Bharati Vidyapeeth

(Deemed to be University)
Pune, India

College of Engineering, Pune

B.Tech. Computer Science and Business Systems

(2023 Course)

Program Curriculum

As Per NEP Guidelines

VISION OF UNIVERSITY:

Social Transformation through Dynamic Education

MISSION OF UNIVERSITY:

- To make available quality education in different areas of knowledge to the students as per their choice and inclination.
- To offer education to the students in a conducive ambiance created by enriched infrastructure! and academic facilities in its campuses.
- To bring education within the reach of rural, tribal and girl students by providing them substantive fee concessions and subsidized hostel and mess facilities.
- To make available quality education to the students of rural, tribal and other deprived sections of the population

VISION OF THE INSTITUTE:

To be World Class Institute for Social Transformation Through Dynamic Education.

MISSION OF THE INSTITUTE:

- To provide quality technical education with advanced equipment, qualified faculty members, infrastructure to meet needs of profession and society.
- To provide an environment conducive to innovation, creativity, research and entrepreneurial leadership.
- To practice and promote professional ethics, transparency and accountability for social community, economic and environmental conditions.

VISION OF THE DEPARTMENT

To syndicate industry and institute to impart high quality knowledge through scholarity, research and creative endeavour

MISSION OF THE DEPARTMENT

- To impart contemporary technology conforming to a dynamic curriculum.
- To engage in professional development and scholarly endeavour through knowledge of common business principles.
- To promote the awareness of business discipline and ethical responsibility through industry alliance

Program Educational Objectives (PEOs)

1. Prevail technical competency to concord the industry's engrossment.
2. Assimilate business management skills.
3. Instigate business level innovation with societal consideration.

Program Specific Outcomes (PSOs)

Students of B. Tech (CSBS) will be

PSO1: Able to solve business problems using creative thinking, practical ideas, and knowledge of finance and modern technologies.

PSO2: Able to choose effective business communication techniques in professional Institute/organization.

Program Outcomes (POs)

The students of B.Tech (Computer Science & Business Systems) will be able to

1. Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified to develop to the solution of complex engineering problems.
2. Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
3. Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
4. Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
5. Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
6. Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
7. Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.
8. Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
9. Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences .
10. Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one’s own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
11. Recognize the need for and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

A. DEFINITION OF CREDITS:

1 Hour Lecture (L) per week	1 credit
1 Hour Tutorial (T) per week	1 credit
1 Hour Practical (P) per week	0.5 credits
2 Hours Practical (Lab)/week	1 credit

B. COURSE CODE AND DEFINITION

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
TW	Term Work
O	Oral
SEE	Semester End Examination
MJ	Major (Core) Courses
MI	Minor Courses
GE	General Elective Courses
OE	Open Elective Courses
SE	Skill Enhancement Courses
AE	Ability Enhancement Courses
VE	Vocational Enhancement Courses
VS	Vocational Skill Courses
MAC	Mandatory Credit Course
VA	Value Added Courses
CC	Co-curricular Courses
EC	Extra-Curricular Courses
ID	Inter-disciplinary Courses

MD	Multidisciplinary Courses
RP	Research I Project Courses
PC	Practical Courses
BS	Basic Science
ES	Engineering Science
AC	Audit Course
EC	Extracurricular Activities
BM	Basic Mathematics
BP	Basic Physics
BC	Basic Chemistry
UH	Universal Human Values
ET	Electrical Technology

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE
B. Tech. (CSBS): Semester –I (NEP 2023 COURSE)

Sr. No	Category	Subject Code	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	Internal Assessment	TW	PR	OR	Total	L	P	T	Total
1.	MJ	MJ1106101	Discrete Mathematics	3	2	-	60	40	25	-	-	125	3	1	-	4
2.	BM	BM1106102	Introductory Topics in Statistics, Probability and Calculus	4	-	-	60	40	-	-	-	100	4	-	-	4
3.	MJ	MJ1106103	Fundamentals of Computer Science	4	2	-	60	40	25	25	-	150	4	1	-	5
4.	ET	ET1106104	Principles of Electrical Engineering	3	2	-	60	40	25	-	-	125	3	1	-	4
5.	BP	BP1106105	Physics for Computing Science	3	2	-	60	40	50	-	-	150	3	1	-	4
6.	AE	AE1106106	Business Communication & Value Science- I	2	2	-	-	-	25	-	25	50	2	1	-	3
7.	SE	SE1106107	Skill Based Course I- (Computer Aided Drawing and Design)	-	2	-	-	-	25	25	-	50	-	1	-	1
			Total	**19**	**12**	**0**	**300**	**200**	**175**	**50**	**25**	**750**	**19**	**6**	**0**	**25**
8.	BS	BS1106108	Induction Program (Non-Credit)	-	-	-	-	-	-	-	-	-	-	-	-	-

