scientific Publishing Company, 2011

Format of Question Paper:

Internal Continuous Assessment: (20 marks)

Assignment/viva Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	Class Test	Total
05	15	20

Semester End Examination: (30 marks)

Semester End Examination will be of 30 marks of 01 hour duration covering entire syllabus of the semester. All questions are Compulsory.

Theory Question Paper Pattern:

Q 1	Attempt any one question out of two questions (Module I and II)	Max. marks: 10
Q 2	Attempt any two questions out of three questions (Module I)	Max. marks: 10
Q 3	Attempt any two questions out of three questions (Module II)	Max. marks: 10

Semester-IV**Minor-II****Name of the course: Practical based on Statistical Methods -II**

Sr. No.	Heading	Particulars
1	Description the course : Including but Not limited to :	Introduction: Statistical Methods-II paper covers basic concept of continuous probability distribution, estimation theory and hypothesis testing methods which is useful to gain in-depth knowledge of given concept for other than statistics students of same faculty.
2	Vertical :	Minor
3	Type :	Practical
4	Credit:	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5	Hours Allotted :	60 Hours
6	Marks Allotted:	50 Marks

Credit: 2	Minor Subject Practical on Statistical Methods-II	No. of Hours: 60
	<p>CO2: Students will be able to,</p> <ol style="list-style-type: none"> 1. Understand the fundamental concepts of continuous probability distributions. 2. Study the concept of estimate and estimator. 3. Understand the concept of testing of hypothesis and large sample test. <p>OC2: Students Should be able to,</p> <ol style="list-style-type: none"> 1. Explain the continuous probability distributions such as Uniform, Exponential, Normal distributions and apply to real life applications. 2. Compute mean, variance and standard deviations for continuous probability distributions. 3. Apply testing of hypothesis technique to solve statistical problems. 	

	List of Practicals on Statistical Methods -II	
	<ol style="list-style-type: none">1. Continuous Random Variable2. Uniform and Exponential Distribution3. Normal Distribution and application of central limit theorem4. Point and Interval Estimation.5. Testing of Hypothesis6. Large Sample Test <p>Practical's using EXCEL</p>	60

Reference Books

- 1 Medhi J.: Statistical Methods, An Introductory Text, Second Edition, New Age International Ltd.
- 2 Agarwal B. L.: Basic Statistics, New Age International Ltd.
- 3 Spiegel M. R.: Theory and Problems of Statistics, Schaum's Publications series. Tata McGraw-Hill.
- 4 Kothari C. R.: Research Methodology, Wiley Eastern Limited.
- 5 David S.: Elementary Probability, Cambridge University Press.
- 6 Hogg R. V. and Tannis E.P.: Probability and Statistical InferenceMcMillan Publishing Co. Inc.
- 7 Goon A. M., Gupta M. K., Dasgupta B.: Fundamentals of Statistics,Volume II : The World PressPrivate Limited, Calcutta.
- 8 Miller I. & Miller M (2006), John E. Freund's Mathematical Statistics with applications, 7thedition, Pearson Education Asia
- 9 Gupta, S. C. and Kapoor, V. K. (2002), Fundamentals of Mathematical Statistics, eighth Edition,Sultan Chand and Sons Publishers, New Delhi.
- 10 Gupta, S. C. and Kapoor, V. K. (2004), Fundamentals of Applied Statistics, Third Edition, SultanChand and Sons Publishers, New Delhi.
- 11 Sarma, K. V. S. (2001). Statistics Made it Simple: Do it yourself on PC.Prentce Hall of India,New D

**Format of Practical Question Paper:
Internal Practical Continuous Assessment: (20 marks)**

Journal	Assignment/Viva	Total
05	15	20

Semester End Practical Examination: (30 marks)

Semester End practical Examination will be of 30 marks of 01 hour duration covering all practical listed above of the semester. Examiners should frame questions for Q.1, Q.2 and Q.3. Each question carrying 10 marks. All questions are compulsory to solve.

Practical Question Paper Pattern:

Q 1	Max. marks: 10	All questions are compulsory.
Q 2	Max. marks: 10	
Q 3	Max. marks: 10	

A student must have a certified journal before appearing for the practical examination.

In case a student does not possess a certified journal, he/she is not qualified for journal 5 marks

For each paper minimum 75% of the practical must be completed to the journal certified.

Sd/-
Sign of the BOS
Chairman
Dr. Santosh Gite
Board of Studies in
Statistics

Sd/-
Sign of the
Offg. Associate Dean Dr.
Madhav R. Rajwade
Faculty of Science &
Technology

Sd/-
Sign of the Offg.
Dean
Prof. Shivram S. Garje
Faculty of Science &
Technology

As Per NEP 2020

University of Mumbai



Syllabus for CC

Ad- hoc Board of Studies in N.C.C./N.S.S./Sports Co-Curricular

UG First Year Programme – National Service Course

Semester	III & IV	
Title of Paper	Sem	Credits
Study of Indian Social Reformers	III	2
Youth and Disaster Management	IV	2
From the Academic Year		2025-26

UNIVERSITY OF MUMBAI

Semester III

(w.e.f. June, 2025)

Sub: - NSS- Study of Indian Social Reformers

Credits: 02

Lectures: 30

Marks:50

Unit Number	SEMESTER 3 Title of the Unit	No. of Lecture	No. of Credits
1	History of Social work in India	15	1
	Social Reformers: Definition, concept and Nature		
	History of Indian Social Reformers		
	Characteristics Indian Social Reformers - Pre-Post Independence		
	Skills for NSS volunteers:		
	Soft Skills for NSS Volunteers – Communication skills, Public speaking skills, Body Language, Content writing, Resume writing.		
	Life Skills – problem solving, Empathy, coping with emotions, self- Awareness and inter personal skills.		
2	Contributions of Social Reformers	15	1
	• Mahatma Gandhi		
	• Swami Vivekanand		
	• Sant Gadge Baba		
	• Mahatma Jyotiba Phule		
	• Rajshri Shahu Maharaj		
	• Baba Amte		
• RajaRam Mohan Roy			

