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:**	**Introduction to Communication Skills in English I** 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=15 Hours for Theory in a semester)
5	**Hours Allotted:**	30Hours
6	**Marks Allotted**:	50Marks
7	**Course Objectives:** 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. P*rofessional 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 Heasiey. 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/rAPl0fSborU 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/p4OyCNctKXg
- Video on the English language: Where did English come from? https://youtu.be/YEaSxhcns7Y

12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** • 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) **Suggested Activities:** ▪ 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	**Format of Question Paper:** for the final examination 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 –24/11/2023
Item No. – 6.2 (N)

As Per NEP 2020

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** **R. _____**	A	One Year
		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 enables 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 aim 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 Struture Sem I & II)

	R: _____A									
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC, RP**	**Cum. Cr. / Sem.**	**Degree/ Cum. Cr.**
		Mandatory	**Electives**							
	I	**6**		**-**	**2+2**	**VSC:2, SEC:2**	**AEC:2, VEC:2, IKS:2**	**CC:2**	**22**	**UG Certificate 44**
		• Programming 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**	
		• OOPs with C++ - 02 • Web Designing - 02 • Practical II - 02				• VSC : Assembly Language Programming – 02 • SEC: 02 • Web Programming **OR** • 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 Majorand 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**	
		• Python Programming -02 • Python Programming Practical-02 • Data Structures-02 • Data Structures Practical-02				VSC : Operating Systems-02				**UG Diploma 88**
	R: _____D									
	IV	**6**		**4**	**2**	**SEC:2**	**AEC: 2**	**CEP : 2 CC: 2**	**22**	
		• Core Java - 02 • Core Java Practical-02 • Software Engineering-02 • Software Engineering Practical-02				• 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 Continuewith 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**	
		• Advanced Web Programming-02 • Advanced Web Programming Practical-02 • Business Intelligence-02 • Business Intelligence Practical-02 • Software Project Management-02	• Linux Administration-02 • Linux Administration Practical-02 OR • EARN-02 • EARN Practical-02 OR • Enterprise Java-02 Enterprise Java Practical-02			• Advanced Mobile Programming-02		FP: Project Dissertation-02	22	**UG Degree 132**
	R: _____E									
	VI	**10**	**4**	**4**				**OJT:4**	**22**	
		• Security in Computing -02 • Security in Computing Practical-02 • AI and ML-02 • AI and ML Practical-02 • Software Quality Assurance-02	• Enterprise Networking-02 • Enterprise Networking Practical-02 OR • Principles of GIS-02 • Principles of GIS Practical-02					• 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:**	
	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	**15 Hrs**
	Module 2:	

	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	**Books and References:** 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	**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: 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):** CO 1. To make students aware fundamentals of database system. CO 2. To give idea how ERD components helpful in database design and implementation. CO 3. To experience the students working with database using MySQL. CO 4. To familiarize the student with normalization, database protection and different DDL, DML, DQL, DCL Statements CO 5. To make students aware about importance of protecting data from unauthorized users.		
8	**Course Outcomes (OC):** OC 1. Define and describe the fundamental elements of relational database management system. OC 2. To relate the basic concepts of relational data model, entity-relationship model, relational database OC 3. Design ER-models to represent simple database application scenarios. OC 4. Understand the normalization and its role in the database design process OC 5. Transform the ER-model to relational tables, populate relational database and formulate SQL OC 6. Understand basic database storage structures and access techniques: file and page organizations, indexing methods and hashing.		
9	**Modules:-** **Module 1:**		
	1. Introduction to Databases and transactions What is database system, purpose of database system, view of data, relational databases, database architecture, transaction management **2. Data Models** The importance of data models, Basic building blocks, Business rules, The evolution of data models, Degrees of data abstraction **3. Database Design, ER-Diagram** Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, Codd's rules, Relational Schemas **4. Relational database model** Logical view of data, keys, integrity rules		**15 Hrs**

	Module 2:	
	1. Database Design theory and normalization: Basics of functional dependencies and normalization for relational databases. Relational database design and further dependencies. **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 **3. Transaction management and concurrency control and recovery:** Introduction to transaction processing concepts and theory. Concurrency control technique. Database recovery technique	. **15 Hrs**
10	**Text Books** 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 3. Database Systems: Design implementation and management by Carlos Coronel, Steven Morris, Peter Rob	
11	**Reference Books** 1. "Database System Concepts", Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw Hill, 2017 2. "MySQL: The Complete Reference", Vikram Vaswani , McGraw Hill, 2017 3. "Learn SQL with MySQL: Retrieve and Manipulate Data Using SQL Commands with Ease", Ashwin Pajankar, BPB Publications, 2020	
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 1

Sr.No.	Heading	Particulars
1	**Description the course : Including but Not limited to:**	Programming with C -practical This course is stepping stone to learn other languages. This course provides students hands on experiences of coding exercises and projects. . Database Management System's 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):** CO 1. To provide exposure in developing algorithm, flowchart and to write efficient code. CO 2. To understand loops and decision making in programming. CO 3. To understand the arrays, structures, union. CO 4. To understand the use of function and pointers. CO 5. To Identify entities and its relationship with relational model structure. CO 6. To understand relational database using SQL and constraints implementation using create table queries. CO 7. To Understand DML operations and backing of database CO 8. To understand how to retrieve data from database and learn how to retrieve single value after performing calculations on group of values CO 9. To understand built-in functions to perform operations on data CO 10. To understand how to fetch data from two or more tables, which is joined to appear as single set of data CO 11. To understand nested and larger query as advanced fetching of data to understand concept of virtual table. CO 12. To understand how to control user access in a database.	

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	**Module 1:- Programming with C** **1. Practical 1**:- a. To calculate simple interest taking principal, rate of interest and number of years as input from user. Write algorithm & draw flowchart for the same. b. Write a program to find greatest of three numbers using conditional operator. Write algorithm & draw flowchart for the same. c. Write a program to check if the year entered is leap year or not. Write algorithm & draw flowchart for the same. **2. Practical 2:-** a. Write a program to calculate roots of a quadratic equation. b. Write a menu driven program using switch case to perform add / subtract / multiply / divide based on the users choice. c. Write a program to print the pattern of asterisks. **3. Practical 3** a. Write a program using while loop to reverse the digits of a number. b. Write a program to calculate the factorial of a given number. c. Write a program to print the Fibonacci series. **4. Practical 4** a. Write a program to print area of square using function. b. Write a program using recursive function. c. Write a program to square root, abs() value using function. d. Write a program using goto statement . **5. Practical 5** a. Write a program to print rollno and names of 10 students using array. b. Write a program to sort the elements of array in ascending or descending order **6. Practical 6** a. Write a program to extract the portion of a character string and print the extracted part. b. Write a program to find the given string is palindrome or not. c. Write a program to using strlen(), strcmp() function . **7. Practical 7** 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. **8. Practical 8** a. Write a program to read a matrix of size m*n. b. Write a program to multiply two matrices using a function. **9. Practical 9** Write a program to print the structure using Title Author Subject Book ID Print the details of two students. **10. Practical 10** Create a mini project on “Bank management system”. The program should be menu driven.	**30 Hrs**

		Module 2 1. Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.) 2. Perform the following: • 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: • Altering a Table • Dropping/Truncating/Renaming Tables • Backing up / Restoring a Database 4. Perform the following: • Simple Queries • Simple Queries with Aggregate functions 5. Queries involving • Date Functions • String Functions • Math Functions 6. Join Queries • Inner Join • Outer Join 7. Subqueries • 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 • Creating Views (with and without check option) • Dropping views • Selecting from a view 10. DCL statements • Granting and revoking permissions • Saving (Commit) and Undoing (rollback)	**30 Hrs**
10	**Text Books:** 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		
11	**Reference Books:** 1. MASTERING C, K. R. Venugopal and Sudeep R. Prasad, Tata McGraw-Hill Publications. 2. “A Computer Science –Structure Programming Approaches using C”, Behrouz		

	Forouzan, Cengage Learning. 3. Schaum's outlines "Programming with C", Byron S. Gottfried, Tata McGraw-Hill Publications. 4. "Basics of Computer Science", Behrouz Forouzan , Cengage Learning. 5. "Programming Techniques through C", M. G. Venkateshmurthy, Pearson Publication. 6. "Programming in ANSI C", E. Balaguruswamy, Tata McGraw-Hill Education. 7. "MySQL: The Complete Reference", Vikram Vaswani , McGraw Hill, 2017. 8. "Learn SQL with MySQL: Retrieve and Manipulate Data Using SQL Commands with Ease", Ashwin Pajankar, BPB Publications, 2020.	
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	

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:**	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. 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. The course will cover the various techniques and tools used in digital circuit design, including Boolean algebra and K-map simplification. 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. 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. 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. 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,

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

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

	f. Design of 3-bit synchronous counter using 7473 and required gates. g. Design of 3-bit ripple counter using IC 7473. **9. Study of counter ICs and designing Mod-N counters.** 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) **10. Design of shift registers and shift register counters.** 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** 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	**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 Course (SEC)

Name of the Course: Office Tools for Data Management

Sr.No.	Heading	Particulars
1	**Description the course:**	• **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):**	

	CO 1. Participants will grasp essential database concepts, including tables, relationships, and normalization principles. CO 2. Participants will design and construct well-organized databases in MS Access, showcasing proficiency in table design and data validation. CO 3. Participants will master the creation of complex queries in MS Access, enabling them to extract specific information efficiently. CO 4. Participants will develop expertise in crafting user-friendly forms and interfaces in MS Access, optimizing data entry processes. CO 5. Participants will generate comprehensive reports in MS Access, demonstrating skills in grouping, sorting, and presenting data for meaningful analysis.	
8	**Course Outcomes (OC):** OC 1. Participants can explain normalization importance, identify table relationships, and justify database design choices. OC 2. Participants create well-structured MS Access databases with proper relationships, data types, and normalization. OC 3. Participants execute advanced queries in MS Access, retrieving specific information based on diverse criteria. OC 4. Participants design intuitive MS Access forms, incorporating controls for an efficient and user-friendly data entry experience. OC 5. Participants produce insightful MS Access reports, organizing and presenting data effectively for analysis.	
9	**Modules:- All Practicals are based on MS Access** **Module 1:**	
	Practical 1: A. Getting familiar with MS Access Ribbon options. 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. 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. **Practical 2:** A. Create and use an Input Mask to enter the data in sample table. B. Adding records in table by using Datasheet View, using a Form and using SQL. C. Create the Employee Database with necessary table and data and then implement the following transitions: • 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". **Practical 3:** A. Create the Bookstore database with necessary table and data and modify the database to accommodate the following:	**30 Hrs**

		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. 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. 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. **Practical 4:** 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. **Practical 5:** 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:	
		Practical 6: 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. **Practical 7:** A. Demonstrate use of look up tables. B. Use the Report Wizard to create a report having the following requirements: 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.	**30 Hrs**

	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, 1st Edition, 2020. 2. Step by Step Microsoft Access 2013, by Joyce Cox and Joan Lambert, 1st Edition, Microsoft Press, 2013 3. Access 2019 Bible, by Michael Alexander, Richard Kusleika, Wiley, 1st Edition, 2018 4. Access 2019 For Dummies, by Laurie A. Ulrich, Ken Cook, Wiley, 1st 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:**	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. 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

		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.	

	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. 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. 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. 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. CO 6. Evaluate the challenges of small cells in 5G mobile networks and identify the capacity limits and achievable gains with densification.	
8	**Course Outcomes (OC):** OC 1. Identify the fundamental concepts and terminologies of signals and systems theory through an introduction to sets, mappings, functions, and systems operators. 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. 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. 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. 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. OC 6. Evaluate the challenges of small cells in 5G mobile networks and identify the capacity limits and achievable gains with densification.	
9	**Modules:-** **Module 1: Signals and Systems:** 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	**15 Hrs**
	Module 2: Fundamentals of 5G Networks	
	4. **Drivers for 5G:** Introduction, Historical trend of Wireless Communication, Evolution of LTE technology to beyond 4G, 5G	**15 Hrs**

	Roadmap, 10 pillars of 5G, 5G in Europe, 5G in Asia, 5G in Asia, 5G Architecture 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 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	
10	**Text Books:** 1. Signals and Systems, Michael Adams, University of Victoria, 3rd Edition, 2012 2. Fundamentals of 5G Mobile Networks, Edited by Jonathan Rodriguez, Wiley Publications, 2015	
11	**Reference Books** 1. Signals and Systems, Michael Adams, University of Victoria, 3rd Edition, 2012 2. Fundamentals of 5G Mobile Networks, Edited by Jonathan Rodriguez, Wiley Publications, 2015	
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)	

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):** CO 1. To explain the difference between object oriented programming and procedural programming. CO 2. To understand OOP principles to create modular, reusable, and maintainable code. CO 3. To understand the concept of polymorphism ,virtual functions,inheritance and exception handling. CO 4. To understand file handling concepts using C++.	
8	**Course Outcomes (OC):** OC 1. Students can explain the key concept of OOP and their application in software development. OC 2. Students can Design and implement classes and objects to model real-world entities. OC 3. Students can apply the concepts of polymorphism, virtual functions, inheritance and exception handling in program. OC 4. Students can apply operator overloading, runtime polymorphism, generic Programming OC 5. Students can implement file handling concepts in program	
9	**Modules:-** **Module 1:**	
	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. 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.	**15 Hrs**

	3. Constructors and Destructors: Introduction, Default Constructor, Parameterized Constructor and examples, Destructors. 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.	
	Module 2:	
	5. Polymorphism: Concept of function overloading, overloaded operators, overloading unary and binary operators. 6. Virtual Functions: Introduction and need, Pure Virtual Functions, this Pointer, abstract classes, virtual destructors. 7. Exception Handling: Introduction, Exception Handling Mechanism, Concept of throw & catch with example. 8. Working with Files: Introduction, File Operations, Various File Modes, File Pointer and their Manipulation.	**15 Hrs**
10	**Text Books** 1. Object-oriented Programming C++, Hari Mohan Pandey , Laxmi Publications 2. C++ Programming: An Object-Oriented Approach, Behrouz A. Forouzan, Richard F. Gilberg , McGraw-Hill Education 3. C++ How to Program , Paul Deitel, Harvey Deitel	
11	**Reference Books** 1. Object Oriented Programming in C++ , E Balagurusamy 2. Object-Oriented Programming in C++ , Robert Lafore, Pearson Education. 3. Programming with ANSI C++ , Bhushan Trivedi 4. Demystified Object- Oriented Programming with C++, Dorothy R. Kirk	
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: 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, onDblClick, 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** 1. Step by Step HTML5 by Faithe Wempen, Microsoft Press,2011 2. The Complete Reference HTML & CSS, Thomas A. Powell. McGrawHill, 5 th 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, 2ed Kindle Edition,by DT Editorial Services 6. JSON at work ,Tom MArrs,O'REILLY,First edition,2017	
11	**Reference Books** 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 usng 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. WherereadNo() 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 itssum

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 staticfunction

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

NAME	SUBJECT	MARKS

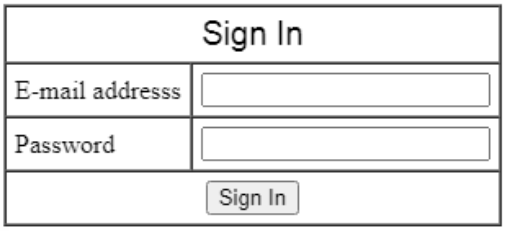
30 Hrs

Hillary	Advanced Web	75
	Operating System	60
Lary	Advanced Web	80
	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



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.

	8. Java Script : Handling the events a.Using java script, demonstrate the use of onAbort, onBlur, onChange, onClick, onDblClick events b. Using java script, demonstrate the use of onDragDrop, onError, onFocus events c. Using java script, demonstrate the use of onKeyDown, onKeyPress, onKeyUp, onLoad, onReset, onResize, onSelect, onSubmit, onUnload events d. Using java script, demonstrate the use of onMouseDown, onMouseMove, onMouseOut, onMouseOver, onMouseUp, onMove events. e. Using java script, demonstrate the use of onKeyDown, onKeyPress, onKeyUp, onLoad, onReset, onResize, onSelect, onSubmit, onUnload events 9. JQuery a. use JQuery effect in page b. Write a jQuery Code to find the data passed with the on() method for each element. c. Use JQuery Events d. JQuery traversal and manipulation 10. JSON Basics and Working with JSON a. Creating JSON b. Parsing JSON c. Persisting JSON d. Demonstrate use of JSON objects in array, print array on web page using document object e. Read data from json file and convert it into a JavaScript object and display the data in web page using document object	
10	Text Books 1. Object-oriented Programming C++, Hari Mohan Pandey 2. C++ Programming: An Object-Oriented Approach, Behrouz A. Forouzan, Richard F. Gilberg 3. C++ How to Program, Paul Deitel, Harvey Deitel 4. Step by Step HTML5, Faithe Wempen, Microsoft Press,2011 5. The Complete Reference HTML & CSS, Thomas A. Powell. McGraw Hill, 5th Edition,2010	
11	**Reference Books** 1. Object Oriented Programming in C++, E Balagurusamy 2. Object-Oriented Programming in C++ by Robert Lafore 3. Programming with ANSI C++, Bhushan Trivedi 4. Demystified Object- Oriented Programming with C++, Dorothy R. Kirk 5. Learning Web Design A Beginner's Guide to Html, CSS, JavaScript, And Web Graphics, Jennifer Niederst Robbins, O'Reilly, 5th Edition,2018. 6. "Web Enabled Commercial Applications Development using HTML, DHTML, Javascript, Perl CGI", Ivan Bayross, BPB, 2004 7. HTML 5 for Web Designers (By: Jeremy Keith) – http:// freepdf-books.com	
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	

Vocational Skill Courses (VSC)

Name of the Course: Assembly Language Programming

Sr.No.	Heading	Particulars
1	**Description the course : Including but Not limited to:**	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. 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. 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. 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. 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

		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 **2. Simple assembly language programs.**	**30 Hrs**

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 4002Hand 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 l'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 I'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 I, 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	**Text Books** 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:**	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. 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. 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. 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.
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)** **CO1:** To understand how to use Java script objects and XML. **CO2:** To create well organized, styled web pages **CO3:** To add versatility to a web page using jQuery **CO4:** To deploy a local web server and run a simple web application. **CO5:** To read and process data in MySQL using PHP. **CO6:** To understand usage of Bootstrap	
8	**Course Outcomes (OC)** OC1: Knowledge in different java script objects. OC2: How to use XML with CSS and XSL OC3: validate a form using jQuery OC4: handle asynchronous requests OC4: Write and deploy PHP with database and to simplify web development. OC5: Create a responsive layout using the Bootstrap	

	9	**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.	**30 Hrs**
		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	**30 Hrs**
	10	**Text Books** • 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	

	• PHP: A Beginners Guide, Vikram Vaswani, TMH	
11	**Reference Books** • 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 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		**30 Hrs**

	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)

<table>
<tr><td rowspan="4">I</td><td colspan="2">A Theory of 2 credits is evaluated for a total of 50 Marks</td></tr>
<tr><td>Internal Continuous Assessment:</td><td>40%[20 Marks]</td></tr>
<tr><td colspan="2">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</td></tr>
<tr><td colspan="2">External Semester End Examination: 60%[30 Marks]</td></tr>
<tr><td colspan="3">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)</td></tr>
<tr><td rowspan="4">II</td><td colspan="2">A Practical of 2 credits is evaluated for a total of 50 Marks</td></tr>
<tr><td>Internal Continuous Assessment:</td><td>40%[20 Mrks]</td></tr>
<tr><td colspan="2">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.</td></tr>
<tr><td colspan="2">Semester End Examination: 60%[30 Marks]</td></tr>
<tr><td colspan="3">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</td></tr>
</table>

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

Appendix B

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. – 6.6 Sem. I (2b)

As Per NEP 2020

University of Mumbai

Syllabus for Basket of OE	
Board of Studies in Information Technology	
UG First Year Programme	
Semester	**I**
Title of Paper	**Credits 2/ 4**
I. **IT_Google Workspace** (Open Elective) [OE]	**2**
From the Academic Year	**2024-2025**

Name of the Course: IT_Google Workspace

Sr.No.	Heading	Particulars
1	**Description the course : Including but Not limited to:**	Google Workspace is a collection of cloud-based productivity tools that are designed to help individuals and organizations to work and collaborate efficiently. This course will provide an introduction to applications such as Gmail, Google Drive, Google meet and Google Calendar Google Docs, Google Sheets, Google Slides, Google Forms, Google Classroom.
2	**Vertical :**	**Open Elective**
3	**Type :**	Practical
4	**Credits :**	2 credits
5	**Hours Allotted :**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives(CO):** CO 1. Understand Google Workspace and its applications. CO 2. Gain proficiency in key features of Google workspace application. CO 3. Acquire proficiency in Google workspace to collaborate, manage tasks and communicate effectively. CO 4. Leverage possibilities of Google workspace tolls to enhance productivity and streamline workflow.	
8	**Course Outcomes (OC):** OC 1. Manage email communications with Gmail. OC 2. Schedule and organize meetings and events using Google Calendar. Arrange and attend video meetings with Google Meet, Communicate with others using Google Chat. OC 3. Save , manage, and share files with Google Drive. OC 4. Generate and collaborate documents, spreadsheets and presentations. OC 5. Design Google Forms and collect data for surveys . Generate reports based on the collected data and integrate it with other Google Workspace applications. OC 6. Use Google Classroom to digitally organize, distribute, and gather assignments, course materials, and feedback. OC 7. Navigate confidently and make use of the numerous functionalities of Google Maps. OC 8. Able to design, develop, and maintain informative and visually appealing websites using Google Sites.	
9	**Modules:-** **Module 1:**	