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE
B. Tech. (CSBS): Semester – II (NEP 2023 COURSE)

Sr. No	Category	Subject Code	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	Internal Assessment	TW	PR	OR	Total	L	P	T	Total
1	BS	BS1106201	Linear Algebra	3	2	-	60	40	25	-	-	125	3	1	-	4
2	BS	BS1106202	Statistical Methods & Modelling	4	2	-	60	40	25	-	-	125	4	1	0	5
3	MJ	MJ1106203	Data Structure and Algorithms	4	2	-	60	40	25	25	-	150	4	1	0	5
4	ES	ES1106204	Principles of Electronics	3	2	-	60	40	25	-	25	150	3	1	0	4
5	MJ	MJ1106205	Fundamental of Economics	3	-	-	60	40	-	-	-	100	3	-	-	3
6	MJ	MJ1106206	Business Communications & Value Science - II	2	2	-	-	-	25	-	25	50	2	1	-	3
7	SE	SE1106207	Skill Based Course II- (Computer Workshop Technology)	-	2	-	-	-	25	25	-	50	-	1	-	1
			Total	**19**	**12**	**0**	**300**	**200**	**150**	**50**	**50**	**750**	**19**	**6**	**0**	**25**
8	BS	BS1106208	Environmental Sciences (Non-Credit)	-	-	-	-	-	-	-	-	-	-	-	-	-

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE
B. Tech. (CSBS): Semester – III (NEP 2023 COURSE)

Sr. No.	Category	Subject Code	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1.	MJ	MJ1106301	Formal Language and Automata Theory	3	-	1	60	40	25	-	-	125	3	-	1	4
2.	ID	ID1106302	Computer Organization and Architecture	3	2	-	60	40	25	-	-	125	3	1	-	4
3.	MJ	MJ1106303	Software Engineering	3	2	-	60	40	25	25	-	150	3	1	-	4
4.	MJ	MJ1106304	Computational Statistics	3	-	-	60	40	-	-	-	100	3	-	-	3
5.	MJ	MJ1106305	Object Oriented Programming	3	2	-	60	40	25	-	25	150	3	1	-	4
6.	SE	SE1106306	Skill Based Course III (Data Science with Python)	-	2	-	-	-	25	-	25	50	-	1	-	1
			Total	**15**	**8**	**1**	**300**	**200**	**125**	**25**	**50**	**700**	**15**	**4**	**1**	**20**
7.	AC	AC1106307	Indian Knowledge System	2	-	-	-	100	-	-	-	-	-	-	-	2
8.	VA	VA1106308	Value Added Course- I	2	-	-	-	100	-	-	-	-	-	-	-	2

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE
B. Tech. (CSBS): Semester – IV (NEP 2023 COURSE)

Sr. No.	Category	Subject Code	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ES E	IA	TW	OR	PR	Total	L	P	T	Total
1.	MJ	MJ1106401	Operating Systems	3	2	-	60	40	25	25	-	150	3	1	-	4
2.	MJ	MJ1106402	Database Management Systems	3	2	-	60	40	25	-	25	150	3	1	-	4
3.	ID	ID1106403	Introduction to Innovative IP Management & Entrepreneurship	2	-	-	60	40	-	-	-	100	2	-	-	2
4.	MJ	MJ1106404	Design Thinking	3	2	-	60	40	25	-	-	125	3	1	-	4
5.	MJ	MJ1106405	Operation Research	3	2	-	60	40	25	-	-	125	3	1	-	4
6.	SE	SE1106406	Skill Based Course IV (Software Design with UML)	-	2	1	-	-	25	-	25	50	-	1	1	2
			Total	**14**	**10**	**1**	**300**	**200**	**125**	**25**	**50**	**700**	**14**	**5**	**1**	**20**
7.	AE	AE1106407	**MOOC - I	-	-	-	-	-	-	-	-	-	-	-	-	2
8.	EC	EC1106408	**Social Activity	-	-	-	-	-	-	-	-	-	-	-	-	2

**** Indicate this is mandatory but the credits will not be considered in SGPA/CGPA**

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE
B. Tech. (CSBS): Semester – V (NEP 2023 COURSE)

