Modern Education Society's

Nowrosjee Wadia College

(AUTONOMOUS)

NAAC Accredited A+ with CGPA 3.51

Affiliated to the
Savitribai Phule Pune University
(Formerly University of Pune)

Four Year B.Sc. (Honors) Degree Program in Computer Science
(Formerly known as B.C.S.)
(Faculty of Science & Technology)
B.Sc. (Computer Science) (Hons)

National Education Policy (NEP) Syllabus
(Amended in third BOS Meeting)
To be implemented from Academic Year 2024-2025

Title of the Course: B.Sc. (Computer Science)

Preamble for the Syllabus:

In compliance with the directives from the University Grants Commission, under the autonomous status of the college, the syllabus for four-year B. Sc. Computer Science at the undergraduate level is revised and reframed as per the National Educational Policy (NEP 2020) curriculum framework. Nowrosjee Wadia College has decided to change the syllabi for the degree of B.Sc. from June 2023, as the college has already shifted to the autonomous status from the academic year 2022-2023. The present syllabus is prepared by the Board of Studies in Computer Science, Nowrosjee Wadia College, taking into consideration the present relevance and application of the various branches of Computer Science. While preparing this syllabus the U.G.C. model curriculum (LOCF) and existing syllabus given by Savitribai Phule Pune University is followed.

It aims to provide students with thorough knowledge of theoretical and practical aspects of Computer Science. The objective of the course is to prepare students to undertake careers involving problem solving using Computer Science and technologies, or to pursue advanced studies and research in Computer Science. The syllabus which comprises of Computer Science subject along with that of the three allied subjects (Mathematics, Electronics and Statistics) covers the foundational aspects of computing sciences and also develops the requisite professional skills and problem solving abilities using Computing Sciences. The program creates opportunities of hands-on learning through projects and gives knowledge and practical experience of the latest technologies. It also encourages a student to work effectively as team member and demonstrate professional behaviour. On completion of this course, a student will not only develop a diverse set of skills to prepare for higher studies in Computer Science and for employment, but will also encourage students to launch their own start-ups or venture into new types of careers using their interdisciplinary training.

Objectives:

- To develop problem solving abilities using a computer.
- To build the necessary skill set and analytical abilities for developing computer-based solutions for real life problems.
- To train students in professional skills related to the software industry.
- To prepare necessary knowledge base for research and development in Computer Science.
- To help students build a successful career in Computer Science and to produce entrepreneurs who can innovate and develop software products.

PROGRAM OUTCOMES (POs):

The Bachelor of Science with Computer Science (BSc with CS) program enables students to attain by the time of graduation following 10 PO's. The course syllabi and the overall curriculum have been designed to achieve these outcomes:

Program Outcome (PO)	Short title	Description A Graduate student in Computer Science will be able to:
PO1	Knowledge outcome	Fundamental understanding of the principles of Computer Science and its connections with other disciplines
PO2	Problem Analysis and solution	Procedural knowledge that creates different types of professionals related to Computer Science,
PO3	Development of various allied skills	Demonstrate the aptitude of Computer Programming and Computer based problem solving skills with use of basic knowledge in applied subjects Statistics, Electronics and Mathematics. Ability to link knowledge of Computer Science with other two chosen auxiliary disciplines of study.
PO4	Modern Tool usage	Display the knowledge of appropriate theory, practices and tools for the specification, design, and implementation. Ability to formulate, to model, to design solutions, procedure and to use software tools to solve real world problems and evaluate.
PO5	Specialization in Data Science	Specialize in the domain of Data Science and apply the knowledge to solve real world Analytical problems.

PO6	Environment and Sustainability	Understand, critically analyse and attempt at finding the solutions to various environmental issues and obligate themselves towards sustainable development at the local, national and global context.
PO7	Communication and Leadership	Ability to present result using different presentation tools. Communicate proficiently and develop the quality of presentation, good communication, leadership, working in group/team as a member, and other extracurricular activities.
PO8	Research skills and Aptitude	Understand the concept of research, general research methods and is able to analyse, interpret and draw rational inferences. Ability to pursue higher studies of specialization. Ability to appreciate emerging technologies and tools.
PO9	Ethics	Understand professional ethics and human values. Display ethical code of conduct in usage of Internet and Cyber systems.
PO10	Societal Applications	Ability to formulate, to model, to design solutions, procedure and to use software tools to solve real world problems and evaluate. Attempts at analysing and inspecting varied socio-economic issues in computer culture perspective by applying the knowledge to the societal issues.
PO11	Life Skills	Recognise the scope of computers in terms of exploring the career opportunities, employment and life-long engagement in teaching and utilise the knowledge for publication for future academic endeavours.

Eligibility for the Course

XIIth Science or its equivalent examination with Mathematics. All other criteria are same as per Savitribai Phule Pune University rules.

Teaching Scheme:

- The course is a 3 year, 6 semesters full time under graduate course and 1 more year, 2 semester B. Sc. (CS) Honors course.
- The course follows the NEP pattern as per Savitribai Phule Pune University.
- 1 credit theory = 15 hours
- 1 credit practical = 30 hours = 4 hrs week per batch

MODERN EDUCATION SOCIETY'S

NOWROSJEE WADIA COLLEGE, PUNE

(An Autonomous College Affiliated to Savitribai Phule Pune University)

NEP Course Structure and other details

For

B. Sc.(COMPUTER SCIENCE)

(Based on NEP 2020 framework)

(To be implemented from the Academic Year 2024-25)

Savitribai Phule Pune University, Pune
Credit Framework for Under Graduate (UG) (2024 – 25) (3 Subject)

Level / Difficulty	Sem	Subject-1				Subject-2	Subject-3	GE/OE	SEC	IKS	AEC	VEC	CC	Total
4.5 / 100	I	2 (T) + 2 (P)				2(T)+2(P)	2(T)+2 (P)	2 (T)	2 (T/P)	2 (T) (Generic)	2 (T)	2	--	22
	II	2 (T) + 2 (P)				2(T)+2(P)	2(T)+2 (P)	2 (P)	2 (T/P)	--	2 (T)	2	2	22
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor Continue option: Student will select one subject among the (subject 1, subject 2 and subject 3) as major and another as minor and third subject will be dropped.														
Level / Difficulty	Sem	Credits Related to Major				Minor		GE/OE	SEC	IKS	AEC	VEC	CC	Total
		Major Core	Major Elective	VSC	FP / OJT/ CEP									
5.0 / 200	III	4 (T) + 2 (P)	--	2 (T/P)	2 (FP)	2(T)+2(P)	--	2 (T)	--	2 (T) (Subject Specific)	2 (T)	--	2	22
	IV	4 (T) + 2 (P)	--	2 (T/P)	2 (CEP)	2(T)+2(P)	--	2 (P)	2 (T/P)	--	2 (T)	--	2	22
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor														
5.5 /300	V	8(T) + 4(P)	2 (T) + 2 (P)	2 (T/P)	2 (FP/CEP)	2(T)	--	--	--	--	--	--	--	22
	VI	8(T) + 4(P)	2 (T) + 2 (P)	2 (T/P)	4 (OJT)	--	--	--	--	--	--	--	--	22
Total 3 Years		44	8	8	10	18	8	8	6	4	8	4	6	132
Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor														
6.0 /400	VII	6 (T) + 4 (P)	2 (T) + 2 (T/P)	--	--	4 (RP)	4(RM)(T)	--	--	--	--	--	--	22
	VIII	6 (T) + 4 (P)	2 (T) + 2 (T/P)	--	0	8 (RP)	0		0	0	0	0	0	22
Total 4 Years		68	16	8	2	22	22		12	6	8	4	8	176
Four Year UG Honours Degree in Major and Minor with 176 credits OR														
6.0 /400	VII	10(T) + 4(P)	2 (T) + 2 (T/P)	0	0	0	4 (RM)		0	0	0	0	0	22
	VIII	10(T) + 4(P)	2 (T) + 2 (T/P)	0	0	4 (OJT)	0		0	0	0	0	0	22
Total 4 Years		76	16	8	2	14	22		12	6	8	4	8	176
Four Year UG Honours with Research Degree in Major and Minor with 160-176 credits														

Abbreviations used throughout -

OE : Open Elective , VSC : Vocational Skill Courses, VEC: Value Education Courses, CC : Co-Curricular Courses, AEC: Ability Enhancement Course, IKS : Indian Knowledge System, OJT : On Job Training, FP : Field Project, CEP : Community Engagement Project
ST : Statistics, EL : Electronics, M : Mathematics

EVALUATION PATTERN :

Note : The Department follows all rules, regulations and procedure related to the examination decided by Examination Section of college.