1. **Google Workspace & Mastering email communication with Gmail**: Overview of Google Workspace, Setting up a Google account and accessing Google Workspace, Set Profile information and Photo, Send and Receive emails, Organize emails using labels, filters, and stars for easy retrieval and management, Utilize Gmail's advanced features like scheduling emails, snoozing emails, and setting reminders.
   a. Create a Gmail account. Write a brief email to your friends inviting them to a meeting to discuss a possible industrial visit. Attach a document file with the many options for places to visit.
2. **Google Calendar , Meet and Chat** : Create a new calendar, Create an event in Google Calendar, Set remainders and alarms , Share a Calendar with Other People ,Integrate with Gmail and other apps. Scheduling and managing Google Meet events, Features in Google Meet like screen sharing, chat, annotations and recording, Creating public and private Google Chat rooms ,Inviting and managing participants in Google Chat rooms, Utilizing Chat room features like sharing files, links, and multimedia, pinning messages, and polls.
   a. Create a new event in Google Calendar for an event happening on a specific date and time. Set a reminder to alert you one day prior to the event. Share your Google Calendar with a specific email address and grant them view-only access.
   b. Set up a meeting with your project partners, choose the suggested security configurations, and send a meeting invite to the participants via email. Begin the meeting by letting everyone into the meeting room. To demonstrate to them the project's progress, share your screen. Use chats to send brief messages and share relevant documents.
3. **Google Drive** :Managing files and folders in Google Drive, Sharing files and folders with collaborators and setting access permissions.
   a. Create a project folder in Google drive. Add a PowerPoint presentation detailing project milestones and a Word document with project guidelines to the folder. Share the folder and allow the project team members to edit it.
4. **Google Docs**: Document creation with Google Docs, Apply Basic Formatting to Text , Inserting Images, Creating tables, Format a document with styles, Using Find and Replace, Using Regular Expressions for Advanced Searching, Sharing and Collaborating on files.
   a. Create a one page document which best describes you. Add the document's heading and page numbers. Make a list of your hobbies using bullet points. Employ formats and typefaces to give the document an elegant look. To highlight your skills, use hyperlinks to other documents in the folder. Include a picture of yourself on the page as well. Add a table with your educational background in it. Write about your positive college experiences by voice typing. After that, translate the document's content into a different language of your choice.
5. **Google Sheets** :Insert, delete and manage sheets , Insert a Function, Format Spreadsheets, Cells, and Ranges, Apply Number Formatting

	and Conditional Formatting, Insert and View Notes, Choose Spreadsheet Settings, Merge Cells, Wrap and Rotate Cell Contents, Inserting Objects in Google Sheets, Sort and Filter Data, Apply Data Validation to Your Sheets, Protect Ranges in a Sheet, Protect a Sheet, Create and Manage Macros. a. Create a Personal budget sheet, list all your expenses and incomes of the month in the sheet. Use sum function to total the income and expenses. Use IF function to find if the budget is in deficit or not.
	Module 2:
	1. **Google Slides**: Add a Slide to a Presentation, Import Slides from an Existing Presentation, Understanding and Using Views, Work with Text Boxes, Add Audio and Video to a Slide, Insert Shapes and Word Art, Add a Transition and Animations, Edit a Slide Master, Organize the Slides in a Presentation a. Open a new Google Slides presentation titled “Project Presentation”. Add slides to provide a summary of your project. Use themes and transitions to make the slide experience better. 2. **Google Forms**: Create a Form, Choose Settings for a Form, Add Questions to a Form, Add Images to a Question, Add a Video to a Question, Import Questions from an Existing Form, Create a Form with Multiple Sections, Control Progression Based on Answers, Add Collaborators to a Form, Preview and Test a Form, Send a Form to Its Respondents, View the Responses to a Form, Analyse form responses and generate reports. a. Create a Google Form to accept participation entries for the various events your department is organizing on the annual day. Mention the details of event in the form description. Include a dropdown menu to select the events they wish to participate in. Insert relevant multimedia to make the Google Form attractive. b. Create an online evaluation quiz using Google Form. Include a variety of question formats, such as ones with pictures, videos, etc. Assign points to the questions. Share the link with your friends and check out the the summary of the responses. 3. **Google Classroom**: Create and set up a Google Classroom, Add Students and Co-Teachers, Using Google Classroom to share resources, Create assignment, Set due dates and points, Use rubrics for grading, Integrate quizzes created using Google Form with Google Classroom. a. Create a Google Classroom for a certain subject that includes a range of topics, resources, and activities. Include resources for each topic, such as Word docs, PowerPoints, and YouTube links. Include elements that encourage participation and interaction, such as assignments and discussions. 4. **Google Maps:** Search on Maps, Different Map Views (Satellite, Terrain, Street View), Customizing Maps, Get to your destination, Sharing Maps with Others. a. Use google maps to explore local landmarks in your area. Find directions from your current location to a nearby restaurant. Use Maps to check the places you have visited on a particular day.

	5. **Google Sites**: Creating and building simple websites using Google Sites, Adding content, images, and widgets to websites. a. Assume you runs a small business. Create a visually appealing website which includes the following pages: Home page , About the business, Products page, Announcement of discounts.	
10	**Text Books and Online Resources** 1. **Hart-Davis, G. (2021). Teach Yourself Visually Google Workspace. Visual.** 2. **https://support.google.com/a/users#topic=9247638** 3. **https://support.google.com/edu/classroom#topic=10298088** 4. **https://support.google.com/maps/?hl=en#topic=9729258**	
11	**Reference Books** **1. Team, Z. (2017). The Ultimate Guide to G-Suite. Lean Pub G-Suite.** **2. Iyer, b. (2022). Google workspace user guide: a practical guide to using google apps efficiently while integrating them with your data.**	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%**
13	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	
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	

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. – 6.6 Sem. II (1b)

As Per NEP 2020

University of Mumbai



Syllabus for Basket of OE (Scheme I)	
Board of Studies in Mathematics	
UG First Year Programme	
Semester	**II**
Title of Paper	**Credits**
1. Logic and Data Interpretation – II	**2**
2.	**2**
3.	**2**
From the Academic Year	**2024-25**

Name of the Course: Logic and Data Interpretation – II (OE – II)

Sr. No.	Heading	Particulars
1	**Description the course:** **Including but Not limited to:**	This course deals with the Logical Thinking and Data Interpretation, that forms an essential component of Most of the Competitive and Entrance Examinations, such as Banking, Management Entrance, UPSC/MPSC, SET/NET, GMAT/GRE to quote a few. The nature of the problems and the difficulty level of the questions is quite high and a person appearing for such exams is expected to have a thorough understanding of the concepts, to have ability to think logically, and to be able to interpret the data, presented in different manner.
2	**Vertical :**	Open Elective
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 revises the basic mathematical concepts learned during school career. However, the problems asked in this course would be mostly advanced and indirect, and would demand broader and critical thinking. The course aims to enhance the reasoning power and logical thinking of the learners and nurture their intellect so as to make them competent across all competitive exams. CO1. To reinforce the basic math concepts and ideas within the learners CO2. To improve the cognitive power of the learners and make them think over and apply concepts/formulae to solve math problems of indirect nature, thereby developing their problem-solving capacity. CO3. To develop rational thinking of the learners CO4. To make learners competent across all competitive and entrance examinations	
8	**Course Outcomes (OC):** After completion of the course, the learners will be able to OC1: think logically about the problems related to clocks OC2: understand the nature of the calendars, find out the day related to any date in past/future OC3: develop logical thinking and realize the hidden pattern amongst the sequence of figures/diagrams	

	OC4: understand the representation of data in various forms OC5: understand the idea behind displaying data in a web-like diagram and comparing between two sets of data OC6: develop logical thinking to extract information from various graphs, charts, and tables representing data.
9	**Modules:-** **Module 1: Logic and Data Interpretation** 1. Clocks • The proportion of the speeds of different hands of a clock • The angles between the several positions of the hands • Coincidental and collinear but oppositely directed hour-hand and minute hand 2. Calendars • Review of the standard Gregorian calendar, with emphasis on Leap Year (1900 wasn't a leap year but 2000 was!) • Number of weeks in a year • Forward movement of the days with respect to dates (E.g. 1 Jan 2023 was Sunday, but 1 Jan 2024 is Monday) 3. Figures and Images • Sequence of diagrams, identifying the various patterns by which the figures/diagrams undergo changes and then predicting the next (or in between) figure/diagram. • Understanding images of various shapes/figures in mirror and water. Finding out the actual shape from its images in water/mirror. [The problems to be asked should be of varied levels of difficulty. A few ones based on directly applying a given formula may be asked at the beginning; however, the latter ones should demand critical analysis of the given information and a thoughtful selection of the method/formula to solve the same.]
	Module 2: Data Interpretation 1. Types of data: Qualitative and Quantitative 2. Tabulation: Reading and understanding data presented in a tabular form. 3. Interpreting data represented by Bar Graph, Pie Chart, Line graph, Scatter Diagram, Histogram etc. 4. Caselet Data Interpretation – Questions/Problems based on a long paragraph of information. 5. Web-based data interpretation – Display of data in a web-like diagram, Two sets of data and their comparison, Analysing the data 6. Missing Data Interpretation - Filling the missing values in the table from the additional information given or by applying logical thinking.
10	**Text Books** 1. Data Interpretation for CAT, Nishit k Sinha 2. Data Interpretation & Analysis, Aashish Arora

<table>
<tr><td></td><td colspan="2">3. Logical and Analytical Reasoning: Useful for All Competitive Exams, A. K. Gupta</td></tr>
<tr><td>11</td><td colspan="2">Reference Books

1. Arithmetic : Subjective And Objective For Competitive Examinations, R. S. Agarwal
2. A Complete Book on Data Interpretation & Analysis and A Complete Book for Seating Arrangement and Puzzles, Adda247 Publications
3. Reasoning for Competitive Examinations, Nishit K Sinha</td></tr>
<tr><td></td><td colspan="2"><u>Scheme of the Examination</u></td></tr>
<tr><td></td><td colspan="2">The performance of the learners shall be evaluated into two parts.
• Internal Continuous Assessment of 20 marks for each paper.
• Semester End Examination of 30 marks for each paper.
• Separate head of passing is required for internal and semester end examination.</td></tr>
<tr><td>12</td><td>Internal Continuous Assessment: 40%</td><td>Semester End Examination: 60%</td></tr>
<tr><td>13</td><td>Continuous Evaluation through:
Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc.
(at least 3)
<table>
<tr><th>Sr. No.</th><th>Particulars</th><th>Marks</th></tr>
<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>
</table>
Paper pattern of the Test (Offline Mode with One hour duration):
Q1: Definitions/Fill in the blanks/ True or False with</td><td></td></tr>
</table>

	Justification. (04 Marks: 4 x 1). Q2: Attempt any 2 from 3 descriptive questions. (06 marks: 2 × 3)	

14 **Format of Question Paper:**

The semester-end examination will be of 30 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/OC2 (b) Question based on OC3 (c) Question based on OC4 (d) Question based on OC5/OC6	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/OC2 (b) Question based on OC3 (c) Question based on OC4 (d) Question based on OC5/OC6	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/OC2 (b) Question based on OC3 (c) Question based on OC4 (d) Question based on OC5/OC6	15 Marks

Sign of the BOS Chairman
Dr. Bhausaheb S Desale
The Chairman, Board of Studies in Mathematics

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

AC – 24/11/2023
Item No. – 8.2 (N) -5

As Per NEP 2020

University of Mumbai

Title of the Course

Foundation of Behavioural skills – Basic level

Semester – Sem I

Syllabus for Two Credit

(With effect from the academic year 2024-25)

PROGRAM	BA /BSc/ BCOm
SEMESTER	I
COURSE TITLE	Foundation of Behavioural skills Basic level
VERTICLE /CATEGORY	E (Value Education Course)
COURSE LEVEL	50
COURSE CODE	
COURSE CREDIT	2
HOURS PER WEEK THEORY	2
HOURS PER WEEK PRACTICAL/TUTORIAL	

COURSE OBJECTIVE

1. To develop understating about behavioural Skills.

2. To develop communication skills of students through experiential learning.

3. Life skill development through work life balance and stress management training.

4. To developing effective leadership quality among the learners.

COURSE OUTCOME

CO1: Learners will be able to Define and Identify different life skills required in personal and professional life

CO2: Learners will develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.

CO3: Learners will be able to explain the basic mechanics of effective communication and demonstrate these through presentations and take part in group discussions

CO4: Learners will be able to use appropriate thinking and problem-solving techniques to solve new problems

ORGANISATION OF THE COURSE		
UNIT NO	COURSE UNITS	HOURS PER WEEK
1	Module 1: Behavioural skills	2*5=10
2	Module 2: Stress Management	2*2=04
3	Module 3: 21st-century skills	2*5=10
4	Module 4: Understanding Value Education	2*3=6
	TOTAL HOURS	30

COURSE DESIGN

UNIT TITLE	OUTCOME	DESCRIPTION	PEDAGOGICAL APPROACH
Behavioural skills	Learners will be able to Define and Identify different life skills required in personal and professional life.	Overview of Life Skills: Meaning and significance of life skills, skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem solving, Effective communication, interpersonal relationship, coping with stress, coping with emotion. Life skills for professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, helping others, leadership, motivation, self-motivation, and motivating others, personality development, IQ, EQ, and SQ2.	Examples, TED Talks, videos.

Stress Management	Learners will develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.	Stress, reasons and effects, identifying stress, stress diaries, the four A's of stress management, techniques, Approaches: action-oriented, emotion-oriented, acceptance-oriented, resilience, Gratitude Training, Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques.	Examples, Role Plays, Behavioral Simulations and Games
21st-century skills	Learners will be able to explain the basic mechanics of effective communication and demonstrate these through presentations and take part in group discussions	Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking,	Case Discussions, Games and simulations, Group discussions.
Understanding Value Education	Learners will be able to use appropriate thinking and problem-solving techniques to solve new problems	Introduction – Definition, Importance, Process & Classifications of Value Education: Understanding the need, basic guidelines, content and process for Value Education Understanding the thought-provoking issues; need for Values in our daily life Choices making – Choosing, Cherishing & Acting, Classification of Value Education: understanding Personal Values, Social Values, Moral Values & Spiritual Values.	Case Discussions, Games and simulations, Community Service, Presentations

CONTINUOUS ASSESSMENT TESTS (CAT) & SEMESTER END EXAMINATION (SEE)			
NATURE OF ASSESSMENT	**MARKS**	**METHODOLOGY**	**COURSE OUTCOME**
CAT 1 *	10	Online Quiz, Open book test, Presentations, Projects and Viva	CO1
CAT 2 *	05	Presentations, Projects and Viva	CO1, CO2
CAT 3 *	10	Online Quiz, Open book test, Presentations, Project Assignment and Viva	CO3
CAT 4 *	05	Presentations, Projects and Viva	CO4
SEE	30	Five questions of 10 marks each (from each course unit), to be attempted any 3, 10 marks may be subdivided into two sub questions of 5 marks	CO1, CO2,CO3, CO4

*Any Two for 20 marks

ESSENTIAL READINGS	**1.** R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics. 2. Shiv Khera, "You Can Win" , Macmillan Books, New York, 2003. 3. Barun K. Mitra, "Personality Development & Soft Skills", Oxford Publishers, Third impression,2017.
ADDITIONAL READINGS	The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change Stephen Covey Free Press (first published August 15th 1989)

Syllabus Drafting Committee

Prof. Dr. Aruna Deshpande

Prof. Dr. Tejashree Deshmukh

Mr. Nitin Vazirani

Signature

Prof. Kavita Laghate

Mr. Bhooshan Mailkani — Chairman of Board of Studies in Value Education

Dr. Vinita Pimple

AC – 24/11/2023
tem No. – 8.4 (N) - 1

As Per NEP 2020

University of Mumbai

Title of the Program

Co-Curricular Course
Introduction to Sports, Physical Literacy, Health and Fitness and Yog

SEM I

Syllabus for Two Credit

(With effect from the academic year 2024-25)

Semester I
Course Structure

Semester	Paper	Title of Paper	No of lecture (Theory)	Internal Evaluation (IE)	End Semester Evaluation	Total Marks	Credits
First	CC	Introduction to Sports, Physical Literacy, Health & Fitness and Yoga	30	20	30	50	02
Second	CC	Introduction to Sports, Physical Literacy, Health & Fitness and Yoga	30	20	30	50	02
Total	**-**	**-**	**60**	**40**	**60**	**100**	**04**

Semester I

1.1 Preamble:

India is growing rapidly as a global super-power. To face the challenges of the century and to keep up with the pace of the world, maintaining health is of prime importance. Giving thrust to healthy society, Physical Education, Sports, Health & fitness and Yoga are of great significance in today's world. The Government of India insists on Physical Fitness, Mental Health and Overall Development of Personality for every citizen. In these lines, the Government has launched Fit India Movement, Khelo India, TOPS and National Sports Day, International Day of Yoga etc. These initiatives have given impetus and awareness among general public, professional and academicians. However, creating efficient and skilled human resource in the field of Physical Education, Sports and Yoga is identified as the need of the hour. Thus, the Governments of India and Government of Maharashtra have included Physical Education, Sports and Yoga as a key area under the NEP 2020.

1.2 Objectives of the Course:

1. To make students familiarize with concepts of Health, Fitness, Yoga, Sports & Physical Literacy.
2. To sensitize the students about background knowledge of Sports structure of Sports Federations, Indian Olympic Association, Khelo India Schemes, FIT India movement, National Sports Day, Intercollegiate Sports structure of University of Mumbai.

3. To familiarize the students with the various physical education concepts and information regarding various Olympic Sports.
4. To make students aware about famous sports personalities and various awards given to Sportsperson and coaches.
5. To educate students regarding various career opportunities in the sports management, sports coaching, sports industry, health and fitness, sports infrastructure, yoga, etc.
6. The course is designed primarily to educate those interested in becoming a Physical Literacy Trainer/Ambassador as well as those who wish to stay lifelong active and want to influence others to be active for life.

1.3 Salient features of the course:

1. The course is designed to enhance the Competency, attitude and skills related knowledge to Physical Literacy, health & fitness, Sports & Yoga.
2. The course is design to implemented as per CBCS pattern .

1.4 Utility of the course:

1. The course may provide opportunity in the field of physical education, sports management, health & fitness, yoga, etc.
2. The course is significant to enhance the abilities of the student to work in the different fields of physical education in the area of coaching, event management, health & fitness, yoga etc.
3. The professional abilities and personality of the students may be enhanced.

1.5 Program outcomes:

By the end of the program the students will be able to:

1. The curriculum would enable the pass out students to be entrepreneur (to start their own fitness center, gym, yoga studio etc.) and device appropriate fitness program for different genders and age groups at all level
2. The curriculum would enable to officiate, supervise various sports events and organize sports events.
3. Students acquire the knowledge of Physical Education, Sports and Yoga and understand the purpose and its development.
4. The student learns to plan, organize and execute sports events.
5. Student will learn theoretical and practical aspects of game of his choice to apply at various levels for teaching, learning and coaching purposes efficiently.
6. Student acquires the knowledge of opted games, sports and yoga and also learns the technical and tactical experience of it.
7. Student will learn to apply knowledge of Physical fitness and exercise management to lead better quality life.
8. Students will understand and learn different dimension of active life style.
9. Student will learn the knowledge of nutrition and diet.
10. Students will be able to assess the physical fitness in a scientific way.
11. The students will be able to continue professional courses and research in Physical Education, sports and yoga.
12. It helps the student to understand theory and practical aspects of physical literacy. These aspects include role of motivation and confidence, how to focus on positive experience, new styles of teaching, inclusive session planning and review the progress in physical activities.

1.6 Programme Duration: The structure of Sports & Physical Literacy has two semesters in total covering a period of two years.

1.7 Duration of the Course:. First Year comprises two semesters. Each semester will have theory paper 30 marks for End Semester Examination and 20 marks for Internal Evaluation for each paper.

1.8 Modes of Internal Evaluation: Assignment, Tutorial, Presentation, MCQs via Google, Field Visits, any other suitable mode along with marks for Attendance of the students.