Sr. No.	Category	Subject Code	Name of Subject	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1	MJ	MJ1106501	Design and Analysis of Algorithms	3	2	-	60	40	25	-	25	150	3	1	-	4
2	MJ	MJ1106502	Computer Network	3	2	-	60	40	25	-	25	150	3	1	-	4
3	MJ	MJ1106503	Business Strategy	2	-	-	60	40	-	-	-	100	2	-	-	2
4	MJ	MJ1106504	Artificial Intelligence	3	2	-	60	40	25	25	-	150	3	1	-	4
5	PE	PE1106505	Program Elective Course I	3	2	-	60	40	25	25	-	150	3	1	-	4
6	SE	SE1106506	Skill-Based Course V (Java Programming)	-	4	-	-	-	25	-	25	50	-	2	-	2
			Total	**14**	**12**	**0**	**300**	**200**	**125**	**50**	**75**	**750**	**14**	**6**	**0**	**20**
7	VA	VA1106507	**Value Added Course- II	2	-	-	-	40	-	-	-	-	2	-	-	2
8	AE	AE1106508	**MOOC - II	-	-	-	-	-	-	-	-	-	-	-	-	2

**** Indicate this is mandatory but the credits will not be considered in SGPA/CGPA**

Sr. No	Program Elective Course (PEC) I
1	Image Processing
2	Data Mining and Analytics
3	Compiler Design

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE
B. Tech. (CSBS): Semester – VI (NEP 2023 COURSE)

Sr. No.	Category	Subject Code	Name of Subject	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1	MJ	MJ1106601	Cloud, Microservices, and Application	3	2	-	60	40	25	25	-	150	3	1	-	4
2	MJ	MJ1106602	Finance and Cost Accounting	3	-	-	60	40	-	-	-	100	3	-	-	3
3	MJ	MJ1106603	Machine Learning	3	2	-	60	40	25	-	25	150	3	1	-	4
4	MJ	MJ1106604	Natural Language Processing	3	-	-	60	40	-	-	-	100	3	-	-	3
5	PS	PS1106605	Professional Skills	-	2	-	-	-	25	-	-	25	-	1	-	1
6	PE	PE1106606	Program Elective Course II	3	2	-	60	40	25	25	-	150	3	1	-	4
7	SE	SE1106607	Skill-Based Course V (Gen - AI)	-	2	-	-	-	25	-	25	50	-	1	-	1
8	AC	AC1106608	Environmental Studies	4	-	-	60	40	-	-	-	100	4	-	-	4
			Total	**19**	**10**	**0**	**300**	**300**	**125**	**50**	**50**	**825**	**19**	**5**	**0**	**24**

Sr. No	Program Elective Course (PEC) II
1	Introduction to IoT
2	Embedded System
3	Machine Organization & Microprocessor

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE

TRACK- I

B.Tech.(Computer Science and Business Systems): Semester–VII (2023 CBCS COURSE)

Sr. No.	Category	Subject Code	Subject	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1.	MJ	MJ1106701	IT Project Management	3	2	-	60	40	25	25	-	150	3	1	-	4
2.	MJ	MJ1106702	Marketing Research and Marketing Strategy	3	-	1	60	40	25	-	-	125	3	-	1	4
3.	PE	PE1106703	Program Elective Course III	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	PE	PE1106704	Program Elective Course IV	3	2	-	60	40	25	25	-	150	3	1	-	4
5.	RP	RP1106705	Major Project	-	16	-	-	-	100	50	-	150	-	8	-	8
		Total		**12**	**24**	**-**	**240**	**160**	**200**	**125**	**25**	**725**	**12**	**11**	**1**	**24**

Program Elective Course (PEC)

Program Elective Course -III	Program Elective Course -IV
Advanced Social, Text and Media Analytics	Financial Management
Mobile Computing	Cognitive Science & Analytics
Augmented & Virtual Reality	Information Retrieval
Quantum Computation & Quantum Information	Enterprise Systems

B.Tech.(Computer Science and Business Systems): Semester– VIII (2023 CBCS COURSE)

Sr. No.	Category	Subject Code	Subject	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	OR	PR	Total	L	Pr/Or	T	Total
1	MJ	MJ1106801	Cyber and Information Security	3	2	-	60	40	25	25	-	150	3	1	-	4
2	PE	PE1106802	Program Elective Course - V	2	-	-	60	40	-	-	-	100	2	-	-	2
3	CC	CC1106803	Seminar	-	4	-	-	-	50	50	-	100	-	2	-	2
4	SE	SE1106804	Internship (Industry/In-house)	-	-	-	-	-	150	100	-	250	-	14	-	14
		Total		**5**	**6**	**-**	**120**	**80**	**225**	**175**	**-**	**600**	**5**	**17**	**-**	**22**

Program Elective Course (PEC)

Program Elective Course - V
Computational Finance & Modeling
Behavioral Economics
Industrial and Organizational Psychology
Services Science & Service Operational Management

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE
TRACK – II
B.Tech.(Computer Science and Business Systems): Semester–VII (2023 CBCS COURSE)