(i) Each course shall be evaluated with Continuous Evaluation (CE) and Semester-end Examination (SEE) mechanism.

(ii) Theory courses: Continuous Evaluation shall be of 15 marks and Final Assessment shall be of 35 marks.

(iii) Practical courses: Continuous Evaluation shall be of 15 marks and Final Assessment shall be of 35 marks.

(iv) To pass a course of 2 credits, a student has to earn minimum 20 marks out of 50, provided that he/she should earn minimum 6 marks in Continuous Evaluation (out of 15) and minimum 14 marks (out of 35) in End-Semester Examination. That is passing criterion is minimum 40% marks in the examination.

(v) For Continuous Evaluation (out of 15 marks), There has to be one written test of 10 marks (Mid-Semester Examination). The remaining 05 marks shall be based on the continuous evaluation consisting of tutorial, viva, seminars, home-assignments, mini project, survey, group discussion etc.(on approval of Head of the Department) and performance and attendance in the lectures and labs.

(vi) There shall be revaluation of the answer scripts of End-Semester Examination (out of 35 marks) of theory papers only, but not of internal assessment papers as per Ordinance No. 134 A and B.

PATTERN OF THE QUESTION PAPER

Continuous Evaluation (Theory papers)

(1) As a part of Internal Evaluation, there shall be written test (Mid-Semester Examination) of 10 marks. Pattern of the question paper is as follows.

(2) Continuous Evaluation (Mid-Semester Examination of 10 marks, Duration: 45 minutes)

Question No.	Total Marks	No. Of questions	Remarks
Q. 1.	05	Solve any 5 out of 7	Short answer / objective type of questions. Each question carry 1 mark.
Q. 2.	05	Solve any 1 out of 2 questions	Each question carry 5 marks

(3) Semester-End Examination for B. Sc. courses, out of 35 marks, shall be of 2 hours duration. The pattern of the question paper will be as decided by the examination section of the college.

AWARD OF GRADES AND GRADE POINTS

The mapping of percentage to letter grade and grade point (for each course) is given in the following Table.

Sr. No.	Grade Letter	Grade Point	Marks
1.	O (Outstanding)	10	45 ≤ Marks ≤ 50
2.	A+ (Excellent	9	40 ≤ Marks ≤ 44
3.	A (Very Good)	8	35 ≤ Marks ≤ 39
4.	B+ (Good)	7	27.5 ≤ Marks ≤ 34
5.	B (Above Average)	6	25 ≤ Marks < 27.5
6.	C (Average)	5	22.5 ≤ Marks ≤ 24
7.	D (Pass)	4	20 ≤ Marks < 22.5
8.	F (Fail)	0	Marks < 20
9.	Ab (Absent)	0	

CGPA :The CGPA is the weighted average of the grade points obtained in all courses (theory and Practicals) by a student in all the courses in 6 semesters.

Based on the performance of the student in the Semester Examinations, Nowrosjee Wadia College will declare the results and issue the Semester Grade sheets. Also, the College will declare the results and issue the Grade sheets at the end of the course. The class will be awarded to a student on the basis of CGPA. The award of the class shall be as per the following table

Sr. No.	CGPA	Class of the degree awarded
1	9.50 or more than 9.50	OUTSTANDING (O)
2	8.50 or more but less than 9.50	EXCELLENT (A+)
3	7.50 or more but less than 8.50	VERY GOOD (A)
4	6.25 or more but less than 7.50	GOOD (B+)
5	5.25 or more but less than 6.25	ABOVE AVERAGE (B)
6	4.75 or more but less than 5.25	AVERAGE (C)
7	4.00 or more but less than 4.75	PASS (D)

MODERN EDUCATION SOCIETY'S

Nowrosjee Wadia College (Autonomous)

Title of the Course: B.Sc. (Computer Science) (Hons)

Structure of Course: w.e.f. Academic Year 2024-25

Year	Semester & Level	Course Type	Choice	Course code and Course Name	Credits
1	1 4.5	Major (Core) Subject 2T 2P	Discipline specific Major I	Computational Thinking	**2**
				Laboratory Course on Computational Thinking	**2**
			Discipline specific Major II	Fundamentals of Electronics I	**2**
				Laboratory Course on Fundamentals of Electronics I	**2**
			Discipline specific Major III	Discrete Mathematics-I	**2**
				Practical Course based on Discrete Mathematics-I	**2**
		Generic / Open Elective	OE 1	Open Elective 1	**2**
		VSC / SEC VSEC	SEC* Skill Paper1 (Practical)	Practical Course on Basic Statistics for Computer Science	**2**
		AEC/ VEC / IKS	IKS*	Generic	**2**
			AEC	English	**2**
			VEC*	Environmental Education	**2**
		OJT / FP, CEP, CC, RP	CC	--	-
Total credits					**22**

IKS*

Indian Knowledge system is the generic subject which will be common for institution or discipline specific choices be provided for Arts and Science students each.

SEC*

Skill Enhancement Course is to be selected by the students as per their choice. Students will select any one subject as SEC from the three major subjects selected by them.

VEC*

Value Education Course will be Environmental Education for all discipline students.

Year	Semester & Level	Course Type	Choice	Course code and Course Name	Credits
1	2 4.5	Major (Core) Subject 2T 2P	Discipline specific Major I	Advanced 'C' Programming	**2**
				Laboratory Course on Advanced 'C' Programming	**2**
			Discipline specific Major II	Fundamentals of Electronics II	**2**
				Laboratory Course on Fundamentals of Electronics II	**2**
			Discipline specific Major III	Discrete Mathematics-II	**2**
				Practical Course based on Discrete Mathematics-II	**2**
		Generic / Open Elective	OE 2	Open Elective 2	**2**
		VSC / SEC VSEC	SEC* Skill Paper2 (Theory)	Practical course on Advanced Statistics for Computer Science	**2**
		AEC/ VEC / IKS	AEC	English	**2**
			VEC	Environmental Education	**2**
		OJT / FP, CEP, CC, RP	CC	Cultural Activities, NSS/NCC and Fine/ Applied/ Visual/ Performing Arts	**2**
Total credits					**22**

SEC*

Skill Enhancement Course is to be selected by the students as per their choice. Students will select any one subject as SEC from the three major subjects selected by them.