1.9 Medium of Instruction: English

1.10 Course Structure

Credits: 02 **Lectures: 30** **Marks: 50**

Unit Number	Title of the Unit	No. of Lecture	No. of Credits
1	**Introduction to Sports, Physical Literacy, Health & fitness and Yoga** 1.1 Meaning and Definition of Sports, Physical Literacy, Health & Fitness and Yoga 1.2 Aim, Objectives & Importance of Sports, Physical Literacy, Health & Fitness and Yoga 1.3 History of Sports, Physical Literacy, Physical Education and Yoga 1.4 Modern trends of Sports, Physical Literacy, Health & Fitness and Yoga	15	1

2	**Introduction to Structure of Sports associations, Fitness Training & Yogic Asanas** 2.1 Various government schemes, awards and famous sports personalities 2.2 Sports Structure of Sports Federations, Khelo India, Sports Tournaments of University of Mumbai and Indian Olympic Association 2.3 Fundamental Principles of Fitness training and Yoga 2.4 Components of health related and skill related physical fitness 2.5 Types of Yogic practices – Asanas, Pranayama and Meditation	15	1

References –

1. Bucher, C. A. (n.d.) Foundation of physical education. St. Louis: The C.V. Mosby Co. Deshpande, S. H. (2014). Physical Education in Ancient India. Amravati: Degree college of Physical education.
2. Mohan, V. M. (1969). Principles of physical education. Delhi: Metropolitan Book Dep. Nixon, E. E. & Cozen, F.W. (1969). An introduction to physical education. Philadelphia: W.B. Saunders Co.
3. William, J. F. (1964). The principles of physical education. Philadelphia: W.B. Saunders Co.
4. Coalter, F. (2013) Sport for Development: What game are we playing? .Routledge.
5. Singh Hardayal (1991), Science of Sports Training, DVS Publication, New Delhi
6. Muller, J. P.(2000). Health, Exercise and Fitness. Delhi : Sports.
7. Russell, R.P.(1994). Health and Fitness Through Physical Education. USA : Human Kinetics.
8. Uppal, A.K. (1992). Physical Fitness. New Delhi : Friends Publication.
9. Nagendra, H. R. & Nagarathna, R. (2002). Samagra Yoga Chikitse. Bengaluru: Swami Vivekananda Yoga Prakasana.
10. Kumar, Ajith. (1984) Yoga Pravesha. Bengaluru: Rashtrothanna Prakashana.
11. D.M Jyoti, Yoga and Physical Activities (2015) lulu.com3101, Hills borough, NC27609, United States
12. D.M Jyoti, Athletics (2015) lulu.com3101, Hills borough, NC27609, United States
13. Gharote, M. L. & Ganguly, H. (1988). Teaching methods for yogic practices. Lonawala: Kaivalyadhama.
14. Pinto John and Roshan Kumar Shetty (2021) Introduction to Physical Education, Louis Publications, Mangalore
15. Shekar, K. C. (2003). Yoga for health. Delhi: Khel Sahitya Kendra.
16. Amit Arjun Budhe, (2015) Career aspects and Management in Physical Education, Sports Publication, New Delhi
17. Pinto John and Ramachandra K (2021) Kannada Version, Daihika Shikshanada Parichaya, Louis

Publications, Mangalore

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** • 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** □ Role of student cultural activities □ History of student cultural activities in India	05

		• 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**	**3.1 Forms / Types of Literary and Fine Arts Activities and its Applied Skills** **3.1.1 Various Forms of Literary Arts** • **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 **3.1.2 Various Forms of Fine Arts** • **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**

		• **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	**4.1 Forms / Types of Performing Arts Activities and its Applied Skills** **4.1.1 Various Forms of Dance** • **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 **4.1.2 Various Forms of Theatre** • History of Indian Theatre • Types and their Uniqueness • Significance of Indian Theatre • **Various Forms of Theatre**: One Act Play, Skit, Mime, Mimicry **4.1.3 Various Forms of Music** • History of Indian Music, • Types and their Uniqueness, • Significance of Music in India • **Various Forms of Music**: Classical Singing, Light Vocal, Percussion, Non-Percussion, Natyasangeet, 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 test- 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 – 24/11/2023
Item No. – 8.4 (N) - 3

As Per NEP 2020

University of Mumbai

Title of the Program

Co-Curricular Course
NATIONAL SERVICE SCHEME

SEM I & SEM II

Syllabus for Two Credit

(With effect from the academic year 2024-25)

UNIVERSITY OF MUMBAI
National Service Scheme

1.1 Preamble:
Students in the National Service Scheme are better able to comprehend all the most recent ideas. These courses include an Introduction to National Service Scheme that covers the concept of social services, which are a variety of public services meant to offer support and help to targeted specific groups, most often the underprivileged. They could be offered by individuals, autonomous, private entities, or under the management of a government body.

1.2 Objectives of the Course:
1. To Introduce National Service Scheme to learners and explain how it is used in current social studies.
2. To make the students aware of the need of having a foundation in social science and NSS.
3. To introduce students to social concepts and issues in society, as well as to get involved in resolving social issues.

1.3 Learning Outcomes of the Course: The students will be able to
1. The course will help students comprehend the foundations of the National Service Program.
2. To understand the unique camping program.
3. Students will learn about the regular activities of NSS.

1.4. Programme Specific Outcomes:
1. Students will be familiar with NSS fundamentals and history, particularly as they pertain to social work.
2. Students will recognize NSS and its ongoing operations.

1.5 Programme Outcomes:
1. Students will comprehend fundamental ideas and facts about the National Service Program.
2. Students will learn the essentials of NSS-related procedures.
3. Students will learn social work skills (such as Voter Awareness, Campus Cleanup, Tree Plantation, and Rallies).

1.6 Modes of Internal Evaluation: Assignment, Tutorial, Presentation, MCQs via Google, Field Visits, any other suitable mode along with marks for Attendance of the students.

UNIVERSITY OF MUMBAI
Semester I
NSS CC
Sub: - Introduction to National Service Scheme

Credits: 02 **Marks:50**

Unit Number	SEMESTER 1 Title of the Unit	No. of Lecture
1	**Introduction to National Services Scheme** NSS- History,Philosophy & Need of Emergence Aims, Objectives, Motto and Emblem of NSS, NSS Theme Song Organizational Structure of NSS-Hierarchy at different levels (National,State,University,College) Roles and Responsibilities of Program Officer Financial Provisions -Grant in Aid for NSS Advisory committees & their functions	15
2	NSS Programmes and Activities (Regular activities) NSS Programmes and Activities (Special Camp activities) Yearly Action Plan of NSS Unit Volunteerism– Meaning, definition, basic qualities of volunteers, need of volunteerism for National development. Opportunities in NSS for Volunteers (Various Camps) Report Writing	15

UNIVERSITY OF MUMBAI
Semester II
NSS CC
Sub: - Leadership and Community Engagement

Credits: 02 **Marks: 50**

Unit Number	SEMESTER 2 Title of the Unit	No. of Lecture	No. of Credits
1	**Leadership & Personality development:** Meaning, definition, qualities, and characteristics of a Leader. Meaning of personality, Dimensions of personality. Personality and Leadership nexus. Universal Human Values and Ethics for youths Sustainable Development Goals	15	
2	**Activity Based Programmes** (Suggestive list given below. Colleges can plan various social activities for learners and make a detailed report) Activities can be conducted throughout the academic year .Evaluation will be based on record keeping of the attendance of the learner. **Shramadhan – P**lantation, Cleaning, Watering, Weeding, Any other activities. **Awareness Programmes –** Seminar, Workshops, Celebration of National and International days, Personality Development Programmes, Group Activities, etc., Rally,Visit to Adopted villages, SwatchathaProgramme, Visit and Conserving Ancient monuments and heritage site, Socio Economic Survey of village/slum, Nature Camp, Environmental Education, Women Empowerment Programme, Health Camps, Blood grouping awareness and Blood donation, Legal awarenessProgramme, Literacy Programme, Water Conservation Programme,One Day Special Camp in a village (preferably in adopted village/Adopted areas/Slums/MR Schools etc).	30	

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.

References:

1. National Service Scheme Manual 2006, Government of India
2. Salunkhe P.B. Ed, Chhtrapati Shahu the Pillar of Social Democracy
3. National Service Scheme Manual, Govt. of India
4. Training Programme on National Programme Scheme TISS
5. Orientation Courses for N.S.S. Programme Officers, TISS
6. Hans Gurmeet, Case Material as a Training Aid for Field Workers
7. Tarachand, History of the Freedom Movement in India Vol.II
8. Kapil K. Krishan, Social Service Opportunities in Hospitals (TISS)
9. Ram, Social Problems in India.
10. Arnold, K. (2018). What is R.E.S.P.E.C.T. When it comes to teamwork? Available at: https://www.extraordinaryteam.com/what-is-r-e-s-p-e-c-t-when-it-comes-to-teamwork/
11. Barnard, I. C. (1938). Functions of the Executive. Boston: Harvard Press.
12. Barrett, R. (2013). The Values-driven Organisation: Unleashing Human Potential for Performance andProfit. London: Fulfilling Books
13. Barret Values Center (2018). Values-based leadership. Available at: https://www.valuescentre.com/mapping-values/leadership/values-based- leadership
14. Bauman, D. C. (2013). Leadership and the three faces of integrity. The Leadership Quarterly, 24(3), 414-426.
15. Bishop, W. H. (2013). Defining the Authenticity in Authentic Leadership. The Journal of Values-BasedLeadership, 6(1), Article 7. Available at : https://scholar.valpo.edu/cgi/viewcontent.cgi?article=1077&context=jvbl
16. Bourne, P. A. (2016). Leadership as a service: a new model for higher education in a new century – a bookreview. Review of Public Administration and Management, 4, 196. Available at:https://www.omicsonline.org/open- access/leadership-as-a-service-a-new-model-for-higher-education-in-a- newcentury--a-book-review-2315-7844-1000196.php?aid=83165
17. Cameron, K. (2008). Positive Leadership. San Francisco: Berret-Koehler.
18. Clarke, S. (2018). Why your values are key to your leadership. Leaderonomic.com Available: https://leaderonomics.com/leadership/values- key-leadership
19. Clarke, N. (2011). An integrated conceptual model of respect in leadership

Credit Structure for 4 Years Honours/Honours with Research Degree Program with ME-ME B.Com.

For Faculty of Commerce

Self-Finance Programs also

Model M1

Academic Level	Semester	Major (M1) Mandatory	Major (M1) Elective	Minor (M2)	OE other Faculty	VSC, SEC (Related to core)	AEC, IKS, VEC	OJT, FP, CEP, CC, RP	Cum Cr/semester	Degree/ Cumm Cr.
4.5	I	2+2+2	-	-	2+2	VSC(2) SEC(2)	AEC(2), VEC(2), IKS(2)	CC (2)	22	UG Certificate 44
	II	2+2+2	-	2	2+2	VSC(2) SEC(2)	AEC(2), VEC(2)	CC (2)	22	
Exit Option Award of UG Certificate in Major with 44 Credits and additional 4 credits core NSQF Course/ Internship or continue with Major and Minor										
5.0	III	4+4		4	2	VSC(2)	AEC(2)	CC(2), FP(2)	22	UG Diploma 88
	IV	4+4		4	2	SEC(2)	AEC(2)	cc(2), CEP(2)	22	
Exit Option Award of UG Diploma in Major with 88 Credits and additional 4 credits core NSQF Course/ Internship or continue with Major and Minor										
5.5	V	4+4+2	4	4		VSC(2)		FP(2), CEP(2)	22	UG Degree 132
	VI	4+4+2	4	4				OJT(4)	22	
Exit option: Award of UG Degree in Major and Minor with 132 Credits of continue with Major and Minor										
6	VII	4+4+4+2	4	RM (4)					22	UG Honours Degree 176
	VIII	4+4+4+2	4					OJT(4)	22	
Four Year UG Honours Degree in Major and Minor with 176 credits										
6	VII	4+4+2	4	RM (4)				RP (4)	22	UG Honours with Research Degree 176
	VIII	4+4+2	4					RP(8)	22	
Four Year UG Honours with Research Degree in Major and Minor with 176 credits										

AC – 28.06.2024
Item No. – 8.1 (N)

As Per NEP 2020

University of Mumbai

Syllabus for Indian Knowledge System	
Board of Studies in Indian Knowledge System	
UG First Year Programme	
Semester	**I OR II**
Title of Paper	**Credits 2 for either I or II Semester**
I) Indian Knowledge System	
From the Academic Year	**2024-2025**

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	**Vertical :**	Major/Minor/Open Elective /Skill Enhancement / Ability Enhancement/Indian Knowledge System (Choose By √)
3	**Type :**	Theory / Practical
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**: (List some of the course objectives) 1. To sensitize the students about context in which they are embedded i.e. Indian culture and civilisation including its Knowledge System and Tradition. 2. To help student to understand the knowledge, art and creative practices, skills and values in ancient Indian system. 3. To help to study the enriched scientific Indian heritage. 4. To introduce the contribution from Ancient Indian system & tradition to modern science & Technology.	
8	**Course Outcomes**: (List some of the course outcomes) 1. Learner will understand and appreciate the rich Indian Knowledge Tradition 2. Lerner will understand the contribution of Indians in various fields 3. Lerner will experience increase subject-awareness and self-esteem 4. Lerner will develop a comprehensive understanding of how all knowledge is ultimately intertwined	
9	**Modules**:-	
	Module 1: (10 Hours)	
	1. Introduction to IKS (What is knowledge System, Characteristic Features of Indian Knowledge System) **2.** Why IKS? (Macaulay's Education Policy and its impact, Need of revisiting Ancient Indian Traditions) **3.** Scope of IKS (The Universality of IKS (from Micro to Macro), development form Earliest times to 18th Century CE) **4.** Tradition of IKS (Ancient Indian Education System: Home, Gurukul, Pathashala, Universities and ancient educational centres) **5**. Relevant sites in the vicinity of the Institute (Water Management System at Kanheri, Temple Management of Ambarnath, etc.)	

	Module 2: (10 Hours)	
	1. Medicine (Ayurveda) **2.** Alchemy **3**. Mathematics **4.** Logic **5.** Art of Governance (Arthashastra)	
	Module 3: **(10 Hours) (Select Any FIVE out of the following)**	
	1. Aesthetics **2.** Town Planning **3**. Strategic Studies **4.** Krishi Shastra **5.** Vyakaran & Lexicography **6**. Natyashastra **7**. Ancient Sports **8**. Astronomy	**9**. Yoga and Wellbeing **10.** Linguistics **11.** Chitrasutra **12.** Architecture **13.** Taxation **14.** Banking **15.** Trade and Commerce
10	**Reference Books** **1.** Concise history of science in India- D.M. Bose, S.N Sen, B.V. Subbarayappa. **2.** Positive sciences of the Ancient Hindus- Brajendranatha seal, Motilal Banrasidas, Delhi 1958. **3.** History of Chemistry in Ancient India & Medieval India, P.Ray- Indian Chemicals Society, Calcutta 1956 **4.** Charaka Samhita- a scientific synopsis, P. Ray & H.N Gupta National Institute of Sciences of India, New Delhi 1965. **5.** MacDonnell A.A- History of Sanskrit literature **6.** Winternitz M- History of Indian Literature Vol. I, II & III **7.** Dasgupta S.N & De S.K- History of Sanskrit literature Vol. I. **8.** Ramkrishna Mission- cultural heritage of India Vol. I, II & III. **9.** Majumdar R. C & Pushalkar A.D- History & culture of the Indian people, Vol. I, II & III. **10.** Keith A.B- History of Sanskrit literature. **11.** Varadachari V- History of Sanskrit literature Chaitanya Krishna- A new History of Sanskrit	
11	**Continuous Internal Assessment: 20 Marks**	**Semester End Examination : 30 Marks**
12	**Continuous Evaluation through:** Assignment/ Presentations/ Projects (Group/Individual) / Field Visit Report **10 Marks,** class Test / MCQ Test **5 Marks,** Overall Conduct and Class Participation **5 Marks**	
13	**Format of Question Paper:** for the final examination Q1. Attempt any TWO Questions out of FIVE. **6 Marks** Q2. Attempt any THREE Questions out of SIX 1**2 Marks** Q3. Attempt any THREE Questions out of SIX. 1**2 Marks**	

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

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

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



University of Mumbai

Guidelines for On-the-Job Training (OJT)
for Post Graduate Students
As per NEP 2020

DRAFT

With effect from 2023-24

Index

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2. Objectives
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1. Introduction:

With the introduction of NEP 2020, the higher education programs in India are gearing up to combine theoretical learning with practical application. On-the-job training and internships are tools that provide students with opportunities to apply theoretical knowledge in real-world settings. This hands-on experience helps bridge the gap between classroom learning and practical application.

Internships and on-the-job training programs also offer students the chance to develop essential skills that employers highly value. These include communication skills, problem-solving abilities, teamwork, and adaptability. By working in a professional environment, students gain valuable experience that enhances their employability. They also learn to navigate professional environments, manage responsibilities, and overcome challenges. This experiential learning fosters independence, confidence, and self-awareness, which are essential for success in both career and life.

Furthermore, students get a first-hand look at various industries and career paths. This exposure allows them to explore different fields, understand industry trends, and identify areas of interest. It also helps students make more informed decisions about their career paths after graduation. At the same time, students get valuable networking opportunities. They interact with professionals in their field, build relationships, and expand their professional network. These connections can benefit future job opportunities, mentorship, and career guidance.

Experience gained through internships/ on-the-job training certainly adds value to students' resumes. Employers often look for candidates with practical experience; internships give students a competitive edge in the job market. In addition, a successful internship can sometimes lead to full-time employment opportunities with the same organization.

It is with this backdrop that the University of Mumbai has crafted its OJT policy in light of the NEP 2020 framework as well as the guidelines provided by the Higher and Technical Education Department, Government of Maharashtra (2024) and **UGC** Guidelines for Internship/Research Internship for Undergraduate Students **2023.**

An Internship/OJT programme aims to provide students or recent graduates with practical

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work experience related to their field of study or career interests. Internships may focus on skill development, career exploration, or both.

According to the UGC guidelines, in an internship programme, students are required to participate in work experience or professional activity, or cooperative education activity with an entity external to the education institution, under the supervision of an expert from the given external entity. A prime aspect of the internship is induction into actual work situations. Internships and OJTs include working with government or private organizations, educational institutions, research and development labs/research organizations/non-government organizations, enterprises, centres involved in research, innovativeness and entrepreneurship, business organizations, local industry, artists, craftspeople, farmers-producer organizations and similar other entities for providing opportunities to students for active engagement in on-site experiential learning.

On-the-job training (OJT) is a practical approach to acquiring new competencies and skills needed for a job in a real, or close to real, working environment. It provides the trainees with opportunities to practice skills and apply their knowledge under the most realistic conditions possible, which are the actual job conditions.

2. **OJT Objectives**:

An OJT programme in general sets out to achieve objectives such as

1. Align classroom learnings with workplace outcomes.
2. Provide students with real-world work experience and align their expectations with job demands.
3. Combine physical and digital learning modes in industry settings, blended with mentorship.
4. Foster research skills, including knowledge discovery, analytical tools, methodologies, and ethical conduct.
5. Introduce students to emerging technologies and their applications in various fields.
6. Strengthen students' entrepreneurial skills and encourage job creation.

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7. Facilitate problem-solving, decision-making, teamwork, and collaboration.
8. Foster social awareness and philanthropic values among students.
9. Encourage collaboration between Higher Education Institutes (HEIs), industry, and academia for internships and research opportunities.
10. Instill professional principles, ethics, values, and integrity to meet employment market demands and social needs.

3. **OJT outcomes**:

After the completion of the OJT programme, the student will be able to;

- apply concepts learned in classrooms to real-world work environments, enhancing their understanding and skills.
- show insights into the challenges, opportunities, and culture of different workplaces, preparing them for future employment.
- navigate through various learning modalities effectively through exposure to hybrid learning models.
- show evidence of research aptitude and skills of critical thinking, analytical skills, and ethical research conduct in the conduct, and communication of their work
- use and appreciate the use of emerging technologies and their applications, enhancing their technological literacy and adaptability.
- display problem-solving abilities in making informed decisions in complex scenarios through practical situations.
- work in teams and collaborate to achieve common goals in diverse work environments through collaborative projects.
- give examples and cite ways of contributing to the field of work in a manner that displays social responsibility and sustainability.
- display integrity in their dealings with their work and the people that they interact

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with by upholding professional; principles and ethical standards.

4. An indicative list of areas for OJT:

- Trade and Agriculture
- Economy & Banking Financial Services and Insurance
- Logistics, Automotive & Capital Goods
- Fast Moving Consumer Goods & Retail
- Information Technology/Information Technology Enabled Services & Electronics
- Handcraft, Art, Design & Music
- Healthcare & Life Science
- Sports, Wellness and Physical Education
- Tourism & Hospitality
- Digitization & Emerging Technologies (Internet of Things/Artificial
- Intelligence/Machine Learning/Deep Learning/Augmented Reality/Virtual Reality etc.)
- Humanitarian, Public Policy and Legal Services
- Communication
- Education
- Sustainable Development
- Environment
- Commerce, Medium and Small-Scale Industries

It may please be noted: This is only an indicative list and not an exhaustive one.

5. Role and responsibilities

Head of the Department (HOD)**:**

- To conduct an orientation session to familiarize students with the OJT purpose and process.
- To establish the code of conduct for the training period and guide students.
- To Assign department faculty members as mentors to OJT students.
- To ensure the OJT program aligns with departmental and institutional academic objectives.
- To Provide resources, training, or assistance to ensure effective supervision.

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OJT Coordinator[1]:

- To oversee the quality and effectiveness of the OJT program.
- To establish mechanisms for evaluating the program and making improvements.
- To act as a liaison between the department, students, faculty mentors, and OJT supervisors (Host institute/organization)

Student Coordinators[2]**:**

- To assist the OJT coordinator in pre-, during and post-OJT activities**.**

Faculty Mentor[3]:

- To assist in identifying OJT opportunities
- To monitor student progress and provide guidance
- To review and approve OJT plans
- To collect and review progress reports
- To evaluate OJT documentation including reports, presentations, or other required deliverables (if applicable)

Host Industry/organization/Institute[4] in the OJT process**:**

- To provide a conducive work and Learning Environment
- To Assign a supervisor
- To offer work exposure
- To aid the student in developing a work plan
- To collaborate with Educational Institutions and enhance networking opportunities

OJT Supervisor[5] (Host Institution/organization):

- To guide and direct interns/OJT students
- To provide students with hands-on training and skill development
- To provide feedback and performance evaluation
- To enhance networking and exposure

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[1] A faculty member from a college/university department who has been appointed to coordinate the OJT Cell activities.
[2] Two students studying in the second semester (PG) appointed by the Head of the department to assist the OJT coordinator.
[3] A faculty member from a college/University department who has been assigned to mentor a student/a group of students in their pre- OJT, During OJT and Post OJT phases.
[4] The organization/institute/industry that offers OJT to students
[5] Person who is designated by the host organization/industry to supervise a student/group of students during their OJT.