Sr. No.	Category	Subject Code	Subject	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	OR	PR	Total	L	Pr/Or	T	Total
1	MJ	MJ1106801	Cyber and Information Security	3	2	-	60	40	25	25	-	150	3	1	-	4
2	PE	PE1106802	Program Elective Course - V	2	-	-	60	40	-	-	-	100	2	-	-	2
3	CC	CC1106803	Seminar	-	4	-	-	-	50	50	-	100	-	2	-	2
4	SE	SE1106804	Internship (Industry/In-house)	-	-	-	-	-	150	100	-	250	-	14	-	14
		Total		**5**	**6**	**-**	**120**	**80**	**225**	**175**	**-**	**600**	**5**	**17**	**-**	**22**

Program Elective Course (PEC)

Program Elective Course - V
Computational Finance & Modeling
Behavioral Economics
Industrial and Organizational Psychology
Services Science & Service Operational Management

B.Tech.(Computer Science and Business Systems): Semester– VIII (2023 CBCS COURSE)

Sr. No.	Category	Subject Code	Subject	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	OR	PR	Total	L	P	T	Total
1.	MJ	MJ1106701	IT Project Management	3	2	-	60	40	25	25	-	150	3	1	-	4
2.	MJ	MJ1106702	Marketing Research and Marketing Strategy	3	-	1	60	40	25	-	-	125	3	-	1	4
3.	PE	PE1106703	Program Elective Course III	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	PE	PE1106704	Program Elective Course IV	3	2	-	60	40	25	25	-	150	3	1	-	4
5.	RP	RP1106705	Major Project	-	16	-	-	-	100	50	-	150	-	8	-	8
		Total		**12**	**24**	**-**	**240**	**160**	**200**	**125**	**25**	**725**	**12**	**11**	**1**	**24**

Program Elective Course (PEC) List

Program Elective Course -III	Program Elective Course -IV
Advanced Social, Text and Media Analytics	Financial Management
Mobile Computing	Cognitive Science & Analytics
Augmented & Virtual Reality	Information Retrieval
Quantum Computation & Quantum Information	Enterprise Systems

Instructions

1. Students shall be permitted to opt for either Track-1 or Track-2.
    A) If the student opts Track-1 then he/she must perform Major Project in Semester-VII and undergo Internship in Sester-VIII.
    B) If the student opts Track-2 then he/she must undergo Internship in Semester-VII and perform Major Project in Sester-VIII.

2. Seminar:

Objectives for the Seminar

The Seminar aims to:

- Develop **self-learning ability** and **research orientation**
- Enhance **technical understanding of emerging technologies**
- Improve **presentation and communication skills**

Scope of Topics

Students must select a topic from E**merging/Recent Technologies, Case Studies, Research-Oriented Topics, Interdisciplinary Topics**

What Students Are Expected to Do

Topic Selection
Literature Survey
Content Preparation
Report Writing
Presentation

3. Major Project:

Objectives of the Major Project

Students are expected to:

- Apply knowledge of Computer/IT engineering to solve **real-world problems**
- Develop **design, implementation, and testing skills**
- Work effectively in a **team environment**
- Demonstrate **innovation, problem-solving, and research aptitude**
- Learn **documentation, presentation, and communication skills**
- Get exposure to **research methodology and publication process**

Nature of Projects

Projects should be:

Application-oriented / Industry-based / Research-based / Interdisciplinary
Should **NOT be repetitive** of previous batches
Must include **significant development and/or research contribution**

Research Publication

To encourage the students to write research articles/paper and presenting/publishing the same in journal/conference/symposium, the guides will may give advantage of credits to the students, even if it is not mandatory.

4. Internship

Objectives of Internship

- To provide real-world exposure to professional environments
- To enhance technical, problem-solving, and teamwork skills
- To bridge the gap between academics and industry expectations
- To develop professional ethics, communication, and responsibility

Guidelines

1) The students who receive an internship in the industry (through institute or own efforts), will do it for one complete semester in the industry.

2) Those students who don not receive the internship in the industry will have to perform it in-house. The Department will prepare modules for in-house internships based on recent domains/technology. The Department faculty plus external experts from industry fir the selected domain will deliver the sessions. In this case, the entire internship of one complete semester will be held in the institute itself.

3) The projects and the required computational facilities for these projects are available at FAIR Lab. The students may use facilities in IDEA and Intel Unnati Lab for this purpose.