Year	Semester & Level	Course Type	Choice	Course code and Course Name	Credits
2	3 5.0	Major (Core) Subject	Major core 4T 2P	Data Structures and Algorithms-I	2
				Fundamentals of Database Management Systems	2
				Laboratory course on Data Structures and Algorithms-I & Fundamentals of Database Management Systems	2
		Major Elective	--	--	--
		VSC / SEC VSEC	VSC	Software Engineering	2
		OJT / FP, CEP	FP*	Field Project Related to Computer Science	2
		Minor	Minor 2T 2P	Principles of Electronics Communication / Computational Geometry	2
				Laboratory Course on Communication Electronics / Mathematics Practical using Python Programming Language - I	2
		Generic / Open Elective	OE 3	Open Elective 3	2
		AEC/ VEC / IKS	IKS*		2
			AEC		2
		CC, RP	CC	Physical Education / Cultural Activities, NSS/NCC and Fine/ Applied/ Visual/ Performing Arts Course	2
Total credits					**22**

Field Project* (FP)

As per the Government Resolution (GR) of Maharashtra dated 20th April 2023, 17th March 2024, a Field Project (FP) worth 2 credits are required in the third semester of undergraduate (UG) courses. This project is related to the core (Major) subject and is to be offered at the departmental level during the third semester. The field project is designed by the guide and students of the specific subject. Research project is to be completed in any recognized institute / laboratory / research laboratory/ academic institution for 120 Hours.

IKS*

Indian Knowledge System in third semester must be based on core subject and framed by concerned Board of studies.

Year	Semester & Level	Course Type	Choice	Course code and Course Name	Credits
2	4 5.0	Major (Core) Subject	Mandatory 4T 2P	Data Structures and Algorithms-II	2
				Advanced Database Management Systems	2
				Laboratory Course based on Data Structures and Algorithms-II & Advanced Database Management Systems	2
		Major Elective	--	--	--
		VSC / SEC VSEC	VSC	Computer Networks	2
			SEC	Python Programming	2
		OJT / FP, CEP	CEP*		2
		Minor	Minor 2T 2P	Embedded Systems and Interfacing / Operations Research	2
				Laboratory Course on Embedded Systems/ Mathematics Practical using Python Programming Language - II	2
		Generic / Open Elective	OE 4	Open Elective 4	2
		AEC/ VEC / IKS	AEC		2
		CC, RP	CC	Physical Education / Cultural Activities, NSS/NCC and Fine/ Applied/ Visual/ Performing Arts Course	2
Total credits					**22**

Community Engagement Service* (CEP)

As per the Government Resolution (GR) of Maharashtra dated 20th April 2023, 17th March 2024, A Community Engagement Program (CEP) worth 2 credits are to be completed in the fourth semester by UG students. As per the GR, the CEP is based on the core subject and aims to convey important aspects of that specific subject, including applicable knowledge,

scientific advancements, recent information, etc., for the upliftment of the community or society. Students will choose a nearby rural area/ urban area/ any suitable locality to disseminate such information to the community during the fourth semester. At the end of the semester, students will prepare a report detailing the information provided to the community, in form of discussions, meetings, talks, programs, etc., conducted in the selected area. After submitting the report, students will receive the credits for this component. For CEP, students must find a suitable rural or urban area for providing information to the community, and the college will provide a letter for their placement.

Year	Semester & Level	Course Type	Choice	Course code and Course Name	Credits
3	5 5.5	Major (Core) Subject	Mandatory 8T 4P	Operating Systems -I	**2**
				Foundations of Data Science	**2**
				Object Oriented Programming using Java	**2**
				Network Security	**2**
				Laboratory Course on OS-I	**2**
				Laboratory Course on Java and Foundations of Data Science	**2**
			Major Elective 2T 2P	Web Technologies - I	**2**
				Laboratory course on Web Technologies - I	**2**
		OR			
			Major Elective 2T 2P	Theoretical Computer Science	
				Laboratory Course on Computer Graphic using Python	
		VSC / SEC VSEC	VSC	Software Testing	**2**
		OJT / FP, CEP	FP*/CEP	FP-II	**2**
		Minor	Minor Paper 5 (Theory)	Wireless Communication and IoT / Linear Algebra	**2**
Total credits					**22**

Field Project* (FP)

As per the Government Resolution (GR) of Maharashtra dated 20th April 2023, 17th March 2024, a Field Project (FP) worth 2 credits are required in the third semester of undergraduate (UG) courses. This project is related to the core (Major) subject and is to be offered at the departmental level during the third semester. The field project is designed by the guide and

students of the specific subject. Research project is to be completed in any recognized institute / laboratory / research laboratory/ academic institution for 120 Hours.

Year	Semester & Level	Course Type	Choice	Course code and Course Name	Credits
3	6 5.5	Major (Core) Subject	Mandatory 8T 4P	Operating Systems-II	**2**
				Data Analytics	**2**
				Advanced Java Programming	**2**
				Artificial Intelligence	**2**
				Laboratory course on Operating Systems II	**2**
				Laboratory Course on Advanced Java Programming & Data Analytics	**2**
			Major Elective 2T 2P	Web Technologies- II	**2**
				Laboratory course on Web Technologies - II	**2**
		OR			
			Major Elective 2T 2P	Compiler Construction	
				Laboratory Course on GitHub Programming	
		VSC / SEC VSEC	VSC	Blockchain Technology	**2**
		OJT / FP, CEP, CC, RP	OJT*	OJT	**4**
Total credits					**22**

On Job Training* (OJT)

As per the Government Resolution (GR) of Maharashtra dated 20th April 2023, 17th March 2024, On Job Training (OJT) is a compulsory component in the sixth semester for UG students, carrying 4 credits (120 clock hours). Students participating in OJT will work in industries/ NGOs/ heritage centres / government agencies/ or other suitable organizations designated by the subject teacher / Course co-ordinator/ mentor or Board of Studies. Upon completion of the OJT program, students must submit a report in a prescribed format

provided by the college. After submitting the detailed report, students will receive the allocated credits for this component. Students complete 120 clock hours of work throughout the six-month semester without disrupting their regular academic activities. Students opting for OJT will receive a letter from the college to join the selected institution. Hands on training in any recognised research institute / any production company related with core subject for 120 contact hours.

Semester 7 (Fourth Year): Data Science Track

Year	Semester & Level	Course Type	Choice	Course code and Course Name	Credits
4	7 6.0	Major (Core) Subject	Mandatory 10T 4P	Data modeling and Data Visualization	**4**
				Machine Learning	**4**
				Design and Analysis of Algorithms	**2**
				Laboratory course on Data modeling and Visualization	**2**
				Laboratory course on Machine Learning	**2**
			Major Elective 2T 2P	Advanced Database technologies	**2**
				Laboratory Course on Advanced database technologies	**2**
		OR			
			Major Elective 2T 2P	Cloud and edge Computing	
				Laboratory Course on Cloud and Edge computing	
		OJT / FP, CEP, CC, RP	RP*		
		Minor	Minor Theory	Research Methodology	**4**
Total credits					**22**

Research Project* (RP)

As per the Government Resolution (GR) of Maharashtra dated 20th April 2023, 17th March 2024, a Research Project (RP) worth 2 credits are required in the third semester of undergraduate (UG) courses. This project is related to the core (Major) subject and is to be offered at the departmental level during the third semester. The field project is designed by

the guide and students of the specific subject. Research project is to be completed in any recognized institute / laboratory / research laboratory/ academic institution for 160 Hours.

Semester 8 (Fourth Year): Data Science Track

Year	Semester & Level	Course Type	Choice	Course code and Course Name	Credits
4	8 6.0	Major (Core) Subject	Mandatory 10T 4P	Software Architecture and Design Patterns	**4**
				Data Security and Data Privacy	**4**
				Web Analytics / Google Analytics	**2**
				Laboratory Course on SADP	**2**
				Laboratory Course on Web Analytics / Google Analytics	**2**
			Major Elective 2T 2P	MEAN Stack development	**2**
				Laboratory Course on MEAN Stack development	**2**
		OR			
			Major Elective 2T 2P	Computer vision	
				Laboratory Course on Computer Vision	
		OJT / FP, CEP, CC, RP	RP*	OJT	**4**
Total credits					**22**

Research Project* (RP)

As per the Government Resolution (GR) of Maharashtra dated April 20, 2023, 17 March 2024, a Research Project (RP) worth 2 credits are required in the third semester of undergraduate (UG) courses. This project is related to the core (Major) subject and is to be offered at the departmental level during the third semester. The field project is designed by the guide and students of the specific subject. Research project is to be completed in any recognized institute / laboratory / research laboratory/ academic institution for 320 Hours.