References –

- 1) Fadake G. D., (Sampadak) – Mahatma FuleSamagraWangmaya.
- 2) Salunkhe P.B., (Sampadak) – Mahatma FuleGouravGranth.
- 3) NarkeHari,(Sampadak) -Mahatma Fule :ShodhachyaNavyaWata.
- 4) Bhosale S. S., (Sampadak) –KrantiSukte: RajarshiChhatrapatiShahu
- 5) PawarJaysingrao, (Sampadak) –RajarshiShahuSmarakGranth
- 6) Dr. BabasahebAmbedkarlekhanaaniBhashanekhand 18, Bhag –1,2,3.
- 7) ToksalePrajecta -VyavysaikSamajkarya

- 8) Dr. V.C. Dande : National Service Scheme Review
- 9) Joshi V.N.-BhartiyTatvdnyanachabruhadItihas, Khand10
- 10) YadiIndumati -BharatratnaShendgeDipak (Anuwad) -MadarTeressa.
- 11) Marathi Vishwakosh, Khanda12.
- 12) Bhagat R.T. - Swami VivekanandTeAcharyaVinoba.
- 13) ShethPurushottam, KhambeteJayashri, Mane ShailajaRashtriyaSevaYojna
- 14) MishrAnupam - AajBhikharehaiTalab(Hindi)
- 15) ThotePurushottam–SamajkaryachiMultatve
- 16) Bhide G.L.,MaharashtratilSamajSudharanechaItihaas

UNIVERSITY OF MUMBAI

Semester IV

(w.e.f. June, 2025)

Sub: - NSS- Youth and Disaster Management

Credits: 02

Lectures: 30

Marks:50

Unit Number	SEMESTER 4 Title of the Unit	No. of Lecture	No. of Credits
1	Youth and Disaster Management- Meaning and Types of Disasters – Natural and Man-Made disasters, preparedness, Disaster Risk reduction: Preparedness, Mitigation, Response, Relief, Rehabilitation, Reconstruction.	10	
2	Project:	20	
	• Project work is mandatory for all the students in IV semester.		
	• They can carry out project work under the supervision of the teacher in-charge of NSS and at the end of the semester a project report shall be presented and viva voce shall be conducted.		
	• The Project work can be carried out independently or in a group.		
	The project work shall be community based and selected preferably from the adopted villages/ slums/ neighborhoods.		
Project Submission and Presentation VIVA-VOCE			

Note:

1. Above Paper will be exempted if the learner is involved in NSS as Volunteer and Successfully completes 60 hours in each Semester.
2. If learner as a NSS Volunteer attends any Camps at National/State/University/District/ College Special Camp will be exempted from either **Sem II OR Sem IV** Paper provided they produce Certificate of Participation or Attendance in Camp certified by the Programme Officer.

**Evaluation Pattern
Internal Assessment**

Assessment Criteria	Marks
Assignment / Project / Quiz/Presentations	10
Attendance, Class and Activity Participation	10
Total	20

**External Assessment
Question Paper Pattern**

Time: 1:00 Hours

Total Marks: 30

- Introduction:-**1. All questions are compulsory.
2. Figure to the Right indicates full marks.
3. Draw neat labeled drawings wherever necessary.
-

Q.1) Rewrite the following by choosing the correct options given below
(with four alternatives) 6 Objectives question of 1 mark each **06 marks.**

1. a) b) c) d)
2. a) b) c) d)

Q.2) Short Notes . (Any Two out of Four) **06marks**

- 1.
- 2.
- 3.
- 4.

Q.3) Answer the following questions (Any Three out of Five) **18 marks**

- 1.
 - 2.
 - 3.
 - 4.
 - 5.
-

NSS Project Report Format

(For Projects in Adopted Area / Village)

➤ **Cover Page**

- Name of the Institution
- Title of the Project (e.g., "Cleanliness Drive in XYZ Village")
- Name(s) of Student Volunteer(s)
- Name of Programme Officer
- Duration of the Project
- Date of Submission

➤ **Certificate**

- Issued by the Programme Officer/NSS Coordinator certifying the successful completion of the project.

➤ **Acknowledgment**

- Brief section to thank authorities, community members, NSS coordinators, peers, etc.

➤ **Index**

- A table listing all sections with corresponding page numbers.

1. Introduction
2. Profile of the Adopted Area / Village
3. Objectives of the Project
4. Planning and Preparation
5. Implementation of Activities
6. Outcomes and Impact
7. Challenges Faced
8. Feedback
9. Conclusion and Suggestions

➤ **Annexures**

- Photographs (with captions)
- Survey forms or questionnaires used
- Newspaper clippings (if any)
- Charts, posters, or flyers prepared

Sd/-

**Sign of the BOS
Chairman
Dr. Sunil Patil
Ad-hoc Board of
Studies in
N.C.C./N.S.S./Sports
Co-Curricular**

Sd/-

**Sign of the
Offg. Associate Dean
Dr. C.A.Chakradeo
Faculty of
Interdisciplinary
Studies**

Sd/-

**Sign of the
Offg. Associate Dean
Dr. Kunal Ingle Faculty
of Interdisciplinary
Studies**

Sd/-

**Sign of the
Offg. Dean
Prof. A. K. Singh
Faculty of
Interdisciplinary
Studies**