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

B. Tech (CSBS) Semester- III/IV/V/VI/VII (NEP-2020 COURSE)

MINOR DEGREE: BUSINESS SYSTEMS DETAILS

Sr. No	Course Code	Name of Course	Teaching Scheme (Hrs./ Week)			Examination Scheme (Marks)						Credits			
			L	P	T	ESE	IA	TW	OR	PR	Total	TH	PR/OR	Tut	Total
1	MI1106301	**Sem III** Business Strategy	3	2	-	60	40	25	25	-	150	3	1	-	**4**
2	MI1106401	**Sem IV** Introduction to Innovative IP Management & Entrepreneurship	3	2	-	60	40	25	25	-	150	3	1	-	**4**
3	MI1106501	**Sem V** Marketing Research and Marketing Management	3	2	-	60	40	25	25	-	150	3	1	-	**4**
4	MI1106601	**Sem VI** Financial and Cost Accounting	3	2	-	60	40	25	25	-	150	3	1	-	**4**
5	MI1106602	**Sem VI** Project	-	8	-	-	-	50	50	-	100	-	4	-	**4**
Total			**12**	**16**	**-**	**240**	**160**	**150**	**150**	**-**	**700**	**12**	**8**	**-**	**20**

DISCRETE MATHEMATICS

TEACHING SCHEME		EXAMINATION SCHEME		CREDITS ALLOTTED	
Theory:	**3 Hours/Week**	**End Semester Examination:**	**60 Marks**	**Theory:**	**3 Credits**
Practical:	**2 Hours/Week**	**Internal Assessment:**	**40 Marks**	**Practical:**	**1Credit**
		Term work:	**25 Marks**	**Total:**	**4 Credits**
		Total:	**125 Marks**		

Course Prerequisite:

Basic Knowledge of Elementary Linear Algebra, Numerical Mathematical Computation, Programming basics.

Course Objective:

The objective is to provide a mathematical foundation and skills those are required in further study of Computer Science. The course Discrete Mathematics deals with discrete objects, countable sets. It helps to develop logical thinking and a wide variety of real-world applications to computer science. It is a very good tool for improving reasoning and problem-solving capabilities.

Course Outcomes: On completion of the course, students will have the ability to:

1. Demonstrate the ability to write the sentences in the symbolic logic and evaluate a proof technique.
2. Apply the basic principles of set theory to analyse the data relationship and prove basic properties of set.
3. Analyse the properties of relations and functions to determine their properties.
4. Apply the knowledge of Boolean algebra for building basic electronic and digital circuits.
5. Solve problems of combinatorics and recurrence relations.
6. Model problems in Computer Science using graphs and trees.

Unit I **06 Hours**

Logic: Propositional calculus - propositions and connectives, syntax; Semantics – truth assignments and truth tables, validity and satisfiability, tautology; Adequate set of connectives; Equivalence and normal forms; Compactness and resolution; Formal reducibility - natural deduction system and axiom system; Soundness and completeness.

Unit II **06 Hours**

Set Theory: Types of sets, Sets operations and laws, Algebra of Sets, Multisets, Application of the principle of inclusion and exclusion.

Boolean algebra: Introduction of Boolean algebra, basic logic gate, basic postulates of Boolean algebra, principle of duality, canonical form, Karnaugh map.

Unit III **06 Hours**

Relations: Basic definition, properties and types of relations, relations and digraphs, paths in relations and digraphs, equivalence and partially ordered relations.

Functions: Types of functions, Identity functions, Composition of functions, Mathematical functions, Pigeonhole principle.

Unit IV **06 Hours**

Algebraic Structures: Isomorphism and Homomorphism. Algebraic Structures with Binary Operations, rings, Cyclic groups, codes.

Unit V **06 Hours**

Combinatorics: Basic counting, balls and bins problems, generating functions, recurrence relations. Proof techniques, principle of mathematical induction, pigeonhole principle.

Unit VI **06 Hours**

Graph Theory Graphs and digraphs, complement, isomorphism, connectedness and reachability, adjacency matrix, Eulerian paths and circuits in graphs and digraphs, Hamiltonian paths and circuits in graphs and tournaments, trees; Planar graphs, Euler's formula, dual of a planer graph, independence number and clique number, chromatic number, statement of Four-color theorem.

Textbooks:

1. Topics in Algebra, I. N. Herstein, John Wiley and Sons.
2. Digital Logic & Computer Design, M. Morris Mano, Pearson.
3. Elements of Discrete Mathematics, (Second Edition) C. L. Liu McGraw Hill, New Delhi.
4. Graph Theory with Applications, J. A. Bondy and U. S. R. Murty, Macmillan Press, London.
5. Mathematical Logic for Computer Science,L.Zhongwan, World Scientific, Singapore.

Reference Books:

1. Introduction to linear algebra. Gilbert Strang.
2. Introductory Combinatorics, R. A. Brualdi, North-Holland, New York.
3. Graph Theory with Applications to Engineering and Computer Science, N. Deo, Prentice Hall, Englewood Cliffs.
4. Introduction to Mathematical Logic (Second Edition), E. Mendelsohn, Van-Nostrand, London.