6. Process of OJT Implementation:

The Department/Centre/ Institute may consider the following Mechanism for the implementation of OJT:



1. To facilitate effective implementation of the OJT program, Colleges/Departments/Institutes are encouraged to establish an OJT Cell responsible for overseeing its smooth functioning. It will consist of the following: Head of the department, OJT Coordinator, Faculty Mentors and one/two student coordinators[6].
2. One teaching faculty member and one/two students from each postgraduate department will be nominated to serve as coordinators for the OJT program. These coordinators will play a crucial role in coordinating and implementing the program within their respective departments.

[6] The Department, however, may decide if they should have student coordinators, based the strength of the batch undergoing OJT.

3. The teacher coordinator will take the lead in preparing an action plan for the implementation of the OJT program. They will also be responsible for coordinating with the central team of the University/College to ensure alignment with broader institutional goals.
4. To streamline the administrative process, the Department/Centre will provide necessary formats to students for documentation related to the OJT program.
5. Each Department/Centre must ensure collaborations with 8-10 relevant organizations, industries, or research institutes. These collaborations will serve as crucial avenues for facilitating internship opportunities for students.
6. Furthermore, the College/Department/Centre/Institute is encouraged to explore and initiate the process of signing a Memorandum of Understanding (MOU) with local businesses, research organizations, and Higher Educational Institutions (HEIs). Such agreements will facilitate training, research, and potential employment opportunities for students.
7. Effective communication is key to the success of the OJT program. All communication about the program will be channeled through the designated OJT coordinator of the department/centre/Institute. This individual will also be responsible for maintaining relevant documents related to the program.
8. Before the commencement of the OJT program, an orientation session will be conducted by the Head of Department. This session will serve to familiarize students with the purpose, process, and code of conduct associated with the program.
9. In addition to orientation, the OJT Cell may design programs or workshops aimed at preparing students for their OJT/internship experience.
10. To ensure effective mentoring and support, an equal number of students will be allocated to each faculty member of the department. These faculty members will act as internship/OJT mentors and will be responsible for monitoring and evaluating the progress of the allotted students.
11. Once students are shortlisted for OJT/internship opportunities, they will consult with the internship/OJT coordinator and mentor. Upon obtaining due permission from the parent institution, students will join the host organization for their OJT/internship experience.
12. Throughout the OJT/internship period, students will maintain activity reports as per the provided format. These reports will be duly signed by the respective supervisor at

the host institution and submitted to their department mentors regularly.

13. Upon completion of the OJT/internship program, students must submit a completion certificate duly signed by the OJT supervisor or a competent authority designated by the host organization. Additionally, they are required to submit a report highlighting their learning and experiences during the internship period to the OJT coordinator.
14. To ensure transparency and accountability, students will also present their work done during the internship to the Department/Centre/Institute committee, which may consist of the OJT Coordinator and Department Mentor.
15. Finally, student feedback will be collected to evaluate the effectiveness of the OJT program and identify areas for improvement in both the program implementation and the broader curriculum.

7. Credits and Duration of On-the-Job Training (OJT):

a) On-the-job training (OJT) will carry a weightage of Four Credits.

b) Each student is required to complete one hundred and twenty clock hours of On-the-Job Training (OJT)[7].

c) The OJT program is to be completed during Semester II. According to the guidelines outlined in the National Education Policy (NEP), postgraduate students are expected to fulfil this requirement either within the second semester of their PG program or during the semester break following the second semester[8].

8. Evaluation of OJT:

Evaluation during the OJT program involves two key components: External Evaluation (50%) and Internal Evaluation (50%). The following is a suggested two-fold pattern of evaluation.

1. Host Organization Evaluation: The host organization will assess students based on criteria such as punctuality, completion of hours, and proficiency in required skill sets. They will also provide feedback on the student's overall performance.
2. Department Mentor Evaluation: Additionally, students will be evaluated by their department mentor based on their weekly reporting, written report, and viva voce/presentations.

[7] In the event that a student is unable to fulfill their obligation to report to their designated organization on a particular day due to medical or other critical reasons, they are required to promptly notify both their department and the organization.

[8] In case of the non-completion of On-the-Job Training (OJT) during the second semester, student must ensure that the backlog be completed before the conclusion of the third semester.

The suggested evaluation grid for the assessment:

External (OJT Supervisor, for instance)	Completion of Hours	Quality/Performance	Punctuality/Regularity	Total
	20	20	10	50
Department Mentor	Weekly Reporting	Written Report	Viva-Voce /Presentation	
	15	20	15	50
Total				**100**

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Appendices

Appendix I: OJT Undertaking

1. Student Name:	
2. Current Address	
3. Residence Address	
4. Email ID	
5. Mobile No.	
6. Aadhar	
7. PAN	
8. Overall GPA	
9. Mode of Internship	
I confirm that I agree with the terms, conditions, and requirements of the OJT Policy Student Signature: Date_____	
I confirm that the student has attended the OJT orientation, and he/she has met all paperwork and process requirements to participate in the OJT programme and has received approval from his/her mentor. Sign of Head of the Department/ Department Coordinator/Mentor Date_____	

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Appendix II: Draft Resume Template

Name
Contact Number and Email ID:

Education

HEI Name Year
Degree / Specialization:
CGPA:

HEI Name: <bachelor's degree> Year
Degree / Specialization:
CGPA:

Internship / Work Experience

organization Project: Year
Brief:

Academic Experience

Semester Year
Project:
Brief:

- Emphasize accomplishments that are relevant to the field
- Be specific—omit unnecessary words and sentences
- Start your sentence with an action verb, not a passive one-Use past-tense verb to show what you have accomplished Quantify results as much as possible
- Use keywords that will catch a recruiter's eye

Other Achievements and Personal Interests

- List other achievements also in reverse chronological order
- Leadership positions held outside your formal work environment
- Personal interests and accomplishments that will distinguish you from other applicants
- Volunteer service/Social Work

Languages known (Mention the level of Proficiency)

Computer Proficiency (Mention the skills you possess)

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Appendix III: organization Outreach Letter

<College/Department/Centre/Institute Letter Head>

To

The (Designation of the person addressed)

.....

Subject: Request for_____weeks/hours OJT of Students

pursuing_____

Dear Sir/Madam,

The (Name of the College/department/centre/Institute) established in _____, is one of the leading Colleges/departments that reflects the vision of leading industrialists and educationalists. The College/department/centre/Institute has been recognized for its overall academic excellence and infrastructure[9].

In view of the above, I request your good self to allow our following (no. of students) students for practical training in your esteemed organization. Kindly accord your permission and give at least one week for students to join training after confirmation.

Sr. No.	Name	Roll no.	Year	Department

The resumes of these students are attached to this letter. If vacancies exist, kindly plan for interviews for the students in the above branches.

A line of confirmation will be highly appreciated.

Yours sincerely,

OJT/Internship Coordinator/Head of Department

<Department/Centre Name and Date>

[9] Each College/Department/Centre may customize the content in the main body to suit their specifications.

Appendix IV: Joining Letter of student

< College/Department/Centre/Institute >

To

(Designation of Person addressed)

.....

.....

Subject: Joining letter of student

Dear Sir,

Kindly refer to your letter/e-mail dated on the above-cited subject. As permitted by your good self the following students will undergo OJT/ Internship in your esteemed organization under your sole guidance and direction

Sr. No.	Name	Roll no.	Year	Department

This training is an essential part of the curriculum, and the following guidelines have been prescribed in the curriculum for the training. You are, therefore, requested to please issue the following guidelines to the concerned OJT supervisor.

- Each student is required to prepare an OJT diary and report.
- Kindly check the OJT diary of the student on a timely manner.
- Issue instructions regarding working hours during training and maintenance of the attendance record

You are requested to evaluate the student's performance based on the below-mentioned parameters (we will provide you with the evaluation sheet):

Completion of Hours	Quality/Performance	Punctuality/Regularity

The performance report may please be forwarded to the undersigned on completion of training in a sealed envelope or in an email.

Your efforts in this regard will positively enhance the knowledge and practical skills of the students, your cooperation will be highly appreciated, and we shall feel obliged.

The students will abide by the rules and regulations of the organization and will maintain proper discipline with keen interest during their OJT. The students will report to you on _____(date) along with a copy of this letter.

Yours sincerely,

Internship Coordinator/HoD

<Department Name and Date>

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Appendix V: Student Diary (Log) Recording Format

Week	Task Assigned	Activities Performed	Key Learnings	Additional Remarks

Signature of Industry/organization Supervisor

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Appendix VI: Attendance Sheet[10]

<Organization Letter Head>

Name & Address of organization

_____
_____
_____
_____

Name of the Student	
Roll Number	
Name of Course	
Date of Commencement of Training	
Date of Completion of Training	

Month and Year:

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

- The attendance sheet should remain affixed to the Daily Training Diary. Do not remove or tear it off.
- Holidays should be marked in Red Ink in the attendance column. Absent should be marked as 'A' in Red Ink.

Name and Signature of OJT Supervisor (with date)_____

[10] Even in case of hybrid mode, a certificate of attendance duly signed by the OJT Supervisor needs to be submitted.

Appendix VII: Supervisor Evaluation of OJT Student[11]

<Organization Letter Head>

Student Name:_____ Date:_____

OJT Supervisor:_____ Title:_____

Organization:_____

OJT Address: _____

Dates of OJT: From_____ To _____

Please evaluate the intern based on the points mentioned in the table below.

S.no.	Particular	Marks
1	**Completing of Hours (out of 20)**	
2	**Quality/Performance (out of 20)**	
3	**Punctuality/Regularity (out of 10)**	
	Total **(out of 50)**	

Overall performance of student intern (circle one): (Needs improvement / Satisfactory / Good / Excellent)

Additional comments, if any:

Signature of Industry/organization supervisor_____

[11] Please note that this is a suggested template. However, the department may modify as per their parameters.

Appendix VIII: Proforma for Evaluation of OJT by Institute

<Name of the College/Department/Centre/Institute>

1. Name of Student _____
2. Mob. No._____
3. Roll No. _____
4. Branch/Semester_____
5. Period of Training_____
6. Address of Training Site/organization: _____
7. Type of Work
   Date of Evaluation
   Please rate the following:

S.no.	Particular	Marks
1	**Weekly Reporting (out of 15)**	
2	**Written Report (out of 20)**	
3	**Viva-Voce /Presentation (out of 15)**	
	Total **(out of 50)**	

Additional Remarks (if any):

Signature of Faculty Mentor

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Appendix IX: Proforma for OJT COMPLETION CERTIFICATE

The student should attach OJT completion certificate, duly signed by the industry/organization supervisor to his/her report. A representative format for the OJT completion certificate is as given below:

CERTIFICATE

(On Company/Institute Letterhead)

This is to certify that Ms./Mr. _____, has successfully completed the On-Job training in the _____, from _____ to _____ under the supervision of _____

Authorized signature

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Appendix X – Format of OJT Report

- Title of the Report: On-the-Job Training Experience Report
- Name of the Student:
- Name of the organization:
- Department/Division Where Training took place
- Duration of Training: [Start Date to End Date of Training]
- Date of Submission: [Date of Submitting the Report]

The following is a suggested outline. However, the students are advised to consult their respective OJT Mentors.

- Introduction
- Company Overview
- Training Objectives
- Training Experience
- Skills Developed
- Achievements & Contributions
- Challenges Faced
- Lessons Learned
- Recommendations
- Conclusion
- Appendices (if any)
- References

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Appendix XI: Student Feedback of OJT[12]

(To be filled by Students after OJT completion)

Student Name:_____Date:_____

Industry/Organization Supervisor:_____Title:_____

Supervisor Email:_____OJT is:__Paid_____Unpaid_____

Organization:_____

OJT Address:_____

Faculty Coordinator:_____Department:_____

Dates of OJT: From_____To _____

Give a brief description of your OJT work (title and tasks for which you were responsible): Was your internship experience related to your major area of study?

- Yes, to a large degree
- Yes, to a slight degree
- No, not related at all

Indicate the degree to which you agree or disagree with the following statements.

This experience has:	Strongly Agree	Agree	No opinion	Disagree	Strongly Disagree
Given me the opportunity to explore a career field					
Allowed me to apply classroom theory to practice					
Helped me develop my decision-making and problem-solving skills					
Expanded my knowledge about the work world before permanent employment					
Helped me develop my written and oral communication skills					
Provided a chance to use leadership skills (influence others, develop ideas with others, stimulate decision-making and action)					

[12] The College/Department/Centre may generate the form using Google Form.

Expanded my sensitivity to the ethical implications of the work involved					
Made it possible for me to be more confident in new situations					
Given me a chance to improve my interpersonal skills					
Helped me learn to handle responsibility and use my time wisely					
Helped me discover new aspects of myself that I didn't know existed before					
Helped me develop new interests and abilities					
Helped me clarify my career goals					
Provided me with contacts which may lead to future employment					
Allowed me to acquire information and/ or use equipment not available at my Institute					

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- In the Institute OJT program, faculty members are expected to be mentors for students. Do you feel that your faculty coordinator served such a function? Why or why not?

- How well were you able to accomplish the initial goals, tasks and new skills that were set down in your learning contract? In what ways were you able to take a new direction or expand beyond your contract? Why were some goals not accomplished adequately?

- In what areas did you most develop and improve?

- What has been the most significant accomplishment or satisfying moment of your OJT?

- What did you dislike about the OJT?

- Considering your overall experience, how would you rate this OJT? (Circle one).
  -Satisfactory/ Good/ Excellent

- Give suggestions as to how your OJT experience could have been improved. (Could you have handled added responsibility? Would you have liked more discussions with your professor concerning your OJT? Was closer supervision needed? Was more of an orientation required?)

<Signature of Student>
<Name, Roll number, Date>

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Under the Guidance of

Hon'ble Vice Chancellor
Prof. Dr. Ravindra Kulkarni

Hon'ble Pro-Vice Chancellor
(Prin.) Dr. Ajay Bhamare

OJT Guidelines Draft Committee

Dr. Sachin Labade Hon. Director, Career Training and Placement Cell Nodal Officer, Internship Cell, University of Mumbai	Convener
Prof. Dr. Meher Bhoot Department of German	Member
Prof. Dr. Sybil Thomas Department of Education	Member
Prof. Dr. Rajesh Kamble Department of Chemistry	Member
Dr. Manisha Rao Department of Sociology	Member
Dr. (Mrs.) R. Srivaramangai Head, Department of Information Technology	Member
Dr. Anil Raghav Department of Physics	Member
Dr. Anagha Kamble Department of History	Member
Dr. Wilbur Gonsalves Department of Psychology	Member
Dr. Pravin Walke National Institute of Nano Science and Nano Technology	Member
Dr. Alok Dabade Department of Statistics	Member
Dr Naina Kurane Alkesh Dinesh Modi Institute of Finance and Management Studies	Member
Dr. Pravin Kokane Department of Geography	Member

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As per 20-04-2023

SCHEME 1: 1 Subject

Credit distribution structure for 4- years Honours/ Honours with Research Degree Program with ME-ME

(B. Sc.) - Major & Minor

Year (Level)	Semester	Major (M1)		Minor (M2)	Open Electives Related to other faculty	VSC, SEC Related to core	AEC, VEC, IKS	OJT, FP, CEP, RP Related to core	Minimum credits for the year (Sem)	Cumulative minimum credits required for award of Certificate/Diploma/Degree
		Mandatory	Electives							
1 **4.5**	I	6 (2+2+2)	---	---	2+2	VSC:2 SEC: 2	AEC: 2 VEC: 2 IKS: 2	CC: 2	**44** **(22 + 22)**	**(44) Certificate in Faculty**
	II	6 (2+2+2)	---	2	2+2	VSC:2 SEC: 2	AEC: 2 VEC: 2	CC: 2		
	Cum Cr.	***12***	***---***	***2***	***8***	***8 (4+4)***	***4+4+2***	***4***		
	Exit option: Award of UG Certificate in Major with 44 credits and additional 4 credits core NSQF course/ Internship OR continue with Major & Minor									
2 **5**	III	8	---	4	2	VSC: 2	AEC: 2	CC: 2 FP: 2	**44** **(22 + 22)**	**(88) Diploma in Faculty**
	IV	8	---	4	2	SEC:2	AEC: 2	CC: 2 CEP: 2		
	Cum Cr.	***28***	***---***	***10***	***12***	***6+6***	***8+4+2***	***8+2+2***		
	Exit option: Award of UG Diploma in Major with 88 credits and additional 4 credits core NSQF course/ Internship OR continue with Major & Minor									

SCHEME 1: 1 Subject

Year (Level)	Semester	Major (M1)		Minor (M2)	Open Electives Related to other faculty	VSC, SEC Related to core	AEC, VEC, IKS	OJT, FP, CEP, RP Related to core	Minimum credits for the year (Sem)	Cumulative minimum credits required for award of Certificate/Diploma/Degree
		Mandatory	Electives							
3 **5.5**	V	10	4	4	----	VSC:2	---	CEP/FP: 2	**44** **(22 + 22)**	**(132)** **Three years Bachelor-Major and Minor**
	VI	10	4	4	---	---	---	OJT: 4		
	Cum Cr.	***48***	***8***	***18***	***12***	***8+6***	***8+4+2***	***8+2+2+2+4***		
	Exit option: Award of UG Degree in Major and Minor with 132 credits OR continue with Major & Minor									
4 **6.0**	VII	14	4	---	RM: 4	---	---	---	**44** **(22 + 22)**	**(176)** **Four years UG Honours Degree- Major and Minor**
	VIII	14	4	---	---	---	---	OJT: 4		
	Cum Cr.	***76***	***16***	***18***	***12+4***	***8+6***	***8+4+2***	***8+2+2+2+4+4***		
	Award of Four year UG Honours Degree in Major and Minor with 176 credits									
4 **6.0**	VII	10	4	---	RM: 4	---	---	RP: 4	**44** **(22 + 22)**	**(176)** **Four years UG Honours with Research Degree- Major and Minor**
	VIII	10	4	---	---	---	---	RP: 8		
	Cum Cr.	***68***	***16***	***18***	***12+4***	***8+6***	***8+4+2***	***8+2+2+2+4+12***		
	Award of Four year UG Honours Research Degree in Major and Minor with 176 credits									

As per 16-03-2024

SCHEME 2: 2 Subjects

Credit distribution structure for 4- years Honours/ Honours with Research Degree Program with ME-ME

(B. Sc.)- Major & Minor

Year (Level)	Semester	Major (M1)		Minor (M2)	Open Electives Related to other faculty	VSC, SEC Related to core	AEC, VEC, IKS	OJT, FP, CEP, RP Related to core	Minimum credits for the year (Sem)	Cumulative minimum credits required for award of Certificate/Diploma/Degree
		Mandatory	Electives							
1 **4.5**	I	6 (2+2+2)	---	4 (2+2)	2	SEC: 2	AEC: 2 VEC: 2 IKS: 2	CC: 2	**44** **(22 + 22)**	**(44) Certificate in Faculty**
	II	4 (2+2)	---	6	2	VSC:2 SEC: 2	AEC: 2 VEC: 2	CC: 2		
	Cum Cr.	***10***	***---***	***10***	***4***	***6 (2+4)***	***4+4+2***	***4***		
	Exit option: Award of UG Certificate in 2 Core (M1 & M2) with 44 credits and additional 4 credits core NSQF course/ Internship OR continue with Major & Minor									
2 **5**	III	8	---	4	2	VSC: 4	AEC: 2	FP: 2	**44** **(22 + 22)**	**(88) Diploma in Faculty**
	IV	6	---	6	2+2	SEC:2	AEC: 2	CEP: 2		
	Cum Cr.	***24***	***---***	***20***	***10***	***6+6***	***8+4+2***	***4+2+2***		
	Exit option: Award of UG Diploma in Major AND Minor with 88 credits and additional 4 credits core NSQF course/ Internship OR continue with Major & Minor									

SCHEME 2: 2 Subjects

Year (Level)	Semester	Major (M1)		Minor (M2)	Open Electives Related to other faculty	VSC, SEC Related to core	AEC, VEC, IKS	OJT, FP, CEP, RP Related to core	Minimum credits for the year (Sem)	Cumulative minimum credits required for award of Certificate/Diploma/Degree
		Mandatory	Electives							
3 **5.5**	V	10	4	4	----	VSC:2	---	CEP/FP: 2	**44** **(22 + 22)**	**(132)** **Three years Bachelor-Major and Minor**
	VI	10	4	4	---	---	---	OJT: 4		
	Cum Cr.	***44***	***8***	***28***	***10***	***8+6***	***8+4+2***	***4+2+2+2+4***		
	Exit option: Award of UG Degree in Major and Minor with 132 credits OR continue with Major & Minor									
4 **6.0**	VII	14	4	---	RM: 4	---	---	---	**44** **(22 + 22)**	**(176)** **Four years UG Honours Degree- Major and Minor**
	VIII	14	4	---	---	---	---	OJT: 4		
	Cum Cr.	***72***	***16***	***28***	***10+4***	***8+6***	***8+4+2***	***4+2+2+2+4+4***		
	Award of Four year UG Honours Degree in Major and Minor with 176 credits									
4 **6.0**	VII	10	4	---	RM: 4	---	---	RP: 4	**44** **(22 + 22)**	**(176)** **Four years UG Honours with Research Degree- Major and Minor**
	VIII	10	4	---	---	---	---	RP: 8		
	Cum Cr.	***64***	***16***	***28***	***10+4***	***8+6***	***8+4+2***	***4+2+2+2+4+12***		
	Award of Four year UG Honours Research Degree in Major and Minor with 176 credits									