Semester 7 (Fourth Year): Software development track

Year	Semester & Level	Course Type	Choice	Course code and Course Name	Credits
4	7 6.0	Major (Core) Subject	Mandatory 10T 4P	Software Architecture and Design Patterns	**4**
				Software Quality Assurance	**4**
				Cloud and Edge computing	**2**
				Laboratory course on SADP	**2**
				Laboratory course on Cloud and Edge computing	**2**
			Major Elective 2T 2P	Full Stack development	**2**
				Laboratory Course on Full stack	**2**
		OR			
			Major Elective 2T 2P	Design and analysis of Algorithms	
				Laboratory course on DAA	
		Minor	Minor Theory	Research Methodology	**4**
Total credits					**22**

Semester 8 (Fourth Year): Software development track

Year	Semester & Level	Course Type	Choice	Course code and Course Name	Credits
4	8 6.0	Major (Core) Subject	Mandatory 10T 4P	Quantum Computing	**4**
				Software defined networks	**4**
				UI/UX design	**2**
				Laboratory Course on SDN	**2**
				Laboratory Course on UI/UX design	**2**
			Major Elective 2T 2P	DevOps	**2**
				Laboratory course on DevOps	**2**
		OR			
			Major Elective 2T 2P	Emerging Technologies (Semantic Web)	
				Laboratory on implementation of Emerging Technologies(Semantic Web)	
			OJT(4)	OJT	**4**
Total credits					**22**

Subject Code: Subject Title: Computational Thinking Semester I (Major Paper 1) Theory		
Teaching Scheme 30 Hours	**No. of Credits** 2	**Examination Scheme** CE: 15 marks SEE: 35 marks

Course Objectives

1. To provide knowledge on how to apply procedural approach to real life problems
2. To understand underlying abstractions in programming through examples: concept of variables, iterations, filtering etc.
3. Designing algorithmic techniques to solve a given problem: searching, sorting etc.
4. Understanding the execution and testing process for algorithms, understand debugging concept
5. To provide knowledge on selection of appropriate data structures for data storage and representation. Trees, graphs, lists etc.

Course Contents

Unit 1	**Introduction: Why study Computational thinking?**	**8**

1.1 What is Computational Thinking?
1.2 Logical & Algorithmic thinking
1.3 Problem-solving and decomposition
1.4 Abstraction and Modeling
1.5 Anticipating and dealing with errors
1.6 Evaluating a solution

Unit 2	**Getting started with Computation thinking**	**10**

2.1 Iterators
2.2 Variables
2.3 Filtering
2.4 Data types
2.5 Filtering: dynamic conditions
2.6 What is a pseudocode
2.7 Pseudocode and parameters
2.8 Modular design approach to pseudocode
2.9 Pseudo codes - notations, examples, advantages and limitations.

Unit 3	**Computational thinking in software development**	**5**

3.1 Introduction to C programming
3.2 Structure of a ‘C’ program.
3.3 Character set, Keywords, Identifiers, Variables, Constants
3.4 Data Types (Built-in and user defined data types).
3.5 Operators, Expressions, Character, String, Formatted input and output.

Unit 4	Decision Making and Iteration	7

4.1 Decision making structures
4.2 Loop control structures
4.3 Concept of Modular design using Functions, Recursive functions
4.4 Standard library functions, User defined functions.

Learning Outcomes:

1. Students would have understood the concept of Computational Thinking and its application for problem solving.
2. Students will understand how to develop their ideas into flowcharts, algorithms and convert them into programming language •

Learning Resources:

1. "Computational thinking, A beginner's guide to problem solving and programming", Karl Beecher, The Chartered Institute for IT, 2017
2. "Computational thinking, A Primer for programmers and data scientist", G Venkatesh & Madhavan Mukund, Copyright.
3. "Computational Thinking Handbook", Enoch Hunsakerc 2020 Mylspot Education Services Private Limited.
4. "Computational thinking", Jean M. wing, 2007
5. "Essential Computational thinking", Ricky J. Sethi, Copyright @ 2019 by Cognella, Inc.
6. "Problem Solving and Programming Concept", Maureen Sprankle, 7th Edition, Pearson Publication.
7. "C: the Complete Reference" , Schildt Herbert, 4th edition, McGraw Hill
8. "A Structured Programming Approach Using C", Behrouz A. Forouzan, Richard F. Gilberg, Cengage Learning India
9. "The 'C' programming language", Brian Kernighan, Dennis Ritchie, PHI.

Subject Code: Subject Title: Laboratory Course on Computational Thinking Semester I (Major Paper 1) Practical		
Teaching Scheme 4 hours/week (60 Hours)	**No. of Credits** **2**	**Examination Scheme** CE: 15 marks SEE: 35 marks

Course Objectives

1. To provide practical knowledge on how to apply procedural approach to real life problems
2. To provide hands-on experience on Designing algorithmic techniques to solve a given problem.
3. To provide expertise in thinking logically, through implementation of solutions in 'C' Programming.

Course Contents

	Computational Thinking Assignments	
Practical 1	Assignment consisting of small real life problems requiring logical thinking, to generate solutions. (Solution should be Identification of input / processing needed / output generated, generation of a pseudo-code/algorithm)	
Practical 2	Assignment on data types, operators in C.	
Practical 3	Assignment on decision making Conditional statements, Loops in 'C'.	
Practical 4	Assignment on Writing Menu driven programs, in 'C'.	
Practical 5	Assignment on writing modular programs (Functions / Recursive functions) in 'C'.	

Learning Outcomes :

1. Students would have understood the concept of Computational Thinking and its application for problem solving.
2. Students will understand how to develop their ideas into flowcharts, algorithms and convert them into programming language.

Learning Resources:

1. How to Solve it by Computer, R.G. Dromey, Pearson Education.

2. Problem Solving and Programming Concept, Maureen Sprankle, 7th Edition, Pearson Publication.

3. C: the Complete Reference, Schildt Herbert, 4th edition, McGraw Hill

4. A Structured Programming Approach Using C, Behrouz A. Forouzan, Richard F. Gilberg, Cengage Learning India

5. The 'C' programming language, Brian Kernighan, Dennis Ritchie, PHI.

Subject Code: Subject Title: Fundamentals of Electronics I Semester I (Major Paper 2)Theory		
Teaching Scheme 30 Hours	**No. of Credits** 2	**Examination Scheme** CE: 15 marks SEE: 35 marks

Course Objectives:

1. Study of semiconductor devices and their applications.
2. To understand basic concepts of digital electronics.
3. Study different types of Logic gates.
4. Study types of Digital Circuit.
5. Learn to connect and perform experiments with simple circuits.

Course Contents

Unit 1	**Semiconductors and Diodes**	**6**

1.1 Intrinsic and Extrinsic semiconductors.
1.2 PN Diode, Forward and Reverse I-V Characteristics.
1.3 Zener diode- reverse bias characteristics.
1.4 Working principle of LED, Optocoupler and photodiode.
1.5 Rectifier: concept and types, working of bridge rectifier.
1.6 Regulated power supply- block diagram and applications.

Unit 2	**Bipolar Junction Transistor and Applications**	**6**

2.1 Transistors- definition, terminals, types, symbols.
2.2 Working of NPN transistor, CE output characteristics, alpha, beta and relationship between them in transistor.
2.3 Concept of loadline and cut off, saturation, and active region.
2.4 Amplifier- definition, Single Stage Amplifier, concept of Gain and Bandwidth.
2.5 Transistor as switch.