List of Assignments:

The sample class assignments are given below.

1. Given a fact or a statement prove or disprove using suitable technique.
2. Write the given English language sentences represent in the Symbolic logic.
3. Given the statement forms Infer the validity of the statement form.
4. Draw a Hasse diagram and find chains and antichains.
5. Find the number of ways for any event or given sample space.
6. Given a problem represent in a graph and compute the optimal solution.
7. Given a communication network find the path between the given nodes.

List of Laboratory Exercises:

1. Perform set Operations.
2. Compute a power set of a given set.
3. List various properties of Relation and construct a program to evaluate it with a program.
4. Apply Warshall's algorithm to compute a Transitive Closure of a given relation entered by the user (Use any suitable programming language).
5. Solve a programming problem based on application of Eulerian and Hamiltonian Graph.
6. Develop a program using RSA algorithm.
7. Develop a program to apply different algorithms on graph and solve areal tie problem.

List of Project Based Learning Topics:

1. Discrete Mathematics in Railway Planning using graph theory and linear algebra.
2. Object transformations using linear algebra.
3. Discrete mathematics in cryptography.
4. In Google maps to determine fastest driving routes and times.
5. In image processing
6. In relation database using sets.
7. In cyber security using graph theory.
8. Shortest path between two cities using a transportation system.
9. Data compression system with the help of Huffman coding.
10. Find the shortest tour that visits each of a group of cities only once and then ends in the starting city using graphs.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

INTRODUCTORY TOPICS IN STATISTICS, PROBABILITY AND CALCULUS

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Lectures :4 Hrs/Week	**Semester Examination :60 Marks**	**Theory :4 Credits**
	Internal Assessment :40 Marks	**Total:4 Credit**
	Total : 100 Marks	

Course Pre-Requisites:

The students should have basic knowledge of high school mathematics and calculus.

Course Objective:

The course introduces fundamental concepts of statistics and probability.

Course Outcomes:

1. Students will be able to use appropriate statistical terms to describe data.

2. Students will be able to use appropriate statistical methods to collect, organize, display and analyse relevant data.

3. Students will be able to apply concepts of various probability distributions to find probabilities and understand mathematical expectation and moments generating function.

4. Students will be able to apply concepts of Normal, Poisson, Binomial, uniform, exponential,t and F-distribution.

5. Students will be able to apply concepts of differentiation.

6. Students will be able to apply concepts of integration to find area and volume using double and triple integral.

UNIT – I **6 Hours**

Introduction to Statistics: Definition of Statistics. Basic objectives. Applications in various branches of science with examples

Collection of Data**:** Internal and external data, Primary and secondary data. Population and sample, Representative sample.

UNIT – II **6 Hours**

Descriptive Statistics: Classification and tabulation of univariate data, graphical representation, Frequency curves. Descriptive measures - central tendency and dispersion. Bivariate data. Summarization, marginal and conditional frequency distribution. Linear regression and correlation. Rank correlation.

UNIT III **6 Hours**

Probability Theory: concept of experiments, sample space, event. Definition of Combinatorial Probability. Conditional Probability, Bayes Theorem

Mathematical expectation: Expected values & moments: mathematical expectation & its properties, Moments (including variance) & their properties, interpretation, Moment generating function

UNIT – IV **6 Hours**

Probability distributions: Discrete & continuous distributions, Binomial, Poisson & Geometric distributions, Uniform, Exponential, Normal, Chi-square, t, F distributions

UNIT – V **6 Hours**

Differential Calculus: Differential equation and its application

UNIT – VI **6 Hours**

Integral Calculus: Multiple integral, application of double and triple integral.

List of Assignments:

Problem sets to be shared by faculty covering the following topics:

Graphical representation of data, Histograms, Descriptive measures - central tendency and dispersion Estimating moments, Distribution parameters.

List of Project Based Learning Topics:

1. Prepare a questionnaire for survey
2. Do the population survey of a certain area
3. Prepare survey model of literate/illiterate
4. Prepare survey model of employed/ unemployed
5. Classify primary and secondary data
6. Collect the raw data, analyze it and plot it using graphs
7. Find the stability of the data using coefficient of variation
8. Use concept of correlation to find coefficient of correlation between different observations
9. Use Rank correlation to find correlation for qualitative data
10. Derive Spearman's Rank correlation
11. Data fitting using linear regression
12. Data fitting using nonlinear regression
13. Find the chance of happening particular event using Bayes' theorem
14. Find the Moment generating function of given function.
15. Use probability theory to estimate the life of electric equipment
16. Find the height, weight of the population using the example of normal distribution
17. Evaluate the electric circuit problem using differential equations
18. Evaluate the heat conduction problem using differential equations
19. Find the area using double integrals
20. Find the volume using triple integrals

Textbooks:

1. Introduction of Probability Models, S.M. Ross, Academic Press, N.Y.
2. Fundamentals of Statistics, vol. I & II, A. Goon, M. Gupta and B. Dasgupta, World Press.
3. Higher Engineering Mathematics, B. S. Grewal, Khanna Publication, Delhi.