As per 16-03-2024

SCHEME 3: 3 Subjects

Credit distribution structure for 4- years Honours/ Honours with Research Degree Program with ME-ME

(B. Sc.)- Major & Minor

Year (Level)	Semester	Subject M1	Subject M2	Subject M3	Open Electives Related to other faculty	VSC, SEC Related to core	AEC, VEC, IKS	OJT, FP, CEP, RP Related to core	Minimum credits for the year (Sem)	Cumulative minimum credits required for award of Certificate/Diploma/Degree
		M1	M2	M3						
1 **4.5**	I	4	4	4	----	VSC:2 SEC: 2	AEC: 2 VEC: 2 IKS: 2	---	**44** **(22 + 22)**	**(44) Certificate in Faculty**
	II	4	4	4	2	VSC:2 SEC: 2	AEC: 2	CC: 2		
	Cum Cr.	***8***	***8***	***8***	***2***	***4+4***	***4+2+2***	***2***		
	Exit option: Award of UG Certificate in Major with 44 credits and additional 4 credits core NSQF course/ Internship OR continue with Major									
2 **5**	III	4+2	4	---	4	SEC: 2	AEC: 2	CC: 2 CEP/FP: 2	**44** **(22 + 22)**	**(88) Diploma in Faculty**
	IV	4+2	4	---	4	VSC:2	VEC: 2	CC: 2 CEP/FP: 2		
	Cum Cr.	***20***	***16***	***8***	***10***	***6+6***	***6+4+2***	***6+4***		
	Exit option: Award of UG Diploma in Major with 88 credits and additional 4 credits core NSQF course/ Internship OR continue with Major									

SCHEME 3: 3 Subjects

Year (Level)	Semester	Subject 1	Subject 2	Subject 3	Open Electives Related to other faculty	VSC, SEC Related to core	AEC, VEC, IKS	OJT, FP, CEP, RP Related to core	Minimum credits for the year (Sem)	Cumulative minimum credits required for award of Certificate/Diploma/Degree
		M1	M2	M3						
3 **5.5**	V	10+4 (Mandatory + Elective)	2	---	----	VSC:2	---	CC: 2 CEP/FP: 2	**44** **(22 + 22)**	**(132)** **Three years Bachelor-Major and Minor**
	VI	14+4 (Mandatory + Elective)	---	---	---	---	---	OJT: 4		
	Cum Cr.	***52***	***18***	***8***	***10***	***6+6+2***	***6+4+2***	***8+6+4***		
	Exit option: Award of UG Degree in Major with 132 credits OR continue with Major									
4 **6**	VII	14+4 (Mandatory + Elective	---	---	RM: 4	--	--	--	**44** **(22 + 22)**	**(176)** **Four years UG Honours Degree- Major and Minor**
	VIII	14+4 (Mandatory + Elective	---	---	---	---	--	OJT: 4		
	Cum Cr.	***88***	***18***	***8***	***10+4***	***6+6+2***	***6+4+2***	***8+6+4+4***		
	Award of Four year UG Honours Degree in Major with 176 credits									
4 **6**	VII	10+4 (Mandatory + Elective	---	---	RM: 4	---	---	RP: 4	**44** **(22 + 22)**	**(176)** **Four years UG Honours with Research Degree- Major and Minor**
	VIII	10+4 (Mandatory + Elective	---	---	---	---	---	RP: 8		
	Cum Cr.	***80***	***18***	***8***	***10+4***	***6+6+2***	***6+4+2***	***8+6+4+4+8***		
	Award of Four year UG Honours Research Degree in Major and Minor with 176 credits									

AC –24/11/2023
Item No. – 6.2 (N)

As Per NEP 2020

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** **R. _____**	A	One Year
		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 enables 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 aim 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 Struture Sem I & II)

	R: _____A									
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC, RP**	**Cum. Cr. / Sem.**	**Degree/ Cum. Cr.**
		Mandatory	**Electives**							
	I	**6**		**-**	**2+2**	**VSC:2, SEC:2**	**AEC:2, VEC:2, IKS:2**	**CC:2**	**22**	**UG Certificate 44**
		• Programming 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**	
		• OOPs with C++ - 02 • Web Designing - 02 • Practical II - 02				• VSC : Assembly Language Programming – 02 • SEC: 02 • Web Programming **OR** • 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 Majorand 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**	
		• Python Programming -02 • Python Programming Practical-02 • Data Structures-02 • Data Structures Practical-02				VSC : Operating Systems-02				**UG Diploma 88**
	R: _____D									
	IV	**6**		**4**	**2**	**SEC:2**	**AEC: 2**	**CEP : 2 CC: 2**	**22**	
		• Core Java - 02 • Core Java Practical-02 • Software Engineering-02 • Software Engineering Practical-02				• 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 Continuewith 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**	
		• Advanced Web Programming-02 • Advanced Web Programming Practical-02 • Business Intelligence-02 • Business Intelligence Practical-02 • Software Project Management-02	• Linux Administration-02 • Linux Administration Practical-02 OR • EARN-02 • EARN Practical-02 OR • Enterprise Java-02 Enterprise Java Practical-02			• Advanced Mobile Programming-02		FP: Project Dissertation-02	22	**UG Degree 132**
	R: _____E									
	VI	**10**	**4**	**4**				**OJT:4**	**22**	
		• Security in Computing -02 • Security in Computing Practical-02 • AI and ML-02 • AI and ML Practical-02 • Software Quality Assurance-02	• Enterprise Networking-02 • Enterprise Networking Practical-02 OR • Principles of GIS-02 • Principles of GIS Practical-02					• 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:**	
	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	**15 Hrs**
	Module 2:	

	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	**Books and References:** 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	**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: 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):** CO 1. To make students aware fundamentals of database system. CO 2. To give idea how ERD components helpful in database design and implementation. CO 3. To experience the students working with database using MySQL. CO 4. To familiarize the student with normalization, database protection and different DDL, DML, DQL, DCL Statements CO 5. To make students aware about importance of protecting data from unauthorized users.		
8	**Course Outcomes (OC):** OC 1. Define and describe the fundamental elements of relational database management system. OC 2. To relate the basic concepts of relational data model, entity-relationship model, relational database OC 3. Design ER-models to represent simple database application scenarios. OC 4. Understand the normalization and its role in the database design process OC 5. Transform the ER-model to relational tables, populate relational database and formulate SQL OC 6. Understand basic database storage structures and access techniques: file and page organizations, indexing methods and hashing.		
9	**Modules:-** **Module 1:**		
	1. Introduction to Databases and transactions What is database system, purpose of database system, view of data, relational databases, database architecture, transaction management **2. Data Models** The importance of data models, Basic building blocks, Business rules, The evolution of data models, Degrees of data abstraction **3. Database Design, ER-Diagram** Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, Codd's rules, Relational Schemas **4. Relational database model** Logical view of data, keys, integrity rules		**15 Hrs**

	Module 2:	
	1. Database Design theory and normalization: Basics of functional dependencies and normalization for relational databases. Relational database design and further dependencies. **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 **3. Transaction management and concurrency control and recovery:** Introduction to transaction processing concepts and theory. Concurrency control technique. Database recovery technique	. **15 Hrs**
10	**Text Books** 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 3. Database Systems: Design implementation and management by Carlos Coronel, Steven Morris, Peter Rob	
11	**Reference Books** 1. "Database System Concepts", Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw Hill, 2017 2. "MySQL: The Complete Reference", Vikram Vaswani , McGraw Hill, 2017 3. "Learn SQL with MySQL: Retrieve and Manipulate Data Using SQL Commands with Ease", Ashwin Pajankar, BPB Publications, 2020	
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 1

Sr.No.	Heading	Particulars
1	**Description the course : Including but Not limited to:**	Programming with C -practical This course is stepping stone to learn other languages. This course provides students hands on experiences of coding exercises and projects. . Database Management System's 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):** CO 1. To provide exposure in developing algorithm, flowchart and to write efficient code. CO 2. To understand loops and decision making in programming. CO 3. To understand the arrays, structures, union. CO 4. To understand the use of function and pointers. CO 5. To Identify entities and its relationship with relational model structure. CO 6. To understand relational database using SQL and constraints implementation using create table queries. CO 7. To Understand DML operations and backing of database CO 8. To understand how to retrieve data from database and learn how to retrieve single value after performing calculations on group of values CO 9. To understand built-in functions to perform operations on data CO 10. To understand how to fetch data from two or more tables, which is joined to appear as single set of data CO 11. To understand nested and larger query as advanced fetching of data to understand concept of virtual table. CO 12. To understand how to control user access in a database.	

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	**Module 1:- Programming with C** **1. Practical 1**:- a. To calculate simple interest taking principal, rate of interest and number of years as input from user. Write algorithm & draw flowchart for the same. b. Write a program to find greatest of three numbers using conditional operator. Write algorithm & draw flowchart for the same. c. Write a program to check if the year entered is leap year or not. Write algorithm & draw flowchart for the same. **2. Practical 2:-** a. Write a program to calculate roots of a quadratic equation. b. Write a menu driven program using switch case to perform add / subtract / multiply / divide based on the users choice. c. Write a program to print the pattern of asterisks. **3. Practical 3** a. Write a program using while loop to reverse the digits of a number. b. Write a program to calculate the factorial of a given number. c. Write a program to print the Fibonacci series. **4. Practical 4** a. Write a program to print area of square using function. b. Write a program using recursive function. c. Write a program to square root, abs() value using function. d. Write a program using goto statement . **5. Practical 5** a. Write a program to print rollno and names of 10 students using array. b. Write a program to sort the elements of array in ascending or descending order **6. Practical 6** a. Write a program to extract the portion of a character string and print the extracted part. b. Write a program to find the given string is palindrome or not. c. Write a program to using strlen(), strcmp() function . **7. Practical 7** 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. **8. Practical 8** a. Write a program to read a matrix of size m*n. b. Write a program to multiply two matrices using a function. **9. Practical 9** Write a program to print the structure using Title Author Subject Book ID Print the details of two students. **10. Practical 10** Create a mini project on “Bank management system”. The program should be menu driven.	**30 Hrs**

		Module 2 1. Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.) 2. Perform the following: • 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: • Altering a Table • Dropping/Truncating/Renaming Tables • Backing up / Restoring a Database 4. Perform the following: • Simple Queries • Simple Queries with Aggregate functions 5. Queries involving • Date Functions • String Functions • Math Functions 6. Join Queries • Inner Join • Outer Join 7. Subqueries • 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 • Creating Views (with and without check option) • Dropping views • Selecting from a view 10. DCL statements • Granting and revoking permissions • Saving (Commit) and Undoing (rollback)	**30 Hrs**
10	**Text Books:** 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		
11	**Reference Books:** 1. MASTERING C, K. R. Venugopal and Sudeep R. Prasad, Tata McGraw-Hill Publications. 2. “A Computer Science –Structure Programming Approaches using C”, Behrouz		

	Forouzan, Cengage Learning. 3. Schaum's outlines "Programming with C", Byron S. Gottfried, Tata McGraw-Hill Publications. 4. "Basics of Computer Science", Behrouz Forouzan , Cengage Learning. 5. "Programming Techniques through C", M. G. Venkateshmurthy, Pearson Publication. 6. "Programming in ANSI C", E. Balaguruswamy, Tata McGraw-Hill Education. 7. "MySQL: The Complete Reference", Vikram Vaswani , McGraw Hill, 2017. 8. "Learn SQL with MySQL: Retrieve and Manipulate Data Using SQL Commands with Ease", Ashwin Pajankar, BPB Publications, 2020.	
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	

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:**	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. 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. The course will cover the various techniques and tools used in digital circuit design, including Boolean algebra and K-map simplification. 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. 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. 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. 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,

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

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

	f. Design of 3-bit synchronous counter using 7473 and required gates. g. Design of 3-bit ripple counter using IC 7473. **9. Study of counter ICs and designing Mod-N counters.** 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) **10. Design of shift registers and shift register counters.** 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** 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	**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 Course (SEC)

Name of the Course: Office Tools for Data Management

Sr.No.	Heading	Particulars
1	**Description the course:**	• **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):**	

	CO 1. Participants will grasp essential database concepts, including tables, relationships, and normalization principles. CO 2. Participants will design and construct well-organized databases in MS Access, showcasing proficiency in table design and data validation. CO 3. Participants will master the creation of complex queries in MS Access, enabling them to extract specific information efficiently. CO 4. Participants will develop expertise in crafting user-friendly forms and interfaces in MS Access, optimizing data entry processes. CO 5. Participants will generate comprehensive reports in MS Access, demonstrating skills in grouping, sorting, and presenting data for meaningful analysis.	
8	**Course Outcomes (OC):** OC 1. Participants can explain normalization importance, identify table relationships, and justify database design choices. OC 2. Participants create well-structured MS Access databases with proper relationships, data types, and normalization. OC 3. Participants execute advanced queries in MS Access, retrieving specific information based on diverse criteria. OC 4. Participants design intuitive MS Access forms, incorporating controls for an efficient and user-friendly data entry experience. OC 5. Participants produce insightful MS Access reports, organizing and presenting data effectively for analysis.	
9	**Modules:- All Practicals are based on MS Access** **Module 1:**	
	Practical 1: A. Getting familiar with MS Access Ribbon options. 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. 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. **Practical 2:** A. Create and use an Input Mask to enter the data in sample table. B. Adding records in table by using Datasheet View, using a Form and using SQL. C. Create the Employee Database with necessary table and data and then implement the following transitions: • 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". **Practical 3:** A. Create the Bookstore database with necessary table and data and modify the database to accommodate the following:	**30 Hrs**

		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. 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. 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. **Practical 4:** 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. **Practical 5:** 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:	
		Practical 6: 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. **Practical 7:** A. Demonstrate use of look up tables. B. Use the Report Wizard to create a report having the following requirements: 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.	**30 Hrs**

	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, 1st Edition, 2020. 2. Step by Step Microsoft Access 2013, by Joyce Cox and Joan Lambert, 1st Edition, Microsoft Press, 2013 3. Access 2019 Bible, by Michael Alexander, Richard Kusleika, Wiley, 1st Edition, 2018 4. Access 2019 For Dummies, by Laurie A. Ulrich, Ken Cook, Wiley, 1st 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:**	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. 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

		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.	

	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. 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. 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. 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. CO 6. Evaluate the challenges of small cells in 5G mobile networks and identify the capacity limits and achievable gains with densification.	
8	**Course Outcomes (OC):** OC 1. Identify the fundamental concepts and terminologies of signals and systems theory through an introduction to sets, mappings, functions, and systems operators. 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. 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. 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. 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. OC 6. Evaluate the challenges of small cells in 5G mobile networks and identify the capacity limits and achievable gains with densification.	
9	**Modules:-** **Module 1: Signals and Systems:** 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	**15 Hrs**
	Module 2: Fundamentals of 5G Networks	
	4. **Drivers for 5G:** Introduction, Historical trend of Wireless Communication, Evolution of LTE technology to beyond 4G, 5G	**15 Hrs**

	Roadmap, 10 pillars of 5G, 5G in Europe, 5G in Asia, 5G in Asia, 5G Architecture 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 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	
10	**Text Books:** 1. Signals and Systems, Michael Adams, University of Victoria, 3rd Edition, 2012 2. Fundamentals of 5G Mobile Networks, Edited by Jonathan Rodriguez, Wiley Publications, 2015	
11	**Reference Books** 1. Signals and Systems, Michael Adams, University of Victoria, 3rd Edition, 2012 2. Fundamentals of 5G Mobile Networks, Edited by Jonathan Rodriguez, Wiley Publications, 2015	
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)	

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):** CO 1. To explain the difference between object oriented programming and procedural programming. CO 2. To understand OOP principles to create modular, reusable, and maintainable code. CO 3. To understand the concept of polymorphism ,virtual functions,inheritance and exception handling. CO 4. To understand file handling concepts using C++.	
8	**Course Outcomes (OC):** OC 1. Students can explain the key concept of OOP and their application in software development. OC 2. Students can Design and implement classes and objects to model real-world entities. OC 3. Students can apply the concepts of polymorphism, virtual functions, inheritance and exception handling in program. OC 4. Students can apply operator overloading, runtime polymorphism, generic Programming OC 5. Students can implement file handling concepts in program	
9	**Modules:-** **Module 1:**	
	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. 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.	**15 Hrs**

	3. Constructors and Destructors: Introduction, Default Constructor, Parameterized Constructor and examples, Destructors. 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.	
	Module 2:	
	5. Polymorphism: Concept of function overloading, overloaded operators, overloading unary and binary operators. 6. Virtual Functions: Introduction and need, Pure Virtual Functions, this Pointer, abstract classes, virtual destructors. 7. Exception Handling: Introduction, Exception Handling Mechanism, Concept of throw & catch with example. 8. Working with Files: Introduction, File Operations, Various File Modes, File Pointer and their Manipulation.	**15 Hrs**
10	**Text Books** 1. Object-oriented Programming C++, Hari Mohan Pandey , Laxmi Publications 2. C++ Programming: An Object-Oriented Approach, Behrouz A. Forouzan, Richard F. Gilberg , McGraw-Hill Education 3. C++ How to Program , Paul Deitel, Harvey Deitel	
11	**Reference Books** 1. Object Oriented Programming in C++ , E Balagurusamy 2. Object-Oriented Programming in C++ , Robert Lafore, Pearson Education. 3. Programming with ANSI C++ , Bhushan Trivedi 4. Demystified Object- Oriented Programming with C++, Dorothy R. Kirk	
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: 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, onDblClick, 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** 1. Step by Step HTML5 by Faithe Wempen, Microsoft Press,2011 2. The Complete Reference HTML & CSS, Thomas A. Powell. McGrawHill, 5 th 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, 2ed Kindle Edition,by DT Editorial Services 6. JSON at work ,Tom MArrs,O'REILLY,First edition,2017	
11	**Reference Books** 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 usng 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. WherereadNo() 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 itssum

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 staticfunction

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

NAME	SUBJECT	MARKS

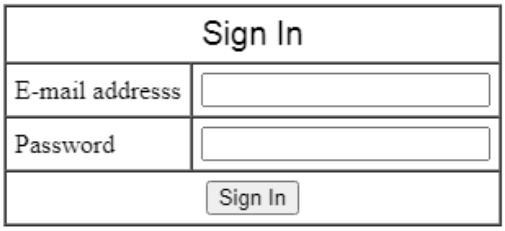
30 Hrs

Hillary	Advanced Web	75
	Operating System	60
Lary	Advanced Web	80
	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



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.

	8. Java Script : Handling the events a.Using java script, demonstrate the use of onAbort, onBlur, onChange, onClick, onDblClick events b. Using java script, demonstrate the use of onDragDrop, onError, onFocus events c. Using java script, demonstrate the use of onKeyDown, onKeyPress, onKeyUp, onLoad, onReset, onResize, onSelect, onSubmit, onUnload events d. Using java script, demonstrate the use of onMouseDown, onMouseMove, onMouseOut, onMouseOver, onMouseUp, onMove events. e. Using java script, demonstrate the use of onKeyDown, onKeyPress, onKeyUp, onLoad, onReset, onResize, onSelect, onSubmit, onUnload events 9. JQuery a. use JQuery effect in page b. Write a jQuery Code to find the data passed with the on() method for each element. c. Use JQuery Events d. JQuery traversal and manipulation 10. JSON Basics and Working with JSON a. Creating JSON b. Parsing JSON c. Persisting JSON d. Demonstrate use of JSON objects in array, print array on web page using document object e. Read data from json file and convert it into a JavaScript object and display the data in web page using document object	
10	Text Books 1. Object-oriented Programming C++, Hari Mohan Pandey 2. C++ Programming: An Object-Oriented Approach, Behrouz A. Forouzan, Richard F. Gilberg 3. C++ How to Program, Paul Deitel, Harvey Deitel 4. Step by Step HTML5, Faithe Wempen, Microsoft Press,2011 5. The Complete Reference HTML & CSS, Thomas A. Powell. McGraw Hill, 5th Edition,2010	
11	**Reference Books** 1. Object Oriented Programming in C++, E Balagurusamy 2. Object-Oriented Programming in C++ by Robert Lafore 3. Programming with ANSI C++, Bhushan Trivedi 4. Demystified Object- Oriented Programming with C++, Dorothy R. Kirk 5. Learning Web Design A Beginner's Guide to Html, CSS, JavaScript, And Web Graphics, Jennifer Niederst Robbins, O'Reilly, 5th Edition,2018. 6. "Web Enabled Commercial Applications Development using HTML, DHTML, Javascript, Perl CGI", Ivan Bayross, BPB, 2004 7. HTML 5 for Web Designers (By: Jeremy Keith) – http:// freepdf-books.com	
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	

Vocational Skill Courses (VSC)

Name of the Course: Assembly Language Programming

Sr.No.	Heading	Particulars
1	**Description the course : Including but Not limited to:**	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. 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. 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. 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. 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

		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 **2. Simple assembly language programs.**	**30 Hrs**

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 4002Hand 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 l'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 I'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 I, 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	**Text Books** 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:**	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. 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. 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. 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.
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)** **CO1:** To understand how to use Java script objects and XML. **CO2:** To create well organized, styled web pages **CO3:** To add versatility to a web page using jQuery **CO4:** To deploy a local web server and run a simple web application. **CO5:** To read and process data in MySQL using PHP. **CO6:** To understand usage of Bootstrap	
8	**Course Outcomes (OC)** OC1: Knowledge in different java script objects. OC2: How to use XML with CSS and XSL OC3: validate a form using jQuery OC4: handle asynchronous requests OC4: Write and deploy PHP with database and to simplify web development. OC5: Create a responsive layout using the Bootstrap	

	9	**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.	**30 Hrs**
		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	**30 Hrs**
	10	**Text Books** • 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	

	• PHP: A Beginners Guide, Vikram Vaswani, TMH	
11	**Reference Books** • 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 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		**30 Hrs**

	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)

<table>
<tr><td rowspan="4">I</td><td colspan="2">A Theory of 2 credits is evaluated for a total of 50 Marks</td></tr>
<tr><td>Internal Continuous Assessment:</td><td>40%[20 Marks]</td></tr>
<tr><td colspan="2">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</td></tr>
<tr><td colspan="2">External Semester End Examination: 60%[30 Marks]</td></tr>
<tr><td colspan="3">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)</td></tr>
<tr><td rowspan="4">II</td><td colspan="2">A Practical of 2 credits is evaluated for a total of 50 Marks</td></tr>
<tr><td>Internal Continuous Assessment:</td><td>40%[20 Mrks]</td></tr>
<tr><td colspan="2">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.</td></tr>
<tr><td colspan="2">Semester End Examination: 60%[30 Marks]</td></tr>
<tr><td colspan="3">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</td></tr>
</table>

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

Appendix B

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 – 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 – II)			
Faculty of Science			
Board of Studies in Mathematics			
Second Year Programme in Minor (Mathematics)			
Semester		**III & IV**	
Title of Paper		**Sem. III**	**Total Credits**
Choose any one of the following:			**4**
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**
Following Courses are Compulsory			**6**
1)	Calculus IV	IV	2
2)	Ordinary Differential Equations	IV	2
3)	PM-4 Calculus IV and Ordinary Differential Equations	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):** 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. **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. **CO2**: Illustrate the expansive nature of the subject by fostering the acquisition of essential mathematical tools for continued studies across various scientific fields. **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. **CO4**: Ensure exposure to both global and local issues within the realm of Mathematical Sciences, allowing learners to explore diverse aspects of the discipline.	