Unit 3	**Number Systems and Digital Codes**	**6**

3.1 Number Systems: Binary and Hexadecimal number systems and their inter conversions.
3.2 Representation of Data: Signed Magnitude, one's complement and two's complement.
3.3 Binary addition and binary subtraction using 2's complement method.
3.4 Codes: BCD, Gray code, ASCII code.

Unit 4	**Logic Gates and Boolean Identities**	**3**

4.1 Basic gates: AND, OR and NOT.
4.2 Derived gates: NAND, NOR , XOR and XNOR gates.
4.3 Universal gates, De Morgan Laws.

Unit 5	**Combinational Circuits**	**4**

5.1 Definition of multiplexer and need.
5.2 2 to 1 Multiplexer.
5.3 1 to 2 Demultiplexer.

5.4 Encoder: Definition, 4 to 2 encoder working. 5.5 Decoder: Definition, 2 to 4 decoder working.		
Unit 6	**Sequential Circuits**	**5**
6.1Introduction to sequential circuits. Difference between combinational circuits and sequential circuits. 6.2 Flip Flops (Clocked RS circuit and truth table), JK, D, T block diagram and truth tables. 6.3 Shift register: Types and applications. 6.4 Counters: Synchronous and Asynchronous counters. 6.5 Three bit asynchronous Up and down counter (connections, truth table and timing diagram).		
Learning Outcomes: **On completion of this course, students will be able to:** 1. Understand semiconductor devices and their applications. 2. Solve problems on Number systems and their representations. 3. Familiar with logic gate, its use in combinational and sequential circuits.		
Learning Resources: 1. Electronics Principles: A.P. Malvino David J. Bates, McGraw Hill Higher Education publication, 7th Edition. 2. Principles of Analog Electronics: V.K. Mehta, S. Chand and Company publication. 3. Electronics Devices: Thomas .L.Floyd, Pearson PHI,7th Edition. 4. Digital Electronics: R.P. Jain, Tata McGraw Hill. 5. Digital Principles and Applications: Malvino Leach, Tata Mc Graw Hill. 6. Digital Fundamentals: Floyd, Jain R.P., Pearson Education.		

Subject Code:
Subject Title : Laboratory course on Fundamentals of Electronics I
Semester I (Major Paper 2) Practical

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	2	CE: 15 marks SEE: 35 marks

Course Objectives:

1. To design simple digital circuits and learn how to connect them
2. Understand the difference between sequential and combinational circuits.
3. Understand the working of various analog devices and how they are used.

Course Contents

Group A	**Digital Electronics Experiments** **Any 4 experiments out of the following:**	**4 hours each experiment**

1. Study of Logic Gates (Verification of Truth tables).
2. Study of Decimal to BCD/ (Binary) Converter.
3. 4-bit binary parallel adder and subtractor using IC7483.
4. BCD to 7 segment conversion using IC 7447.
5. Verification of De Morgans theorems.
6. Study of read and write action of RAM (using IC 2112/4 or equivalent).
7. Inter conversion of gates using universal gates.

Group B	**Analog Electronics Experiments** **Any 4 experiments out of the following:**	**4 hours each experiment**

1. Study of Zener regulator.
2. Study of Half Wave and Bridge Rectifier.
3. PN junction diode characteristics.
4. Zener diode characteristics.
5. Bipolar junction transistor as an amplifier.
6. Bipolar junction transistor as a switch
7. Verification of KVL and KCL.

Learning Outcomes:

On the completion of the course student will be able to:

1. To understand semiconductor devices and their applications.
2. Be familiar with logic gates and its use in combinational and sequential circuits.
3. To learn to work with simple digital circuits.
4. To understand how to read circuits and make circuit connections.

Subject Code
Subject Title: Discrete Mathematics-I
Semester I (Major Paper 3) Theory

Teaching Scheme	No. of Credits	Examination Scheme
30 Hours	2	CE: 15 marks SEE: 35 marks

Course Objectives

1. To build the necessary skill and analytical abilities for developing computer based solutions using mathematical concepts.
2. To get the relational understanding of mathematical concepts.
3. To develop a positive attitude towards mathematics as an interesting subjects in study of Computer Science.

Course Contents

Unit 1	**Set and Relation**	**12**

1.1 1. Introduction, Sets and Definition, Examples
1.2 Types of Sets : Empty set, Singleton set
1.3 Operations On Set (Union, Intersection, Complement)
1.4 Cardinality Of Set, Finite and Infinite Set
1.5 Power Set
1.6 Subsets
1.7 Ordered Pairs, Cartesian product of sets.
1.8 Relations, types of relations, equivalence relations, partial ordering, poset, Lattice (Definition only).
1.9 Equivalence class, properties and partition of a set.
1.10 Diagraph of relations, matrix representation and Hasse Diagram.

Unit 2	**Binary Operations**	**8**

2.1 Functions (Definition and Examples)
2.2 One-to-one Function, Onto Function.
2.3 Inverse Functions and Composition Function.
2.4 Some important Functions.
2.5 Binary operations
2.6 Properties of Binary Operations
2.7 Algebraic Structure
2.8 Groups (Definition only), Examples.

Unit 3	**Counting Principle**	**10**

3.1 Introduction
3.2 Basic Rule:
    3.2.1 The Multiplication Rule.
    3.2.2 The Addition Rule.
3.3 Principle of Inclusion and Exclusion.
3.4 Pigeon Hole Principle
3.5 Permutation and Combination (definition, Examples and basic properties)

3.6 Binomial Theorem (Statements only and Examples)

Learning Outcomes:

On the completion of the course student will be able to:

1. Students will understand basic concepts of Set theory.
2. Learn some fundamental concepts and terminology.
3. They will be able to solve problems based on permutation, Combinations.
4. Able to understand the general concept of a function, such as domain, range, function type etc.

Learning Resources:

1. Discrete Mathematics and its applications (Tata McGraw Hill) by Kenneth Rosen, 7^{th} edition.

   Unit-I : Text Book 1:
   Chapter 2: section 2.1, 2.2
   Chapter 5 : section 5.1

   Unit-II: Text Book 1:
   Chapter 5 : section 5.1

   Unit-III: Text Book 1:
   Chapter 6 : section 6.1, 6.2, 6.3, 6.4

Subject Code:
Subject Title : Practical Course based on Discrete Mathematics-I
Semester I (Major Paper 3) Practical

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	2	CE: 15 marks SEE: 35 marks

Course Objectives:

1. Student should be able to solve problems depending on contents in Discrete Mathematics-I

Course Contents

List of practical:

1. Operations on set.
2. Subset, Power set and cardinality of set.
3. Equivalence Relation
4. Poset and Hasse Diagram
5. Functions
6. Binary Operations
7. Algebraic Structure and Groups
8. Multiplication Rule, Addition Rule and Inclusion and Exclusion Principle
9. Permutation, Combination and Binomial theorem
10. Miscellaneous

Learning Outcomes

On the completion of the course student will be able to.

1. The exercises develop basic techniques and tests understanding of concepts and enhance mathematical ability.
2. It promotes abstract and analytical thinking of the students.

Subject Code:
Subject Title: Practical Course on Basic Statistics for Computer Science
Semester I (SEC) Theory

Teaching Scheme	No. of Credits	Examination Scheme
30 hours	2	CE: 15 marks SEE: 35 marks

Prerequisites
Knowledge of Counting Principles.