Reference Books:

1. A first course in Probability, S.M. Ross, Prentice Hall.
2. Probability and Statistics for Engineers (Fourth Edition), I.R. Miller, J.E. Freund and R. Johnson, PHI.
3. Introduction to the Theory of Statistics, A.M. Mood, F.A. Graybill and D.C. Boes, McGraw Hill Education.
4. Advanced Engineering Mathematics, (Seventh Edition), Peter V. O'Neil, Thomson Learning.
5. Advanced Engineering Mathematics, (Second Edition) M. D. Greenberg, Pearson Education.
6. Applied Mathematics, Vol. I & II, P. N. WartikarandJ. N. Wartikar,VidyarthiPrakashan.

Syllabus for Unit Test:

Unit Test –I	UNIT – I, II and III
Unit Test -II	UNIT – IV, V and VI

INTRODUCTORY TOPICS IN STATISTICS, PROBABILITY AND CALCULUS

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Lectures :4 Hrs/Week	**Semester Examination :60 Marks**	**Theory :4 Credits**
	Internal Assessment :40 Marks	**Total:4 Credit**
	Total : 100 Marks	

Course Pre-Requisites:

The students should have basic knowledge of high school mathematics and calculus.

Course Objective:

The course introduces fundamental concepts of statistics and probability.

Course Outcomes:

1. Students will be able to use appropriate statistical terms to describe data.

2. Students will be able to use appropriate statistical methods to collect, organize, display and analyse relevant data.

3. Students will be able to apply concepts of various probability distributions to find probabilities and understand mathematical expectation and moments generating function.

4. Students will be able to apply concepts of Normal, Poisson, Binomial, uniform, exponential,t and F-distribution.

5. Students will be able to apply concepts of differentiation.

6. Students will be able to apply concepts of integration to find area and volume using double and triple integral.

UNIT – I **6 Hours**

Introduction to Statistics: Definition of Statistics. Basic objectives. Applications in various branches of science with examples

Collection of Data**:** Internal and external data, Primary and secondary data. Population and sample, Representative sample.

UNIT – II **6 Hours**

Descriptive Statistics: Classification and tabulation of univariate data, graphical representation, Frequency curves. Descriptive measures - central tendency and dispersion. Bivariate data. Summarization, marginal and conditional frequency distribution. Linear regression and correlation. Rank correlation.

UNIT III **6 Hours**

Probability Theory: concept of experiments, sample space, event. Definition of Combinatorial Probability. Conditional Probability, Bayes Theorem

Mathematical expectation: Expected values & moments: mathematical expectation & its properties, Moments (including variance) & their properties, interpretation, Moment generating function

UNIT – IV **6 Hours**

Probability Distributions: Discrete & continuous distributions, Binomial, Poisson & Geometric distributions, Uniform, Exponential, Normal, Chi-square, t, F distributions

UNIT – V **6 Hours**

Differential Calculus: Differential equation and its application

UNIT – VI **6 Hours**

Integral Calculus: Multiple integral, application of double and triple integral.

List of Assignments:

Problem sets to be shared by faculty covering the following topics:

Graphical representation of data, Histograms, Descriptive measures - central tendency and dispersion Estimating moments, Distribution parameters.

List of Project Based Learning Topics:

21. Prepare a questionnaire for survey
22. Do the population survey of a certain area
23. Prepare survey model of literate/illiterate
24. Prepare survey model of employed/ unemployed
25. Classify primary and secondary data
26. Collect the raw data, analyze it and plot it using graphs
27. Find the stability of the data using coefficient of variation
28. Use concept of correlation to find coefficient of correlation between different observations
29. Use Rank correlation to find correlation for qualitative data
30. Derive Spearman's Rank correlation
31. Data fitting using linear regression
32. Data fitting using nonlinear regression
33. Find the chance of happening particular event using Bayes' theorem
34. Find the Moment generating function of given function.
35. Use probability theory to estimate the life of electric equipment
36. Find the height, weight of the population using the example of normal distribution
37. Evaluate the electric circuit problem using differential equations
38. Evaluate the heat conduction problem using differential equations
39. Find the area using double integrals
40. Find the volume using triple integrals

Textbooks:

4. Introduction of Probability Models, S.M. Ross, Academic Press, N.Y.
5. Fundamentals of Statistics, vol. I & II, A. Goon, M. Gupta and B. Dasgupta, World Press.
6. Higher Engineering Mathematics, B. S. Grewal, Khanna Publication, Delhi.