8	**Course Outcomes (OC):** After completion of the course, students will be able to **OC1** Understand and remember the concepts such as convergence/ divergence of series, Riemann Integration, beta-gamma functions and related results. **OC2**: Apply the formulae and concepts to solve the examples related to series, Riemann Integral, area between two curves etc. **OC3**: Analyse the convergence and divergence of series and integrability of given function. **OC4**: Justify/ check the integrability of function, absolute and conditional convergence of series. **OC5:** Construct counter examples related to absolutely convergent/ divergent series, non-integrable functions etc.
9	**Modules: -** **Module 1**: **Infinite Series (15 Lectures)**
	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 $a_n \to 0$ but converse is not true. Cauchy Criterion, Algebra of convergent series and related examples. 2. Tests for convergence: Comparison Test, Limit Comparison Test (without proof), Ratio Test (without proof), Root Test (without proof), Examples, p- series test. 3. Alternating series. Leibnitz's Test. Examples. Absolute convergence, absolute convergence implies convergence but not conversely. Conditional Convergence.
	Module 2: **Riemann Integration and Applications (15 Lectures)**
	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. 2. Criterion for Riemann integrability, Characterization of the Riemann integral as the limit of a sum. (without proof). Examples. 3. Algebra of Riemann integrable functions and basic results such as if (i) f:[a,b]$\longrightarrow\mathbb{R}$ 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 $\int_a^b f(x)dx \geq 0$ 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. 5. First and Second Fundamental Theorems of Calculus. 6. Area between the two curves. Lengths of plane curves. Surface area of surfaces of revolution. 7. Gamma and Beta functions and their properties. Relationship between them (without proof).
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 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 × 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)

<table>
<tr><td>Sr. No.</td><td>Heading</td><td>Particulars</td></tr>
<tr><td>1</td><td>Description the course: Including but not limited to:</td><td>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.</td></tr>
<tr><td>2</td><td>Vertical:</td><td>Minor</td></tr>
<tr><td>3</td><td>Type:</td><td>Practical</td></tr>
<tr><td>4</td><td>Credits:</td><td>2 credits
(1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)</td></tr>
<tr><td>5</td><td>Hours Allotted:</td><td>30 Hours</td></tr>
<tr><td>6</td><td>Marks Allotted:</td><td>50 Marks</td></tr>
<tr><td>7</td><td colspan="2">Course Objectives (CO):
This course emphases on problem solving and motivates to think on the basic concepts of Calculus with rigour and prepares students to study further courses.
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.
CO2. To reflect the broad nature of the subject and develop mathematical tools for continuing further study in various fields of sciences.
CO3. To enhance students' overall development, problem solving skills, creative talent, and power of communication. These are necessary for various kinds of employment.
CO4. To give adequate exposure to global and local concerns that would help learners explore many aspects of Mathematical Sciences.</td></tr>
<tr><td>8</td><td colspan="2">Course Outcomes (OC):
After completion of the course, students will be able to
OC1: Apply the formulae and concepts to solve the examples related to series, Riemann Integral, area between two curves etc.
OC2: Analyze the convergence and divergence of series and integrability of given function.
OC3: Justify/ check the integrability of function, absolute and conditional convergence of series.
OC4: Construct counter examples related to absolutely convergent/ divergent series, non-integrable functions etc.</td></tr>
<tr><td>9</td><td colspan="2">Modules: -
Practical for Calculus III (30 Hours)
<table><tr><td>1.</td><td>Convergent and divergent series and algebra of convergent series.</td></tr><tr><td>2.</td><td>Comparison and limit comparison test.</td></tr><tr><td>3.</td><td>Ratio test and root test.</td></tr><tr><td>4.</td><td>Alternating Series and p-series test.</td></tr></table></td></tr>
</table>

	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 Yorm, 1992. 6. M. H. Protter; Basic Elements of Real Analysis; Springer-Verlag, New York, 1998.	
	<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) 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):** 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. 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. CO2. To reflect the broad nature of the subject and develop mathematical tools for continuing further study in various fields of sciences. CO3. To enhance students' overall development, problem-solving skills, creative talent, and power of communication are necessary for various kinds of employment. CO4. To give adequate exposure to global and local concerns that would help learners explore many aspects of Mathematical Sciences.	
8	**Course Outcomes (OC):** After completion of the course, students will be able to OC1: Understand, remember the concepts and properties vector spaces. OC2: Apply the formulas and the concepts to solve examples on subspaces, sum and intersection of subspaces. OC3: To analyse the properties of vector spaces, row space and column space of a matrix OC4: Justify or check a set to be a vector space. OC5: Construct counterexamples related to vector spaces and subspaces.	
9	**Modules: -** **Module 1: Vector spaces and subspaces (15 Hours)**	

	(a) Definition of a vector space over R. Examples such as: (i)Euclidean space R^n. (ii) The space of $m \times n$ matrices over R. (iii)The space of polynomials with real coefficients. (b) Subspaces: definition, criterion for a nonempty subset to be a subspace of a vector space. Examples, including: (i) Lines in R^2, Lines and planes in R^3. (ii) The solutions of a homogeneous system of linear equations. (iii) The spaces of symmetric, skew-symmetric, upper triangular, lower triangular, and diagonal matrices. (iv) The space of polynomials with real coefficients of degree $\leq n$. (c) The sum, union and intersection of subspaces, direct sum of vector spaces. Cosets, Introduction to quotient space.	
	Module 2: System of linear equations, Linear combination, Basis of vector spaces (15 Hours)	
	(a) (i) Introduction to linear systems, Matrix representation of the system of homogeneous and non-homogeneous linear equations, row echelon form, Gauss Elimination. (ii) Linear combination of vectors. (iii) Linear span of a subset of a vector space. (iv) Linear dependence and independence of a set. (b) Basis of a vector space, Dimension of a vector space. The discussion of these concepts is for finitely generated vector spaces only. (c) (i) Row space, column space of a $m \times n$ matrix over R and row rank, column rank of a matrix. (ii) Equivalence of row rank and column rank, computing the rank of a matrix by row reduction.	
10	**Text Books** 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** 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>	
	The performance of the learners shall be evaluated in two parts. ● 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	**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 × 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-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):** 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. 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. CO2. To reflect the broad nature of the subject and develop mathematical tools for continuing further study in various fields of sciences. CO3. To enhance students' overall development, problem-solving skills, creative talent, and the power of communication are necessary for various kinds of employment. CO4. To give adequate exposure to global and local concerns that would help learners explore many aspects of Mathematical Sciences.	
8	**Course Outcomes (OC):** After completion of the course, students will be able to OC1: Apply the formulas and the concepts to solve examples related to vector spaces. OC2: To analyse and test the property of vector subspaces on sets. OC3: To check linear independence, and dependence of vectors. OC4: Construct basis and counter-examples related to vector spaces and subspaces.	
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
	9.	Direct sum of subspaces
	10.	Cosets, Quotient spaces

Module 2: System of linear equations, Linear combination, Basis of vector spaces (30 Hours)

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**

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**

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.

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 **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. 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).
	Module 2: Applications of linear systems and introduction to platonic solids (15 Hours)
	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.
10	**Text Books:** 1. Hermann Weyl, Symmetry, Princeton University Press, 1952. 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.
	<u>Scheme of the Examination</u>
	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.

<table>
<tr><td>12</td><td>Internal Continuous Assessment: 40%</td><td>Semester End Examination: 60%</td></tr>
<tr><td>13</td><td colspan="2">Continuous Evaluation through: Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments, etc.
(at least 3)
<table>
<tr><th>Sr. No.</th><th>Particulars</th><th>Marks</th></tr>
<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>
</table>
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)</td></tr>
<tr><td>14</td><td colspan="2">Format of Question Paper:
The semester-end examination will be of 30 marks of one hour duration, covering the entire syllabus of the semester.
<table>
<tr><td colspan="4">Note: Attempt any TWO questions out of THREE.</td></tr>
<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)
(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>
</table></td></tr>
</table>

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

<table>
<tr><td>Sr. No.</td><td>Heading</td><td>Particulars</td></tr>
<tr><td>1</td><td>Description of the course: Including but not limited to:</td><td>To demonstrate the importance of mathematics in real life by considering interdisciplinary applications of basic concepts in real life.</td></tr>
<tr><td>2</td><td>Vertical:</td><td>Minor</td></tr>
<tr><td>3</td><td>Type:</td><td>Practical</td></tr>
<tr><td>4</td><td>Credits:</td><td>2 credits
(1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)</td></tr>
<tr><td>5</td><td>Hours Allotted:</td><td>30 Hours</td></tr>
<tr><td>6</td><td>Marks Allotted:</td><td>50 Marks</td></tr>
<tr><td>7</td><td colspan="2">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 recognise the role of geometry (in particular Platonic solids) in science streams.</td></tr>
<tr><td>8</td><td colspan="2">Course Outcomes (OC):
After completion of the course, students will be able to
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</td></tr>
<tr><td>9</td><td colspan="2">Modules: -
Module 1: Practicals for Polynomials and Interpolation (30 Hours)

<table>
<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>
</table>
</td></tr>
</table>

	9. Polynomial Interpolation in Degree Three. 10. Vandermonde Determinant and Invertibility.	
	Module 2: Practicals for Applications of linear systems and introduction to Platoonic 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-	

<table>
<tr><td></td><td>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.</td><td></td></tr>
<tr><td>14</td><td colspan="2">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.

<table>
<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>

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.</td></tr>
</table>

Sem. - IV

Syllabus
B.Sc. (Mathematics)
(Sem.- IV)
Name of the Course: Calculus IV

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):** 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. **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. **CO2**: To demonstrate competence in analyzing neighbourhoods in $\mathbb{R}^n$ and applying concepts of limits and continuity to scalar fields. **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. **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. **CO5**: To utilize concept of differentiation for practical applications, including the understanding of tangent planes and maxima-minima. **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.	
8	**Course Outcomes (OC):** After completion of the course, students will be able **OC1**: understand and remember the concepts such as Euclidean spaces, norm, inner product, limit, continuity, derivatives of scalar fields etc.	

	OC2: apply first and second derivative tests to find extreme values of scalar fields. **OC3**: verify the relationship between Differentiability and Continuity, directional derivative and continuity etc. **OC4**: check differentiability and continuity of scalar and vector fields. **OC5**: create counter examples related to continuity and differentiability, directional derivative and continuity, partial derivatives and total derivative etc.
9	**Modules: -** **Module 1**: **Functions of Several Variables (15 Lectures)**
	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 emphsis 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 $\mathbf{R^3}$). 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.
	Module 2: Applications of Differentiability (15 Lectures)
	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	**Recommended Reference Books:** 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

<table>
<tr><td></td><td colspan="2">New Delhi, 1996.
6. K. Stewart; Calculus; Booke/Cole Publishing Co, 1994.</td></tr>
<tr><td>11</td><td colspan="2">Additional Reference Books
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. Shabanov, Sergei; Concepts in Calculus, III: Multivariable Calculus; University Press of Florida, 2012.
4. S C Malik and Savita Arora; Mathematical Analysis; New Age International Publishers.</td></tr>
<tr><td></td><td colspan="2"><u>Scheme of the Examination</u></td></tr>
<tr><td></td><td colspan="2">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.</td></tr>
<tr><td>12</td><td>Internal Continuous Assessment: 40%</td><td>Semester End Examination: 60%</td></tr>
<tr><td>13</td><td>Continuous Evaluation through:
Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc.
(at least 3)

<table>
<tr><th>Sr. No.</th><th>Particulars</th><th>Marks</th></tr>
<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>
</table>
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)</td><td></td></tr>
</table>

14 **Format of Question Paper:**

The semester-end examination will be of 30 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: Ordinary Differential Equations

Sr. No.	Heading	Particulars
1	**Description the course:** **Including but not limited to:**	This course covers fundamental concepts differential equations. It includes a review of differential equations and its solution, understanding homogeneous and non-homogeneous higher order linear differential equations. Additionally, the course delves into concepts like differential operators, method of variation of parameters and method of undetermined coefficients of solving higher order linear differential equations with constant coefficients.
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 gives introduction to basic concepts and methods of solving differential equations and prepares students to study further courses in differential equation. In this course, importance is given to basic concept and various methods of solving differential equations which also enhances understanding of the subject of Mathematics as a whole. **CO1.** To give sufficient knowledge of basic concepts and methods of solving differential equations and a clear perception of numerous powers of mathematical ideas and tools and the skills to use them by modelling, solving and interpreting. **CO2.** To reflect the broad nature of the subject and develop mathematical tools for continuing further study in various fields of sciences. **CO3.** To enhance students' overall development, problem solving skills, creative talent and power of communication are necessary for various kinds of employment. **CO4.** To give adequate exposure to global and local concerns that would help learners explore many aspects of Mathematical Sciences.	
8	**Course Outcomes (OC):** After completion of the course, students will be able to **OC1**: Understand and remember basic concept of differential equations and various methods of solving higher order linear ordinary differential equations. **OC2**: apply the methods of solving linear differential equations with constant coefficients. **OC3**: verify the given solutions of differential equations are linearly dependent or independent and also to verify auxiliary equations have real or complex roots. **OC4**: evaluate the complementary function and particular integral of given ordinary linear differential equations. **OC5**: construct ordinary differential equation for the given solution.	

9	**Modules: -** **Module 1**: **Homogeneous Higher Order Linear Differential Equations (15 Lectures)**	
	(a) The general n-th order linear differential equation, linear independence of solutions of LDE, existence and uniqueness theorem (Statement only), Wronskian, classification of D.E.: homogeneous and non-homogeneous, general solution of homogeneous and non-homogeneous LDE, the differential operator and its properties. (b) Higher order homogeneous linear differential equations with constant coefficients, the auxiliary equations, roots of the auxiliary equations: real and distinct, real and repeated, complex and complex repeated.	
	Module 2: **Non-Homogeneous Higher Order Linear Differential Equations (15 Lectures)**	
	(a) Non-homogeneous equations: The inverse differential operator and particular integral, evaluation of $\frac{1}{f(D)}$ for the functions like e^{ax}, $sinax$, $cosax, x^m$, $x^m \sin ax$ (without proof), $x^m \cos ax$ (without proof), $e^{ax}V$(without proof) and xV (without proof) where V is any function of x. (b) The method of undetermined coefficients. The method of variation of parameters. (c) Construction of ordinary differential equation for the given solution.	
10	**Recommended Reference Books:** 1. George F. Simmons, Differential Equations with Applications and Historical Notes, Taylor's and Francis, Third Edition, 2017. 2. E.D. Rainville and P.E. Bedient; Elementary Differential Equations; Macmillan.	
11	**Additional Reference Books:** 1. E.A. Coddington and R. Carlson: Linear Ordinary Differential Equations, SIAM. 2. M.D. Raisinghania; Ordinary and Partial Differential Equations; S. Chand.	
	<u>Scheme of the Examination</u>	
	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 × 3)

14 **Format of Question Paper:**

The semester-end examination will be of 30 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-4 Calculus IV and Ordinary Differential Equations

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):** This course introduces basic concepts of Calculus and differential equation with rigour and prepares students to study further courses. **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. **CO2**. To reflect the broad nature of the subject and develop mathematical tools for continuing further study in various fields of sciences. **CO3**. To enhance students' overall development, problem solving skills, creative talent, and power of communication, which are necessary for various kinds of employment. **CO4**. To give adequate exposure to global and local concerns that would help learners explore many aspects of Mathematical Sciences.	
8	**Course Outcomes (OC):** After completion of the course, students will be able **OC1**: apply first and second derivative tests to find extreme values of scalar fields and also apply the various methods to solve ordinary linear differential equations. **OC2**: verify the relationship between Differentiability and Continuity, directional derivative and continuity etc. **OC3**: check differentiability and continuity of scalar and vector fields and evaluate the complementary function and particular integral of given ordinary linear differential equations. **OC4**: create counter examples related to continuity and differentiability, directional derivative and continuity, partial derivatives and total derivative etc.	

9 **Modules: -**

Module 1: Practical for Calculus IV (30 Hours)

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.

Module 2: Ordinary Differential Equation (30 Hours)

1.	Wronskian and linear independence of solutions.
2.	Higher order homogeneous linear differential equations with constant coefficients.
3.	Evaluation of particular integral for $X = e^{ax}$.
4.	Evaluation of particular integral for $X = sinax, cosax$.
5.	Evaluation of particular integral for $X = x^m, x^m \sin ax\,, x^m \cos ax$.
6.	Evaluation of particular integral for $X = e^{ax}V$ and $X = xV$ where V is any function of x.
7.	Method of undetermined coefficients.
8.	Method of variation of parameters.

10 **Text Books**

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.
7. George F. Simmons, Differential Equations with Applications and Historical Notes, Taylor's and Francis, Third Edition, 2017.
8. E.D. Rainville and P.E. Bedient; Elementary Differential Equations; Macmillan.

11 **Reference Books**

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.
6. George F. Simmons, Differential Equations with Applications and Historical Notes, Taylor's and Francis, Third Edition, 2017.
7. E.D. Rainville and P.E. Bedient; Elementary Differential Equations; Macmillan.

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 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.

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**

AC – 20/04/2024
Item No. – 6.7 Sem. II (1c)

As Per NEP 2020

University of Mumbai

Syllabus for Basket of Minor	
Board of Studies in Mathematics	
UG First Year Programme	
Semester	**II**
Title of Paper	**Credits 2/ 4**
I) Basics of Mathematics in Real Life (Minor III)	
II)	
III)	
From the Academic Year	**2024-25**

Name of the Course: Basics of Mathematics in Real Life (Minor III)
(Sem II)

Sr. No.	Heading	Particulars
1	**Description the course:** **Including but not limited to:**	This course gives introduction to basic concepts of mathematics, highlighting practical aspects with concrete examples. In this course, students from various science streams will recognize the importance of mathematics and learn.
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):** (List the course objectives) This course gives introduction to basic concepts of mathematics, highlighting practical aspects with concrete examples. In this course, students from various science streams will recognize the importance of mathematics and learn. CO1: To develop matrix based techniques for solving linear system of equations. CO2: To identify underlying principles for balancing chemical equations. CO3: To associate geometrical objects for understanding maximization and minimization problems. CO4: To recognize the role of matrices in solving real life problems.	
8	**Course Outcomes (OC):** (List the course outcomes) At the end of the course, the students will be able OC1: to derive the formulae for simple curves passing through given set of points. OC2: to perform various useful operations on matrices like computing inverse, adjoint, determinant etc. OC3: to predict when two matrices commute. OC4: to outline basic linear programming problem and steps for its solution. OC5: to evaluate the polar form of complex numbers. OC6: to illustrate the use of reflection and rotation matrices in computer graphics.	
9	**Modules** **Module 1: Matrices and systems of linear Equations (15 Hours)**	
	1. Drawing curve through given set of points: formula and simple curves. 2. Kepler's law and equation of the orbit of an asteroid around the sun. 3. Two by two matrices: traces, determinant, commutation and anticommutation, $[X\ Y] = XY - YX$, $[X\ Y] = XY + YX$.	