Course Objectives

1. To study basic statistical concepts & procedures required for Computer Science
2. To solve problems which later on can be applied in data analysis
3. To apply these statistical tools in CS applications
4. To understand and apply various probability techniques

Course Contents

Unit 1	**Data Condensation and Presentation of Data**	**4**

1.1 Definition, importance, scope (especially in Computer Science and Information Technology) and limitations of statistics.
1.2 Data Condensation: Types of data (Primary and secondary), Attributes and variables, discrete and Continuous variables.
1.3 Graphical Representation: Histogram, Steam and leaf chart. [Note: Theory paper will contain only procedures. Problems to be included in practical]
1.4 Numerical problems related to real life situations.

Unit 2	**Descriptive Statistics**	**11**

2.1 Measures of central tendency: Concept of central tendency.
2.2 Arithmetic mean: Definition, computation for raw data, properties of arithmetic mean (without proof), combined mean, weighted mean, merits and demerits.
2.3 Median and Mode: Definition, formula for computation for raw data, merits and demerits. Empirical relation between mean, median and mode (without proof)
2.4 Partition Values: Quartiles, Box Plot.
2.5 Concept of dispersion, absolute and relative measures of dispersion.
2.6 Measures of dispersion : Range and Quartile Deviation for raw data and their coefficients, merits and demerits
2.7 Variance and Standard deviation: definitions for raw data, coefficient of variation, merits and demerits.
2.8 Measures of Skewness: Types of skewness, Pearson's and Bowley's coefficient of skewness.
2.9 Moments – concept and definition.(Calculations to be covered in Practical)
2.10Measure of Kurtosis: Types of kurtosis, Measure of kurtosis based on moments.
2.11Numerical problems related to real life situations

Unit 3	**Basic Probability tools**	**11**

3.1 Review of counting principles
3.2 Deterministic and non-determination models
3.3 Random Experiment, Sample Spaces (Discrete and continuous)
3.4 Events: Types of events, Operations on events
3.5 Probability - classical definition, probability models, axioms of probability

3.6 Theorems of probability (without proof) i) $0 \leq P(A) \leq 1$ ii) $P(A) + P(A') = 1$ iii) $P(\Phi) = 0$ iv)$P(A) \leq P(B)$ when $A \subset B$ v) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$		
Unit 4	**Advanced Probability tools**	**4**
4.1 Concepts and definitions of conditional probability, multiplication theorem $P(A \cap B)=P(A).P(B\|A)$ 4.2 Bayes' theorem (without proof). Application of Bayes theorem. 4.3 Concept of Posterior probability, problems on posterior probability 4.4 Concept and definition of independence of two events 4.5 Numerical problems related to real life situations		

Learning Outcomes

On completion of this course, students will be able to :

CO1 – get knowledge of basic statistical concepts
CO2 – get basic knowledge of statistical procedures
CO3 – get basic information about methods of data representation and summarization
CO4 - Apply probability techniques in a specific problem
CO4 – apply these tools in solving problems
CO5 – apply these tools in simple analytical situations in computer science
CO6 - strengthen themselves both computationally and analytically

Learning Resources

1. Fundamentals of Applied Statistics, Gupta and Kapoor, (3rd Edition) S. Chand and Sons, New Delhi, 1987.
2. Fundamentals of Statistics, Vol. 1, Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). Sixth Revised Edition. The World Press Pvt. Ltd., Calcutta
3. Basic Statistics, B.L. Agarwal, Fifth Edition New Age International Publishers.
4. Fundamentals of Mathematical Statistics (3rd Edition), Gupta S. C. and Kapoor V. K.1987.S. Chand and Sons, New Delhi.
5. Mathematical Statistics, Mukhopadhyay P. 2015, (3rd Edition) Books and Allied (P), Ltd.

Subject Code: Subject Title : Advanced 'C' Programming Semester II (Major Paper 4) Theory		
Teaching Scheme 30 hours	No. of Credits 2	Examination Scheme CE: 15 marks SEE: 35 marks

Prerequisites

Computational Thinking
Problem Solving tools like algorithms, flowcharts and pseudocodes.
Fundamentals of 'C' language.

Course Objectives

1. To study advanced concepts of programming using the 'C' language.
2. To understand code organization with complex data types and structures.
3. To work with files.

Course Contents

Unit 1	**Arrays and Pointers**	**8**

1.1 Concept of array.
1.2 Types of Arrays – One, Two and Multidimensional array, memory representation and address calculation
1.3 Array Operations - declaration, initialization, accessing array elements
1.4 Passing arrays to functions
1.5 Simple Applications using one dimensional arrays: Finding maximum and minimum, Counting occurrences, Linear search and Binary Search
1.6 Applications using Two dimensional arrays - Matrix operations (addition,transpose)
1.7 Introduction to Pointers
1.8 Declaration, definition, initialization, dereferencing
1.9 Pointer arithmetic
1.10 Arrays and Pointers- Pointer to array, Array of pointers
1.11 Dynamic memory management

Unit 2	**Strings**	**6**

2.1 String Literals, string variables, declaration, definition, initialization
2.2 Predefined string functions
2.3 Array of strings
2.4 Command line arguments

Unit 3	**Structures And Unions**	**8**

3.1 Concept of structure, definition and initialization, use of typedef
3.2 Accessing structure members
3.3 Nested Structures
3.4 Arrays of Structures
3.5 Structures and functions
3.6 Pointers and structures
3.7 Concept of Union, declaration, definition, member access
3.8 Difference between structures and union.

Unit 4	File Handling and Preprocessor	8

4.1 Introduction to streams.
4.2 Types of files- text and binary.
4.3 Operations on text files.
4.4 Random access to files.
4.5 Role of Preprocessor
4.6 Format of preprocessor directive
4.7 File inclusion directives (#include)
4.8 Macro substitution directive, argumented and nested macro
4.9 Macros versus functions

Learning Outcomes

On completion of this course, students will be able to :

1. Develop modular programs using control structures, pointers, arrays, strings and structures
2. Design and develop solutions to real world problems using C.

Learning Resources

1. Problem Solving and Programming Concept, Maureen Sprankle, 7th Edition, Pearson Publication.
2. C: the Complete Reference, Schildt Herbert, 4th edition, McGraw Hill
3. A Structured Programming Approach Using C, Behrouz A. Forouzan, Richard F. Gilberg, Cengage Learning India
4. The ‘C’ programming language, Brian Kernighan, Dennis Ritchie, PHI

Course Code: Title: Lab Course on Advanced 'C' Programming Semester II (Major Paper 4) Practical		
Teaching Scheme 4 hours / week 60 hours	No. of Credits 2	Examination Scheme CE:15 marks SEE: 35 marks

Prerequisites

Computational Thinking

Course Objectives

1. To apply advanced concepts of 'C' Programming to solve problems

Assignments

1. Assignment on 1-d and 2-d Arrays
2. Assignment on Simple pointers and dynamic memory allocation
3. Assignment on String handling
4. Assignment on Structures and Unions
5. Assignment on File Handling

Learning Outcomes:

On completion of the course, student will be able to–

1. Apply advanced 'C' programming concepts

Learning Resources:

1. How to Solve it by Computer, R.G. Dromey, Pearson Education.

2. Problem Solving and Programming Concept, Maureen Sprankle, 7th Edition, Pearson Publication.

3. C: The Complete Reference, Schildt Herbert, 4th edition, McGraw Hill

4. A Structured Programming Approach Using C, Behrouz A. Forouzan, Richard F. Gilberg,Cengage Learning India

5. The 'C' programming language, Brian Kernighan, Dennis Ritchie, PHI.

Subject Code: Subject Title: Fundamentals of Electronics II Semester II (Major Paper 5) Theory		
Teaching Scheme 30 Hours	**No. of Credits** 2	**Examination Scheme** CE: 15 marks SEE: 35 marks

Course Objectives

1. Understand digital circuit designing concept.
2. Study basics of Computer organization and Architecture.

Course Contents

Unit 1	**Digital circuit design**	**10**

1.1 Introduction to Boolean algebra and rules of Boolean algebra.
1.2 Simplification of expressions using rules of Boolean algebra, Concept of SOP and POS, Maxterm and Minterm.
1.3 Introduction to K maps: Concept of Cells, Pairs, Quads, Octets.
1.4 Combinational circuit design.
1.4.1 Half adder and Full adder.
1.4.2 Designing 4 bit Binary to Gray and Gray to Binary converter.
1.5 Sequential circuit Design.
1.5.1 Definition and Truth tables of JK flipflop, D flipflop and T flipflop.
1.5.2 Excitation table for JK flipflop, and T flipflop.
1.5.3 Designing of 3 bit synchronous Up counter.
1.5.4 Designing of 3 bit Synchronous Down counter.

Unit 2	**Introduction to Computer Organization**	**7**

2.1 Block diagram and function of each block of Computer system.
2.2 Block diagram of a CPU and function of its blocks.
2.3 Concept of Buses and registers.
2.4 Stack: Need and its organization.
2.5 I/O organization.
2.5.1 Block diagram and need of I/O interface.
2.5.2 Types of I/O data transfer: (only to be explained conceptually).
2.5.3 Programmed I/O.
2.5.4 Concept of polling.
2.5.5 Interrupt initiated I/O (concepts of interrupts and priority of interrupts).
2.5.6 DMA (Definition, Types of DMA transfer and DMA controller).

Unit 3	**Basics of MOSFET**	**3**

3.1 Types of MOSFET and Symbols.
3.2 Working principle of MOSFET and I/O characteristics.
3.3 Concept of CMOSFET.
3.4 MOSFET as switch.

Unit 4	Operational Amplifier (OPAMP) and applications	5

4.1 Block diagram of OPAMP.
4.2 Ideal and practical (for IC 741) Parameters of OPAMP and symbol of IC 741. OPAMP as comparator.
4.3 Concept of Virtual ground and OPAMP as inverting amplifier.
4.4 OPAMP as non inverting amplifier and OPAMP as unity gain amplifier/buffer.
4.5 OPAMP as Adder and Subtractor.

Unit 5	Oscillators and clock	4

5.1 Concept of feedback and types of feedback, concept of oscillator.
5.2 Conditions for sustained oscillations. Types of oscillators (RC and LC oscillators.) Wein bridge oscillator.
5.3 Concept of clock. Block diagram of IC 555 and its working.
5.4 IC 555 as clock generating circuit.

Learning Outcomes

On the completion of the course student will be able to:

1. Understand the basics of digital circuit design.
2. Design digital circuits.

Learning Resources

1. Modern Digital Electronics by R.P Jain 5th edition McGraw Hill publications.
2. Digital fundamentals by Floyd 11th edition Pearson publications.
3. Microprocessor and interfacing, Douglas Hall 3rd edition Mc Graw Hill publication.
4. Computer architecture by Morris Mano.

Subject Code:
Subject Title : Laboratory course on Fundamentals of Electronics II
Semester II (Major Paper 5) Practical

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	2	CE: 15 marks SEE: 35 marks

Course Objectives

1. To design simple digital circuits and learn how to connect them
2. Understand the difference between sequential and combinational circuits.
3. Understand the working of various analog devices and how they are used.

Course Contents

Any eight from the following:

1. Astable multivibrator IC 555.
2. Wein bridge oscillator.
3. OPAMP as adder/Subtractor.
4. MOSFET as a switch.
5. Study of MOSFET characteristics.
6. OPAMP as inverting and non inverting amplifier.
7. Design of Half and Full adder circuit using K map.
8. Design of 4 bit binary to gray and Gray to binary convertor using K map.
9. Design of 3 bit Synchronous Up/Down/Updown counter using K map.
10. Study of Flipflops.
11. Study of Shift register (SISO and Ring counter).
12. Study of diode matrix ROM.

Learning Outcomes

On the completion of the course student will be able to

1. Design and build common combinational and sequential digital circuits.
2. Understand working of analog devices by using circuits.
3. Learn to use measuring instruments like CRO, Signal generator and Multimeter.

Subject Code
Subject Title: Discrete Mathematics-II
Semester II (Major Paper 6) Theory

Teaching Scheme	No. of Credits	Examination Scheme
30 Hours	2	CE: 15 marks SEE: 35 marks

Course Objectives

1. To build the necessary skills and analytical abilities for developing computer based solutions using mathematical concepts.
2. To develop logical thinking and its applications to computer Science.

Course Contents

Unit 1	**Recurrence Relations**	**8**

1.1 Recurrence Relations: Introduction, Formation.
1.2 Linear Recurrence Relations with constant coefficients.
1.3 Homogeneous Solutions.
1.4 Particular Solutions.
1.5 Total Solutions.

Unit 2	**Graphs**	**10**

2.1 Definition, Elementary terminologies and results, Graphs as Models
2.2 Special types of graphs
2.3 Isomorphism
2.4 Adjacency and Incidence Matrix of a Graph
2.5 Subgraphs, induced subgraphs, vertex deletion, edge deletion
2.6 Complement of a graph and self-complementary graphs
2.7 Union, intersection and product of graphs
2.8 Fusion of vertices
2.9 Walk, Trail, Path, Cycle: definitions and elementary properties
2.10 Connected Graphs: definitions and properties
2.11 Distance between two vertices, eccentricity, center, radius and diameter of a graph
2.12 Isthmus, Cutvertex ; definition and properties
2.13 Cutset, edge-connectivity, vertex connectivity
2.14 Weighted Graph and Dijkstra's Algorithm.

Unit 3	**Eulerian and Hamiltonian Graphs**	**4**

3.1 Seven Bridge Problem, Eulerian Graph : Definition and Examples, Necessary and Sufficient condition.
3.2 Fleury's algorithm
3.3 Hamiltonian Graphs : Definition and Examples, Necessary Condition.

3.4 Introduction of Chinese Postman Problem and Travelling Salesman Problem		
Unit 4	**Trees**	**4**
4.1 Definition, Properties of trees 4.2 Center of a tree 4.3 Binary Tree : Definition and properties 4.4 Tree Traversal : Ordered rooted Tree, Preorder traversal, inorder traversal and postorder traversal, Prefix Notation. 4.5 Spanning Tree : Definition, Properties, Shortest Spanning Tree, Kruskal's Algorithm.		
Unit 5	**Directed Graphs**	**4**
5.1 Definition, Examples Elementary Terminologies and properties. 5.2 Special types of digraphs 5.3 Connectedness of digraphs 5.4 Network and Flows: definition and examples.		

Learning Outcomes

On the completion of the course student will be able to

1. Learn some fundamental concepts and terminology.
2. Acquire ability to describe computer programs in a formal mathematical manner.
3. Able to differentiate between valid and invalid mathematical reasoning.
4. Learn techniques for constructing mathematical proofs illustrated by Discrete Mathematical examples.

Learning Resources

1) Discrete Mathematics and its Applications, (Tata McGraw Hill), Seventh Edition by Kenneth Rosen.
2) A First Look at Graph Theory (Allied Publishers) by John Clark and Derek Holton.
3) Elements of Discrete Mathematics, (Tata McGraw Hill), by C.L.Liu.

Unit 1: Text Book 3: Chapter 10: Sec. 10.1, 10.2, 10.3, 10.4, 10.5, 10.6
Unit 2: Text Book 1: Chapter 8: Sec. 8.1, 8.2, 8.3
Unit 2: Text Book 2: Chapter 1: Sec. 1.5, 1.6, 1.7, 1.8
Unit 2: Text Book 1: Chapter 8: Sec. 8.4
Unit 3: Text Book 1: Chapter 8: Sec. 8.5, 8.6
Unit 4: Text Book 1: Chapter 9: Sec. 9.1, 9.2, 9.3, 9.4, 9.5.
Unit 5: Text Book 2: Chapter 7: Sec. 7.1, 7.2.,
Chapter 8: Sec. 8.1, 8.2.