	4. Equation of line passing through two points, parallel line, intersecting lines, point of intersection. 5. Two by two matrices: traces, determinant, inverse of a matrix and its calculation (without proof). Criterion for invertibility in terms of the determinant. 6. Formula for matrix multiplication (without proof) and examples. 7. Balancing chemical equations-I, Motivation and examples using system of linear equations. 8. System of linear equations in at most three variables and their visualization 9. Three by three matrices: traces, determinant, addition, further properties like symmetric, antisymmetric. 10. Inverse of three by three matrix and solution to a system of three equations in three unknowns (only statement). 11. Balancing chemical equations-II (using three by three matrices and their properties). 12. Basics of complex numbers-I: introduction of the complex plane, modulus of a complex number, complex conjugate. 13. Examples of Pauli matrices (named after Nobel prize winner Wolfgang Pauli) and their properties related to commutation and anticommutation. 14. Magic card trick based on linear system of equations: examples and explanation 15. Variation of card trick based on linear system of equations: Further examples and variations.
	Module 2: Geometry of Linear Equations and Matrices in Action. (15 Hours)
	1. Basics of linear programming-I: set up equations, feasible region, theorem on existence of solution. 2. Basics of linear programming-II: plotting the feasible region and checking its boundedness or unboundedness. 3. Maximization or minimization in industry-I: Objective function, Mathematical formulation (only two variables) examples. 4. Maximization or minimization in industry-II: Optimal solution, Geometrical solution (only two variables) examples. 5. Maximization or minimization in industry-III: exceptional cases: Unbounded solution, feasible region being a line segment. 6. Computer graphics-I: three by n matrices, visualization and introduction of xyz coordinates. Scaling and translation: formula using matrices and its visualization. 7. Introduction to basic trigonometric functions: sine, cosine definition and tabulation of certain standard values. 8. Formulae for sine of a sum of two angles and cosine of two angles and examples. Properties like points of vanishing, graphs of sine and cosine function and periodicity. 9. Basics of complex numbers-II: Polar form, DeMoivre's formula (without proof) and applications, Plotting roots of unity (upto degree four). 10. Computer graphics-II: rotation matrices, formula and

<table>
<tr><td></td><td>visualization. Product of two rotation matrices is again
a rotation, determination of the angle.
11. Computer graphics-III: reflection matrices, formula and visualization. Product of two reflection matrices: formula and properties.
12. Shearing and its formula, visualization, transpose of a matrix, orthogonal matrices: definition and examples, inverse of an orthogonal matrix.
13. Leontief (closed) model in economics (work of Nobel laureate Wassily Leontief): price vector, input-output matrix, Setting up the associated equation using matrices: examples.
14. Statement of the result for existence of solution to the exchange matrix and examples.
15. Linear independence (for columns in 2 by 2 and 3 by 3 matrices), Statement of result related to powers of exchange matrix. Computation of examples.</td></tr>
<tr><td>10</td><td>Text Books:
1) Elementary Linear Algebra Application Version, H. Anton, C. Rorres, Wiley and Sons.
2) Artin, Algebra, Pearson, Second Edition.</td></tr>
<tr><td>11</td><td>Reference Books:
1) Contemporary Abstract Algebra, J. A. Gallian, Narosa publishing house.
2) Halliday and Resnick's Principles of Physics, Wiley, Eleventh Edition.</td></tr>
<tr><td></td><td><u>Scheme of the Examination</u></td></tr>
<tr><td></td><td>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.</td></tr>
<tr><td>12</td><td>Internal Continuous Assessment: 40%
Semester End Examination: 60%</td></tr>
<tr><td>13</td><td>Continuous Evaluation through: Quizzes, Class Tests, presentations, projects, role play, creative writing, assignments etc.
(at least 3)
<table>
<tr><td>Sr. No.</td><td>Particulars</td><td>Marks</td></tr>
<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</td><td>05</td></tr>
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		on any one topic related to the syllabus.	

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)

14 **Format of Question Paper:**

The semester-end examination will be of 30 marks of one hour duration covering the entiresyllabus of the semester. All questions are Compulsory.

Q.No.1	Module 1	A. Attempt any ONE out of TWO.(6 marks) (Theory) (OC1 and OC2) B. Attempt any TWO out of THREE (problems or theory) (4 marks) (OC 3, OC 4, OC 5)	10 Marks
Q.No.2	Module 2	A. Attempt any ONE out of TWO.(6 marks) (Theory) (OC1 and OC2) B. Attempt any TWO out of THREE (problems or theory) (4 marks) (OC 3, OC 4, OC 5)	10 Marks
Q.No.3	Module 1 and 2	Attempt any TWO out of FOUR.(10 marks) (Problems) (OC 5 & OC 6)	10 Marks

Sign of the BOS Chairman
Dr. Bhausaheb S Desale
The Chairman, Board of Studies in Mathematics

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

AC – 25/03/2026
Item No. – 6.18 (N) (1)

As Per NEP 2020

University of Mumbai



Syllabus for Minor (Scheme I / II) Vertical 2		
Faculty of Science & Technology		
Board of Studies in Physics		
Third Year Programme in Minor B.Sc. (Physics)		
Semester	**V**	**Credits**
Title of Paper	**1) Applied Electronics**	**2**
	2) Practical course	**2**
Total Credits		**4**
Semester	**VI**	
Title of Paper	**1) Semiconductor Physics**	**2**
	2) Practical course	**2**
Total Credits		**4**
From the Academic Year	**2026 - 2027**	

SEM – V

Syllabus
B. Sc. Physics
(Semester- V)

Name of the Course: T. Y. B. Sc. Physics Minor Course 11
MN - 11: Applied Electronics (2 Credits)

Sr. No.	Heading	Particulars
1.	**Description the course: (Including but not limited to)**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2.	**Vertical:**	Major/**Minor**/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3.	**Type:**	**Theory**
4.	**Credits:**	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5.	**Hours**	30 Hours
6	**Marks Allotted:**	50 Marks
7.	**Course Objectives (CO):** The students are expected to:	
	CO 1	Learn the construction, working, and characteristics of BJTs and its application as switches.
	CO 2	Learn AM, FM, and different types of modulation techniques.
	CO 3	Learn the functioning and characteristics of FET called JFET and its switching applications.
	CO 4	Learn the operational amplifiers (OPAMP) in basic linear circuit configurations such as amplifiers, adders, and subtractors. Evaluate different op-amp applications like integrators, differentiators, and comparators in signal processing tasks.
8.	**Course Outcomes (OC):** After successful completion of this course, the students will be able to:	
	OC 1	Understand the construction, working, and characteristics of BJTs and its application as switches.
	OC 2	Understanding the fundamental principles of each modulation technique, recognizing their applications in various communication systems.
	OC 3	Understand the functioning and characteristics of FET called JFET and its switching applications.
	OC 4	Understand the operational amplifiers (OPAMP) in basic linear circuit configurations such as amplifiers, adders, and subtractors. Evaluate different op-amp applications like integrators, differentiators, and comparators in signal processing tasks.
9.	**Modules / Units**: - There will be One module / Unit Per Credit	
	Module / Unit I: Transistors and Radio Communication (15 Lectures)	
	Chapter 1: Bipolar Junction Transistor (BJT) Introduction, Types of transistors, Construction and working of transistor, Transistor as amplifier, Characteristics of transistor (CB, CE & CC), Gain in transistor, Transistor as switch.	

	Note: Covered Sufficient number of problems on above given topics. **Chapter 2: Radio communication** **1) Amplitude Modulation:** Need of modulation, concept of modulation, AM waveform, mathematical expression of AM, concept of sideband, demodulation principles. AM Receiver: TRF and super heterodyne receiver. **2) Frequency Modulation:** Definition, mathematical representation, frequency spectrum, bandwidth and modulation index. **3)** Concept of ASK, PSK, FSK, PAM, PWM, PPM, PCM	
	Module / Unit II: FET and Op-Amp: (15 Lectures)	
	Chapter 1: Field Effect Transistors (FET) Introduction, Types of FET, Construction and working of JFET, Difference between JFET and BJT, Characteristics of JFET, Important terms, JFET as switch **Chapter 2: Operational Amplifiers** Introduction, Schematic symbol of operational amplifier, Features of Operational Amplifier, Op-amp as inverting amplifier, Op-amp as non-inverting amplifier, Applications of Op-amp: as voltage follower, as adder, as subtractor, Op-amp as integrator, Op-amp as differentiator, Op-amp as comparator **Note:** Covered Sufficient number of problems on above given topics.	
10.	**References:** 1. **VM:** Principles of Electronics – V. K. Mehta and Rohit Mehta. (S. Chand – Multicolor revised edition) 2. **Kennedy:** Electronics Communication Systems by Kennedy 3. **MB:** Electronic Principles, Malvino & Bates -7th Edition TMH Publication. 4. **AM:** Electronic Devices and Circuits, Allen Mottershead -PHI Publication. 5. **KVR:** Functional Electronics, K.V. Ramanan-TMH Publication 6. **LEF:** Communication Electronics: Principles and applications by Louis E Frenzel, 3rd edition TMH Publications. 7. **VT:** Telecommunication Switching Systems and Network by Vishwanathan and Thiagarajan, PHI publication. **8. DJ:** Electronics Communication Systems by Denis Roddy and John Coolen, PHI publication	
11.	**Individual Passing in Internal and External Examination**	
12.	**Internal Continuous Assessment (40%) (20 Marks)**	**External Assessment, (60%) (30 Marks)**
	Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)	**Evaluation:** through Exam at the End of the Semester / Term.
13.	**Duration of the Term End Examination: One Hour** **Format of Question Paper for Physics Major Term End Examination for 30 Marks:**	
	Unit - I (15 Marks)	Q.1 A) Attempt any Two 10 Marks i) Theory

		ii) Theory iii) Theory iv) Theory B) Attempt any One i) Problem / Theory ii) Problem	 05 Marks
	Unit – II (15 Marks)	Q.2 A) Attempt any Two i) Theory ii) Theory iii) Theory iv) Theory B) Attempt any One i) Problem / Theory ii) Problem	10 Marks 05 Marks

Name of the course: Physics Minor Practical Course 12 –USPHMNP5 (MNP - 5)

Sr. No.	Heading	Particulars
1.	**Description the course: (Including but not limited to)**	Introduction, Relevance, Usefulness, Application, Interest, Connection with other courses, Demand in the Industry, Job Prospects etc.
2.	**Vertical:**	Major / **Minor** / Open Elective / Skill Enhancement / Ability Enhancement / Indian Knowledge System
3.	**Type:**	**Practical**
4.	**Credits:**	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a Semester)
5.	**Hours**	60 Hours
6.	**Marks Allotted:**	50 Marks
7.	**Course Objectives (CO):** The students are expected to:	
	CO 1	learn the skills while performing experiments.
	CO 2	know how to use the apparatus without fear & hesitation.
	CO 3	learn the concepts of physics theory concepts and their practical application.
	CO 4	learn the errors and their estimation**.**
8.	**Course outcomes (OC):** After successful completion of this course, the students will be able to:	
	OC 1	understand & practice the skills while performing experiments.
	OC 2	understand the use of apparatus and their use without fear & hesitation.
	OC 3	correlate the physics theory concepts to practical application.
	OC 4	understand the concept of errors and their estimation**.**
9.	**List of Experiments** 1. To study CE characteristics of Transistor. 2. To study CB characteristics of Transistor. 3. Simple microphone amplifier using a transistor. 4. To study and design transistor as switch. 5. To study JFET as common Source amplifier. 6. To study JFET characteristics. 7. To study of first order active low pass filter circuit (BB) 8. To study of first order active high pass filter circuit (BB) 9. To study Op-amp as log amplifier. 10. To study Op-amp as summing amplifier. 11. To study Op-amp as difference amplifier. 12. To study Op-amp as Astable /Square wave generator. (BB) 13. To study Op-amp as D/A converter: Binary weighted resistors (BB) 14. To study Op-amp as D/A converter: Ladder Network (BB) 15. Op-Amp as Wave generator (Sine, Square and Triangular) (BB) **Note: BB** indicates that practical should be performed using Breadboard. **Skill experiments:** 1.Wiring of simple circuit using Breadboard. 2.To study AM modulator.	

	3.To study FM modulator. 4.Soldering Technique. 5.Use of DMM: To test diode, transistor, LED etc. 6.Us of Oscilloscope (CRO). 7. Drawing of graph on semilogarithmic/logarithmic scale. 8.Use of electronics balance: Find the density of solid cylinder. 9. Estimation of errors from actual experimental data. 10.Any other skill experiment related to syllabus. **Note: Teacher should follow the above guidelines to conduct skill experiment** • Minimum **10 experiments** from the list of experiments and minimum **all skill experiments** must be completed and reported in the journal, in the **Vth Semester**. Certified Journal is a must, to be eligible to appear for the semester end practical examination. • All the measurements and readings should be written with proper units in SI system only. • After completing the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination to be eligible to appear in the Semester End Practical Examination. **General Instructions**: • For practical examinations, the learner will be examined in **One** experiment from the list of experiments. • Evaluation in viva voce will be based on regular experiments and skill experiments. • A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical examination of the semester or a certificate from the Head of the Department / Institute to the effect that the candidate has completed the practical course of that semester of T. Y. B. Sc. Physics as per the minimum requirement. **Note**: • The questions on slips for the same should be framed in such a way that candidate will be able to complete the task within the specified time. • While evaluating practical, weightage should be given to circuit / ray diagram, observations, tabular representation, experimental skills, procedure, graph, calculation and result. • The skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
10.	**Passing standards for Practical:** • Individual Passing in Internal and External Examination
11.	**Scheme of Examination:**
	Semester End Practical Examination: • The duration of **Each** Experiment in Semester End External Practical Examination will be of **Two hours**. • The Semester End External Practical Examination will be for **30 marks** as per the marking scheme given below:

	Sr. No.	Activity	Total 30 Marks
	1	One Experiment	20 Marks
	2	Certified Journal	05 Marks
	3	Viva	05 Marks
	Internal Practical Examination: • The duration of Internal Practical Examination per experiment will be of **Two hours**. • The Internal Practical Examination Pattern for **20 marks (During the Semester)**, will be as per the marking scheme given below:		
	Sr. No.	**Activity**	**Total 20 Marks**
	1	Skill testing related any one Experiment	10 Marks
	2	Overall performance	05 Marks
	3	Viva-Voce	05 Marks

SEM. – VI

Syllabus
B. Sc. Physics
(Semester- VI)

Name of the Course: T. Y. B. Sc. Physics Minor Course 13
MN - 13: Semiconductor Physics (2 Credits)

Sr. No.	Heading	Particulars
1.	**Description the course: (Including but not limited to)**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2.	**Vertical:**	Major/**Minor**/Open Electives /Skill Enhancement / Ability Enhancement/Indian Knowledge System
3.	**Type:**	**Theory**
4.	**Credits:**	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a semester)
5.	**Hours**	30 Hours
6	**Marks Allotted:**	50 Marks
7.	**Course Objectives (CO):** The students are expected to:	
	CO 1	The course objective is to obtain practical knowledge in semiconductor physics and semiconductor devices.
	CO 2	To identify types of semiconductors.
	CO 3	To study the basic concepts regarding properties and applications of semiconductors.
	CO 4	To impart knowledge about identifying the types and its uses in semiconductor industries.
	CO 5	
8.	**Course Outcomes (OC):** After successful completion of this course, the students will be able to:	
	OC 1	Understand the basics of Semiconductor Physics.
	OC 2	Understand the basic concepts of conduction in semiconductors.
	OC 3	Understand the basic concepts of semiconductor diode characteristics.
	OC 4	Understand the properties, application and their significance of the semiconductor materials.
	OC 5	Demonstrate quantitative problem-solving skills in all the topics covered.
9.	**Modules / Units**: - There will be One module / Unit Per Credit	
	Module / Unit I: Conduction in Semiconductors (15 Lectures)	
	Introduction, the bands structure of semiconductors, Types of semiconductors, Intrinsic Semiconductors, Conductivity and Temperature of a Semiconductor, Electrons and Holes in an Intrinsic Semiconductors, Charge Carriers concentration, Fermi Level, Carrier concentrations in an intrinsic semiconductor, Electrical Conductivity. Extrinsic semiconductors, Donor and Acceptor impurities, Charge densities in a semiconductor, Fermi level in extrinsic semiconductors, Carrier generation, Carrier life time, Diffusion of carriers, Einstein relation, Continuity equation, Diffusion length, Hall Effect.	

<table>
<tr><td></td><td colspan="3">Module / Unit II: Semiconductor diode Characteristics (15 Lectures)</td></tr>
<tr><td></td><td colspan="3">The p-n junction and contact potential, Fermi levels, Space charge, Reverse and Forward bias, Qualitative theory of the p-n junction, The p-n junction as a diode, Band structure of an open-circuit p-n junction, The current components in a p-n junction diode, Quantitative theory of p-n diode currents, The Volt-Ampere characteristics, The temperature dependence of p-n characteristics, Diode resistance, The Tunnel Diode, Characteristics of a Tunnel Diode.</td></tr>
<tr><td>10.</td><td colspan="3">References:
1. Electronic Devices and Circuits: Millman, Halkias & Satyabrata Jit. (Third Ed.) Tata McGraw Hill.
2. Solid State Physics: S.O. Pillai (Revised Sixth Edition), New Age International(P) Limited.
3. Physics of Semiconductor Devices – S.M. Sze –Third Edition (John Wiley)
4. An introduction to Semiconductor Devices—Donald A. Neaman –Third Edition (McGraw Hill 2007)
5. Solid State Electronic Devices – B.G. Streetman and S.K. Banerjee (Pearson Education)</td></tr>
<tr><td>11.</td><td colspan="3">Individual Passing in Internal and External Examination</td></tr>
<tr><td rowspan="2">12.</td><td>Internal Continuous Assessment (40%)
(20 Marks)</td><td colspan="2">External Assessment, (60%)
(30 Marks)</td></tr>
<tr><td>Continuous Evaluation through:
Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)</td><td colspan="2">Evaluation: through Exam at the End of the Semester / Term.</td></tr>
<tr><td rowspan="3">13.</td><td colspan="3">Duration of the Term End Examination: One Hour
Format of Question Paper for Physics Major Term End Examination for 30 Marks:</td></tr>
<tr><td>Unit - I (15 Marks)</td><td>Q.1 A) Attempt any Two 10 Marks
i) Theory
ii) Theory
iii) Theory
iv) Theory
B) Attempt any One 05 Marks
i) Problem / Theory
ii) Problem</td></tr>
<tr><td>Unit – II (15 Marks)</td><td>Q.2 A) Attempt any Two 10 Marks
i) Theory
ii) Theory
iii) Theory
iv) Theory
B) Attempt any One 05 Marks
i) Problem / Theory
ii) Problem</td></tr>
</table>

Name of the course: Physics Minor Practical Course - 14 USPHMNP6 (MNP - 6)

Sr. No.	Heading	Particulars
1.	**Description the course: (Including but not limited to)**	Introduction, Relevance, Usefulness, Application, Interest, Connection with other courses, Demand in the Industry, Job Prospects etc.
2.	**Vertical:**	Major / **Minor** / Open Elective / Skill Enhancement / Ability Enhancement / Indian Knowledge System
3.	**Type:**	**Practical**
4.	**Credits:**	2 credits (1 credit = 15 Hours for Theory or 30 Hours of Practical work in a Semester)
5.	**Hours**	60 Hours
6.	**Marks Allotted:**	50 Marks
7.	**Course Objectives (CO):** The students are expected to:	
	CO 1	learn the skills while performing experiments.
	CO 2	know how to use the apparatus without fear & hesitation.
	CO 3	learn the concepts of physics theory concepts and their practical application.
	CO 4	learn the errors and their estimation**.**
8.	**Course outcomes (OC):** After successful completion of this course, the students will be able to:	
	OC 1	understand & practice the skills while performing experiments.
	OC 2	understand the use of apparatus and their use without fear & hesitation.
	OC 3	correlate the physics theory concepts to practical application.
	OC 4	understand the concept of errors and their estimation**.**
9.	**List of Experiments** 1. Study of optoelectronic properties of semiconductor devices (Solar cell). 2. Studies on the characterization of JFET (Output & transfer characteristic). 3. Studies on the characterization of MOSFET. 4. Determination of band gap of semiconductor from temperature dependence of resistivity using four probe methods. 5. Study of Hall voltage as a function of probe current and magnetic field and determination of Hall coefficient and carrier concentration. 6. Temperature and frequency dependent dielectric properties of the material. 7. To determine the Energy Band gap (Eg) of silicon Crystal using energy band gap measurement setup. 8. To determine the type (n or p) and mobility of semiconductor material using Hall-Effect System. 9. To study I – V characteristics of a Photodiode. 10. To study I – V characteristics of a Phototransistor. 11. To study constant current source using IC-741(OPAMP) and PNP transistor. 12. To determine the band gap energy of the material of the given p-n junction diode (Ge diode). 13. To study the static characteristics of a FET. 14. To study the JFET common source amplifier and find it's cut off frequencies and bandwidth. 15. To verify Inverse square law of light using a photo cell. 16. Study of V-I and V-R characteristics of a solar cell and determination of efficiency of	

	solar cell. **<u>Skill experiments</u>:** 1. To study V– I characteristics of a light dependent resistor (LDR). 2. To study the forward bias Characteristic of p-n junction diode. 3. To study the reverse bias Characteristic of p-n junction diode. 4. To study the reverse characteristics of Zener diode. 5. To study the forward characteristics of LED. **Note: Teacher should follow the above guidelines to conduct skill experiment** **Reference Books:** • Minimum **10 experiments** from the list of experiments and minimum **all skill experiments** must be completed and reported in the journal, in the **VIth Semester**. Certified Journal is a must, to be eligible to appear for the semester end practical examination. • All the measurements and readings should be written with proper units in SI system only. • After completing the required number of experiments in the semester and recording them in journal, student will have to get their journal certified and produce the certified journal at the time of practical examination to be eligible to appear in the Semester End Practical Examination. **General Instructions**: • For practical examinations, the learner will be examined in **One** experiment from the list of experiments. • Evaluation in viva voce will be based on regular experiments and skill experiments. • A candidate will be allowed to appear for the semester end practical examination only if the candidate submits a certified journal at the time of practical examination of the semester or a certificate from the Head of the Department / Institute to the effect that the candidate has completed the practical course of that semester of T. Y. B. Sc. Physics as per the minimum requirement. **Note**: • The questions on slips for the same should be framed in such a way that candidate will be able to complete the task within the specified time. • While evaluating practical, weightage should be given to circuit / ray diagram, observations, tabular representation, experimental skills, procedure, graph, calculation and result. • The skill of doing the experiment and understanding physics concepts should be more important than the accuracy of final result.
10.	**Passing standards for Practical:** • Individual Passing in Internal and External Examination
11.	**Scheme of Examination:**

Semester End Practical Examination:

- The duration of **Each** Experiment in Semester End External Practical Examination will be of **Two hours**.
- The Semester End External Practical Examination will be for **30 marks** as per the marking scheme given below:

Sr. No.	Activity	Total 30 Marks
1	One Experiment	20 Marks
2	Certified Journal	05 Marks
3	Viva	05 Marks

Internal Practical Examination:

- The duration of Internal Practical Examination per experiment will be of **Two hours**.
- The Internal Practical Examination Pattern for **20 marks (During the Semester)**, will be as per the marking scheme given below:

Sr. No.	Activity	Total 20 Marks
1	Skill testing related any one Experiment	10 Marks
2	Overall performance	05 Marks
3	Viva-Voce	05 Marks

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
Prof. (Dr.) T. N. Ghorude
Chairman
BOS in Physics

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 – 20/04/2024
Item No. – 6.7 Sem. II (5a)

As Per NEP 2020

University of Mumbai



Syllabus for Basket of Minor	
Board of Studies in Physics	
UG First Year Programme	
Semester	**II**
Title of Paper: Basic Electronics	**Credits 2**
I)	
II)	
III)	
From the Academic Year	**2024-25**

Sr. No.	Heading	Particulars
1	**Description the course :** **Including but Not limited to :**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	**Vertical :**	Minor (Choose By √)
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** / 60 Hours
6	**Marks Allotted**:	**50 Marks**/100 Marks
7	**Course Objectives:** (List some of the course objectives) After successful completion of this course students will be able to: **1.** To impart knowledge of basic concepts in Electronics. **2.** To provide the skills and methods required to construct electronic circuits **3.** To provide exposure of linear and digital electronics circuits.	
8	**Course Outcomes**: (List some of the course outcomes) On successful completion of this course students will be able to: **1.** Understand basic concept of electronic devices resistors, capacitors, inductors, transformers and P-N Junction diode. **2.** Understand the basic concept of AC generator, basic terms, phasor diagram, AC circuit using Resistance, Capacitance and Inductance. **3.** Apply knowledge to develop circuits using electronic devices.	