Subject Code:
Subject Title : Practical Course based on Discrete Mathematics-II
Semester II (Major Paper 6) Practical

Teaching Scheme	No. of Credits	Examination Scheme
4 hours/week	2	CE: 15 marks SEE: 35 marks

Course Objectives

1. Student should be able to solve problems depending on contents in Discrete Mathematics

Course Contents

List of practical:

1. Homogeneous Recurrence Relations
2. Non-homogeneous Recurrence Relations
3. Operations on Graphs and Connected Graphs
4. Isomorphism of Graphs.
5. Eulerian and Hamiltonian Graphs.
6. Algorithms in Graphs
7. Tree
8. Spanning Tree
9. Directed Graphs.
10. Miscellaneous.

Learning Outcomes

On the completion of the course student will be able to.

1. The exercises develop basic techniques and tests understanding of concepts and enhance mathematical ability.
2. It promotes abstract and analytical thinking of the students

Subject Code: Subject Title : Practical course on Advanced Statistics for Computer Science Semester II (SEC)		
Teaching Scheme 30 hours (1 Practical of 4 hours per week)	No. of Credits 2	Examination Scheme CE: 15 marks SEE: 35 marks

Prerequisites

Knowledge of Basic Statistics (as studied in semester I)

Knowledge of Statistics for corresponding Lab course

Course Objectives

1 To study more involved statistical concepts & procedures required for Computer Science
2 To solve problems which later on can be applied in data analysis
3 To apply tools in CS applications
4 To understand basic terminology and techniques of correlation and regression analysis for bivariate data
5 To apply these to some real life data model

Course Contents

Unit 1	**Correlation & Regression**	**7**

1.1 Concept of bivariate data, scatter diagram, its interpretation, concept of correlation, Positive correlation, negative correlation, zero correlation. (For raw data)
1.2 Karl Pearson's coefficient of correlation, properties of correlation coefficient,
1.3 Interpretation of correlation coefficient, coefficient of determination with interpretation.
1.4 Concept of regression, Linear regression.
1.5 Illustrations, appropriate situations for regression and correlation
1.6 Linear regression: Fitting of both lines of regression using least square method. Concept of regression coefficients.
1.7 Properties of regression coefficients : $b_{xy} \cdot b_{yx} = r^2$, $b_{xy} * b_{yx} \leq 1$, $b_{xy} = r\ (\sigma_x / \sigma_y)$ and $b_{yx} = r\ (\sigma_y / \sigma_x)$.(Only Statements)
1.8 Numerical problems

Unit 2	**Standard Discrete & Continuous Distributions**	**12**

2.1 Discrete & Continuous Uniform Distribution: definition, mean, variance
2.2 Binomial Distribution: definition, mean, variance, additive property, Bernoulli distribution as a particular case with n = 1
2.3 Geometric Distribution (p.m.f $p(x) = pq^x$, x = 0,1,2.....): definition, mean, variance
2.4 Poisson Distribution: definition, mean, variance, mode, additive property, limiting case of B(n, p)
2.5 Exponential Distribution: statement of p.d.f. of the form $f(x) = (1/\theta)\ e(-x/\theta)$, mean, variance, nature of probability curve, lack of memory property.(with proof)
2.6 Parato distribution : form of p.d.f. $f(x):\alpha/\ x(\alpha+1)$; $x \geq 1$, $\alpha > 0$. Mean, variance, symmetry
2.7 Normal Distribution: statement of p.d.f., identification of parameters, nature of probability density curve, standard normal distribution, symmetry, distribution of aX+b,

aX+bY+c where X and Y are independent normal variables, computations of probabilities using normal probability table, normal approximation to binomial and Poisson distribution, Box Muller transformation

2.8 Illustration of real life situations of all above distributions

Unit 3	**Simulation**	**2**

3.1 Introduction, concept of simulation, random numbers, pseudo random numbers

3.2 Advantages, Disadvantages of Simulation. Applications

3.3 Drawing sample from a probability distribution using simulation is to be covered in the practical.

Unit 4	**Tests of hypothesis**	**9**

4.1 Terminology - null & alternate hypothesis, parameter, statistic, type I & II errors, level of significance, large and small sample test, one sided and two sided tests, p-value

4.2 Large Sample Tests

Ho: $\mu = \mu o$ Vs H1: $\mu \neq \mu o$, $\mu < \mu o$, $\mu > \mu o$ (One sided and two sided tests)

Ho: $\mu 1 = \mu 2$ Vs H1: $\mu 1 \neq \mu 2$, $\mu 1 < \mu 2$, $\mu 1 > \mu 2$ (One sided and two sided tests)

Ho: P = Po Vs H1: P ≠Po, P < Po, P > Po (One sided and two sided tests)

Ho: P1 = P2 Vs H1: P1≠P2, P1 < P2, P1 > P2 (One sided and two sided tests).

4.3 F-test for testing significance of equality of two population variances.

4.4 Tests based on t – distribution

Ho: $\mu 1 = \mu 2$ Vs H1: $\mu 1 \neq \mu 2$, $\mu 1 < \mu 2$, $\mu 1 > \mu 2$ (One sided and two sided tests)

Paired t-test.

4.5 Tests based on Chi square distribution

Chi-square test for goodness of fit

Test for independence of attributes (m x n and 2x2)

Based on above theory Practical will be conducted (Using Manual as well as Ms-Excel/R-Software)

Title of Practical

1.	Correlation and regression analysis for bivariate data.
2.	Fitting of Binomial distribution and computation of expected frequencies and numerical examples.
3.	Fitting of Poisson distribution and computation of expected frequencies, Numeral examples.
4.	Fitting of normal distribution and computation of expected frequencies, Numerical examples.
5.	Simulation examples.
6.	Large sample tests examples.
7.	F test, t test, χ^2 test examples(one problem each with equal and unequal variance)(χ^2 test – for goodness of fit-use fitted problems of Binomial, Poisson and Normal distribution)
8.	Study of statistical tools in computer science and preparation of a report on it(individual activity)
9.	Real Life Data Collection of Bivariate data and Data analysis using Statistics– the activity to be done in a group of 2 to 4 students

Learning Outcomes

On completion of this course, students will be able to :

CO1 – get deeper knowledge of basic and advanced statistical concepts
CO2 – get deeper knowledge of statistical procedures
CO3 - Apply a specific discrete probability distribution as model in a particular data situation
CO4 - examine various hypotheses involved in a situation and apply tests of hypothesis
CO5 – apply these tools in solving problems
CO6 – apply these tools in simple analytical situations in computer science
CO7 – apply all procedures independently for a real life data set
CO8 – apply these tools in simple analytical situations in computer science
CO9 - strengthen themselves both computationally and analytically

Learning Resources

1. Introduction to linear regression analysis (fifth edition) Douglas C. Montgomery.
2. Fundamentals of Applied Statistics (3rd Edition), Gupta and Kapoor, S. Chand and Sons, New Delhi, 1987.
3. Fundamentals of Mathematical Statistics (3rd Edition), Gupta S. C. and Kapoor V. K.1987 S. Chand and Sons, New Delhi.
4. Fundamentals of Statistics, Vol. 1, Sixth Revised Edition, Goon, A. M., Gupta, M. K. and Dasgupta, B. (1983). The World Press Pvt. Ltd., Calcutta
5. Mathematical Statistics (3rd Edition), Mukhopadhyay P. 2015, Books And Allied (P), Ltd.
6. Programmed Statistics, B.L. Agarwal, New Age International Publishers.