9	**Modules**: - Per credit One module can be created

	Module 1: Unit 1: Basic Circuit Components (15 Lectures)
	1. Resistors: Introduction of resistor, units, Resistor value using Color Code, Resistive circuits: Series circuit, characteristics of series circuit, series voltage divider, open and short in series circuit, Parallel circuit, laws of parallel circuit, open and short in parallel circuit. **2. Capacitors:** Principles of capacitance, units, color code, capacitors in series and parallel. **3. Inductors:** Introduction, units, inductor color code, self and mutual inductance, Inductance in series and parallel **4. Transformers:** Introduction, Step-up and Step-down Transformers, Turn-Ratio, Voltage and Current Ratio. **5. P-N Junction Diode:** construction, formation of depletion layer, forward and reverse biasing, and I-V characteristics.
	Module 2: Unit 2: AC Fundamentals (15 Lectures)
	Types of Alternating Waveforms, Basic AC Generator, Definitions of Cycle, Time Period, Frequency and Amplitude, Characteristics of a Sine Wave, Audio and Radio Frequencies, Different Values of Sinusoidal Voltage and Current, Average and RMS value of AC, Phase of an AC, Phasor Diagram, Vector Representation of an Alternating Quantity, AC through pure resistance, inductance and capacitance. Concept of Reactance and Impedance, Application of AC.

10	**Reference Books:** **1.** Electric Circuits, S. A. Nasar, Schaum's outline series, Tata McGraw Hill (2004) **2.** Electrical Circuits, M. Nahvi, J. Edminister, Schaum's Outline Series, Tata McGraw-Hill **3.** Electrical Circuits, K.A. Smith and R.E. Alley (2014) Cambridge University Press **4.** Network, Lines and Fields, J.D.Ryder, Prentice Hall of India.	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination Individual Passing in Internal and External Examination : 60%**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	

13 **Format of Question Paper for Minor:**
External – 60% (30 Marks) **(2 Credits)**
Internal – 40% (20 Marks)
Question Paper Format for 30 Marks
Duration: One Hours

Attempt any **Four** Questions out of Six from the following.	
1) Answer the following questions	(15 Marks)
i) Theory (Unit-I)	(8 Marks)
ii) Theory (Unit-II)	(7 Marks)
2) Answer the following questions	(15 Marks)
i) Theory (Unit-I)	(8 Marks)
ii) Theory (Unit-II)	(7 Marks)
3) Answer the following questions	(15 Marks)
i) Theory (Unit-I)	(8 Marks)
ii) Theory (Unit-II)	(7 Marks)
4) Answer the following questions	(15 Marks)
i) Theory (Unit-I)	(8 Marks)
ii) Theory (Unit-II)	(7 Marks)
5) Answer the following questions	(15 Marks)
i) Theory (Unit-I)	(8 Marks)
ii) Theory (Unit-II)	(7 Marks)
6) Answer the following questions	(15 Marks)
i) Theory (Unit-I)	(8 Marks)
ii) Theory (Unit-II)	(7 Marks)

Sign of the BOS Chairman
Dr. T.N. Ghorude
Board of Studies in Physics

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

AC – 28/03/2025
Item No. – 6.3 (N) (6ab) Sem. III & IV

As Per NEP 2020

University of Mumbai



Syllabus for Minor Vertical 2 (Scheme-I)		
Faculty of Science and Technology		
Board of Studies in Physics		
Second Year Programme in Minor (Physics)		
Semester	**III & IV**	
Title of Paper	**Sem.**	**Total Credits 4**
I) Digital Electronics	**III**	**2**
II) Applied Optics		**2**
Title of Paper		**Credits**
I) Applied Electronics	**IV**	**2**
II) Electrical Instruments		**2**
From the Academic Year		**2025-26**

Sem. - III

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

Title of Paper: Digital Electronics

Sr. No.	Heading	Particulars
1	**Description of the course :** **Including but Not limited to :**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	**Vertical :**	Minor
3	**Type :**	Theory / Practical
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**: (List some of the course objectives) After successful completion of this course students will be able to: **1)** Know the concept of IC logic families **2)** Learn the basics of Number systems. **3)** Understand the basics of Boolean functions & logic Gates **4)** Learn the basics of combinational logic circuits.	
8	**Course Outcomes**: (List some of the course outcomes) On successful completion of this course students will be able to: **1)** Understand the concept of digital logic system. **2)** Get knowledge of Number systems. **3)** Know the idea of Boolean functions & logic Gates **4)** Understand and explain the different flip-flops and timing circuit.	

9	**Modules**:- Per credit One module can be created	
	Module 1: Unit-I: Number System and Logic Gates (15 Lectures)	
	1. Number system and codes: Binary, octal, hexadecimal and decimal Number systems and their inter conversion, BCD numbers (8421-2421), Binary addition and subtraction, signed and unsigned binary numbers, 1's and 2's complement representation. **2.** Basic logic circuits: Logic gates (AND, OR, NOT, NAND, NOR, Ex-OR, Ex NOR and their truth tables), Universal Gates, Laws of Boolean algebra, De-Morgan's theorem.	
	Module 2: Unit-II: Combinational Logic Circuits (15 Lectures)	
	The Half adder, the full adder, subtractor circuit. Multiplexer demultiplexer, decoder. Flip flop and Timing circuit: set-reset laches, D-flipflop, R-S flip-flop, J-K Flip-flop, Master slave Flip flop, edge triggered flip-flop, T- flipflop.	
10	**Reference Books:** **1)** Digital Fundamentals by T. L. Floyd, Pearson International Publications, Ninth Edition, 2000 **2)** Electronics Principles by Malvino and Leach, Mc. Graw Hill, Third edition. 2000 **3)** Modern Digital Electronics by R P Jain, Tata McGraw-Hill Education, 2003. **4)** Fundamental of Digital Circuits by A. Anand kumar	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	
13	**Format of Question Paper for Minor:** **External – 60% (30 Marks)** **(2 Credits)** **Internal – 40% (20 Marks)** **Question Paper Format for 30 Marks** **Duration: One Hours**	
14	**Individual Passing in Internal and External Examination**	
	Internal Continuous Assessment (40%) (20 Marks)	**External Assessment, (60%) (30 Marks)**
	Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)	**Evaluation:** through Exam at the End of the Semester / Term.
	Duration of the Term End Examination: One Hour **Format of Question Paper for Physics Minor Term End Examination for 30 Marks:**	
	Unit - I (15 Marks)	Q.1 A) Attempt any Two 10 Marks i) Theory ii) Theory iii) Theory iv) Theory

		B) Attempt any One i) Problem / Theory ii) Problem	05 Marks
	Unit – II (15 Marks)	Q.2 A) Attempt any Two i) Theory ii) Theory iii) Theory iv) Theory B) Attempt any One i) Problem / Theory ii) Problem	10 Marks 05 Marks

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

Title of Paper: Applied Optics

Sr. No.	Heading	Particulars
1	**Description of the course :** **Including but Not limited to :**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	**Vertical :**	Minor
3	**Type :**	Theory / Practical
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**: (List some of the course objectives) After successful completion of this course students will be able to: **1)** Understand the principles of thin and thick lenses, including the Lens Maker's Equation, Newton's lens equation, and magnification (both lateral and longitudinal). **2)** Analyze the behavior of lenses in co-axial systems, considering equivalent focal lengths and cardinal points. **3)** Explore the properties of thick lenses, including their cardinal points, with a focus on practical examples. **4)** Investigate aberrations such as spherical aberration and chromatic aberration, emphasizing conditions for achromatic aberration. **5)** Apply knowledge of optical systems to real-world scenarios, including oil immersion objectives in high-power microscopes, telescope objectives, and camera lenses.	
8	**Course Outcomes**: (List some of the course outcomes) By the end of this course, students will be able to: **1)** Solve problems related to lens behaviour, cardinal points, and focal lengths. **2)** Identify and correct aberrations in optical systems. **3)** Analyze and interpret interference phenomena, including thin film interference, fringes in wedge-shaped films, and Newton's rings. **4)** Operate a Michelson's interferometer and apply it for wavelength measurement and other practical purposes. **5)** Demonstrate understanding of Fabry-Perot interferometers and etalons, particularly in qualitative contexts.	

9	**Modules**:- Per credit One module can be created	
	Module 1: Unit-I: Lens and Aberration **(15 Lectures)**	
	1. Thin & thick Lens, Lens Maker's Equation (Review), Newton's lens equation, magnification-lateral, Longitudinal and angular. Equivalent focal length of two thin lenses, cardinal points of co-axial system of two thin lenses, Thick lens, cardinal points of thick lens, Ramsden and Huygens eyepiece. **2. Aberration:** Spherical Aberration, Reduction of Spherical Aberration, Chromatic aberration and condition for achromatic aberration, oil immersion objective of high power microscope, achromatism of telescope objective and camera lens. (Emphasis must be placed on explaining examples from day-to-day life and solving more Problems)	
	Module 2: Unit-II: Interference **(15 Lectures)**	
	1. Interference, Interference in thin films, Fringes in Wedge shaped films, Newton's Rings (Reflective) **2. Michelson's Interferometer:** Principle & Working, Applications: Measurement of Wavelength, Determination of difference in the wavelength of two waves, Thickness of Thin transparent film, Determination of RI of gases, Standardization of Metre scale. Fabry Perot Interferometer and etalon (qualitative) (Emphasis must be placed on understanding applications based on interference and solving more Problems)	
10	**Reference Books:** **1)** N. Subramanyam , Brijlal, and M N Avadhanulu , A Textbook of Optics, 25th revised ed.(2012) S. Chand (Main Reference) **2)** Ashok Kumar, D R Gulati, H R Gulati, Fundamentals of Optics, 2018, R Chand & Co. (Further Reading) **3)** Devraj Singh, Fundamentals of Optics, 2nd edition (2015), PHI (Further Reading)	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	
13	**Format of Question Paper for Minor:** **External – 60% (30 Marks)** **(2 Credits)** **Internal – 40% (20 Marks)** **Question Paper Format for 30 Marks** **Duration: One Hours**	
14	**Individual Passing in Internal and External Examination**	
	Internal Continuous Assessment (40%) (20 Marks)	**External Assessment, (60%) (30 Marks)**
	Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play,	**Evaluation:** through Exam at the End of the Semester / Term.

	creative writing, assignment etc. (at least 3)		
	Duration of the Term End Examination: One Hour **Format of Question Paper for Physics Minor Term End Examination for 30 Marks:**		
	Unit - I (15 Marks)	Q.1 A) Attempt any Two v) Theory vi) Theory vii) Theory viii) Theory B) Attempt any One iii) Problem / Theory iv) Problem	10 Marks 05 Marks
	Unit – II (15 Marks)	Q.2 A) Attempt any Two v) Theory vi) Theory vii) Theory viii) Theory B) Attempt any One iii) Problem / Theory iv) Problem	10 Marks 05 Marks

Sem. - IV

Syllabus
B.Sc. (Physics)
(Sem.- IV)

Title of Paper: Applied Electronics

Sr. No.	Heading	Particulars
1	**Description of the course :** **Including but Not limited to :**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	**Vertical :**	Minor
3	**Type :**	Theory / Practical
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**: (List some of the course objectives) After successful completion of this course students will be able to: **1)** To analyze and synthesize circuits and to become familiar with the propagation of signals through transmission lines. **2)** To illustrate the fundamentals of basic communication system. **3)** To analyze the circuits in time and frequency domain **4)** To study network functions, inter relationship among various circuit parameters. **5)** Investigate tuning circuit behavior, Q-value and bandwidth. **6)** Learn about direct and indirect coupled circuits and filters. **7)** Understand the importance of basic sensors and transducers used in day to day life.	
8	**Course Outcomes**: (List some of the course outcomes) By the end of this course, students will be able to: **1)** Through test, laboratory exercises and home assignment, students will be able to apply their knowledge in solving simple circuits. **2)** Understand the basic components and types of communication systems. **3)** Students will be able to evaluate the time and frequency response which is useful in understanding behavior of electronic circuits and control system. **4)** Design and analyze resonance in series and parallel LCR circuits. **5)** Calculate the Q-value and bandwidth of tuning circuits. **6)** Analyze the use of a variety of transducers used in electronic industry.	
9	**Modules**:- Per credit One module can be created	
	Module 1: Unit-I: Electronic Communication Circuits (15 Lectures)	

	Tuning Circuits and Filters: Resonance in series and parallel LCR circuits – Operating characteristic of a tuning circuit – Q value – Bandwidth – Tuning circuit in radio receivers – Double tuned transformers – direct and indirect coupled circuits – coefficient of coupling – filters: low pass filter-high pass filter– band pass filter-band stop filter. **Modulation**: Basic concepts of wave propagation. Amplitude Modulation (AM), Frequency and Phase modulation (FM & PM)	
	Module 2: Unit-II: Sensors and Transducers **(15 Lectures)**	
	Basics of sensors and transducers: Active and passive transducers, characteristics and selection criteria of transducers, working principle of Eddy current sensors. Pizoelectric transducers, photoelectric and photo voltaic sensors, capacitive sensors. **Displacement and pressure**: Potentiometers, pressure gauges, Linear Variable Differential Transformers (LVDT) for measurement of pressure and displacement, strain gauges. **Temperature transducers**: Resistance Temperature Detectors (RTD), thermistors, and thermocouples, their ranges and applications.	
10	**Reference Books:** **1.** M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 26th Indian Reprint, 2000 **2.** Electronic Instrumentation (2 Ed.) H.S. Kalsi, TMH (2006). **3.** K V V Murty and M S Kamth, "Basic Circuit Analysis", Jaico Publishing house, London **4.** W. Cooper and A. Helfric, "Electronic Instrumentation and Measurement Techniques", PHI, 4th edition, 2009	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	
13	**Format of Question Paper for Minor:** **External – 60% (30 Marks)** **(2 Credits)** **Internal – 40% (20 Marks)** **Question Paper Format for 30 Marks** **Duration: One Hours**	
14	**Individual Passing in Internal and External Examination**	
	Internal Continuous Assessment (40%) (20 Marks)	**External Assessment, (60%) (30 Marks)**
	Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)	**Evaluation:** through Exam at the End of the Semester / Term.

	Duration of the Term End Examination: One Hour **Format of Question Paper for Physics Minor Term End Examination for 30 Marks:**	
	Unit - I (15 Marks)	Q.1 A) Attempt any Two 10 Marks ix) Theory x) Theory xi) Theory xii) Theory B) Attempt any One 05 Marks v) Problem / Theory vi) Problem
	Unit – II (15 Marks)	Q.2 A) Attempt any Two 10 Marks ix) Theory x) Theory xi) Theory xii) Theory B) Attempt any One 05 Marks v) Problem / Theory vi) Problem

Syllabus
B.Sc. (Physics)
(Sem.- IV)

Title of Paper: Electrical Instruments

Sr. No.	Heading	Particulars
1	**Description of the course :** **Including but Not limited to :**	Introduction, relevance, Usefulness, Application, interest, connection with other courses, demand in the industry, job prospects etc.
2	**Vertical :**	Minor
3	**Type :**	Theory / Practical
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**: (List some of the course objectives) After successful completion of this course students will be able to: **1)** Gain knowledge of measuring instruments used in Physics laboratory and Elecrical/ Electronic Industry. **2)** Explore principle of Cathode Ray Oscilloscope and its applications. **3)** To understand basic principles underlying electrical instruments and application in measurement of electronics parameters. **4)** To understand basic functions and principle of working of sensors and components used in Electronic Measurement.	
8	**Course Outcomes**: (List some of the course outcomes) By the end of this course, students will be able to: **1)** Explore the working of basic measuring instrument like Cathode Ray Oscilloscope (CRO) / DSO, including principles of beam deflection. **2)** Students will learn measurement of physical parameters using various transducers and working of sensors. **3)** They will become familiar with basics of instruments and details of operation of measuring instruments and their applications.	
9	**Modules**:- Per credit One module can be created	
	Module 1: Unit-I: Principles of Measurement (15 Lectures)	
	Introduction to basic instruments: Components of generalized measurement system, applications of instrument systems, static and dynamic characteristics of instruments, concepts of accuracy, precision, linearity, sensitivity, resolution, hysteresis, calibration **Errors in measurement**: Errors in measurement, classification of errors, remedies to eliminate errors	

	Module 2: Unit-II: Measuring Instruments - Oscilloscopes (15 Lectures)	
	Cathode ray oscilloscope: Block diagram based Study of CRO, specifications, controls, sweep modes, role of delay line, single- and dual-beam dual-trace CROs, chop and alternate modes, Measurement using oscilloscope: measurement of voltage, frequency, rise time, fall time and phase difference. Lissajous figures in detection of frequency and phase. Digital storage oscilloscope (DSO): Block diagram based study of DSO, study of features like roll, refresh, storage mode and sampling rate; applications of DSO	
10	**Reference Books:** **1.** W. Cooper and A. Helfric, "Electronic Instrumentation and Measurement Techniques", PHI, 4th edition, 2009 **2.** H. S. Kalsi, "Electronics Instrumentation", Tata Mcgraw Hill, 2nd Edition, 2009 **3.** H. Oliver and J. M. Cage, "Electronic Measurement and Instrumentation", McGraw Hill, 3rd edition, 2008 **4.** C. S. Rangan, G.R. Sarma, and V.S.V. Mani, "Instrumentation Devices and Systems", Tata McGraw Hill, 9th edition, 2007 **5.** T. S. Rathore, "Digital Measurement Techniques", Narosa Publishing House, New Delhi, 2nd Edition, 2003	
11	**Internal Continuous Assessment: 40%**	**External, Semester End Examination 60% Individual Passing in Internal and External Examination**
12	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	
13	**Format of Question Paper for Minor:** **External – 60% (30 Marks)** **(2 Credits)** **Internal – 40% (20 Marks)** **Question Paper Format for 30 Marks** **Duration: One Hours**	
14	**Individual Passing in Internal and External Examination**	
	Internal Continuous Assessment (40%) (20 Marks)	**External Assessment, (60%) (30 Marks)**
	Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc. (at least 3)	**Evaluation:** through Exam at the End of the Semester / Term.
	Duration of the Term End Examination: One Hour **Format of Question Paper for Physics Minor Term End Examination for 30 Marks:**	

	Unit - I (15 Marks)	Q.1 A) Attempt any Two xiii) Theory xiv) Theory xv) Theory xvi) Theory B) Attempt any One vii) Problem / Theory viii) Problem	10 Marks 05 Marks
	Unit – II (15 Marks)	Q.2 A) Attempt any Two xiii) Theory xiv) Theory xv) Theory xvi) Theory B) Attempt any One vii) Problem / Theory viii) Problem	10 Marks 05 Marks

Sd/- **Sd/-** **Sd/-**

Sign of the BOS Chairman
Dr. T.N. Ghorude
Board of Studies in Physics

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