Reference Books:

7. A first course in Probability, S.M. Ross, Prentice Hall.
8. Probability and Statistics for Engineers (Fourth Edition), I.R. Miller, J.E. Freund and R. Johnson, PHI.
9. Introduction to the Theory of Statistics, A.M. Mood, F.A. Graybill and D.C. Boes, McGraw Hill Education.
10. Advanced Engineering Mathematics, (Seventh Edition), Peter V. O'Neil, Thomson Learning.
11. Advanced Engineering Mathematics, (Second Edition) M. D. Greenberg, Pearson Education.
12. Applied Mathematics, Vol. I & II, P. N. WartikarandJ. N. Wartikar,VidyarthiPrakashan.

Syllabus for Unit Test:

Unit Test –I	UNIT – I, II and III
Unit Test -II	UNIT – IV, V and VI

FUNDAMENTALS OF COMPUTER SCIENCE

TEACHING SCHEME	EXAMINATION SCHEME		CREDITSALLOTTED
Lectures:4Hrs/Week	**Semester Examination:**	**60 marks**	**Theory:4 Credits**
Practical:2 Hrs/Week	**Internal Assessment:**	**40 marks**	**Practical:1 Credit**
	Term work:	**25 Marks**	**Total:5 Credits**
	Practical:	**25 Marks**	
	Total:	**150 Marks**	

Course Pre-Requisites:

Basic knowledge of computers.

Course Objective:

The course introduces fundamental concepts of computer science

Course Outcomes:

1. Understand the basics of computer science & the process of moving from a problem statement to a computational formulation of a method for solving the problem.
2. Apply the basic concepts of control structures.
3. Understand basic concepts of function.
4. Implement concept of arrays and pointers.
5. Develop an application using the concept of file handling.
6. Describe Unix system interface and programming method.

UNIT – I **6 Hours**

General problem-Solving concepts and Imperative languages: Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops.

Imperative languages: Introduction to imperative language; syntax and constructs of a specific language (ANSI C) .Types Operator and Expressions with discussion of variable naming and Hungarian Notation: Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, proper variable naming and Hungarian Notation

UNIT – II **6 Hours**

Control Flow with discussion on structured and unstructured programming: Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, Goto Labels, structured and un- structured programming

UNIT – III **6 Hours**

Functions and Program Structure with Discussion on Standard Library: Basics of functions, parameter passing and returning type, C main return as integer, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialization, Recursion, Pre-processor, Standard Library Functions and return types

UNIT – IV **6 Hours**

Pointers and Arrays: Pointers and address, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Multi-dimensional array and Row/column major formats, Initialisation of Pointer Arrays, Command line arguments, Pointer to functions, complicated declarations and how they are evaluated.

UNIT – V **6 Hours**

Structures: Basic Structures, Structures and Functions, Array of structures, Pointer of structures, Self-referral Structures, Table look up, Typedef, Unions, Bit-fields
Input and Output: Standard I/O, Formatted Output – printf, Formated Input – scanf, Variable length argument list, file access including FILE structure, fopen, stdin, sdtout and stderr, Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions

UNIT – VI **6 Hours**

Unix System Interface: File Descriptor, Low level I/O – read and write, Open, create, close and unlink, Random access – lseek, Discussions on Listing Directory, Storage allocator

Programming Method: Debugging, Macro, User Defined Header, User Defined Library Function, make file utility.

List of Assignments:

1.Define Algorithm. Explain Characteristics of Algorithm.

2.Explain all types of Operators in detail with example.

3.Explain control structures in detail with example.

4.Define function. Explain types of Functions with example.

5.Write a short note on:

i) Pointers ii) Types of Arrays iii) Pointer Array

6.Define Structure. Explain concept of Array of Structure with suitable example.

7.Explain File Descriptor and Storage Allocator in detail.

List of Laboratory Exercises:

1. Algorithm and flowcharts of small problems like GCD
2. Structured code writing with:
    i. Small but tricky codes
    ii. Proper parameter passing

iii. Command line Arguments
iv. Variable parameter
v. Pointer to functions
vi. User defined header
vii. Make file utility
viii. Multi file program and user defined libraries
ix. Interesting substring matching / searching programs
x. Parsing related assignments

List of Project Based Learning Topics:

1. Inventory Management System using File Handling
2. Online Jewellery Shopping System using File Handling
3. Library Management System using File Handling
4. Online Examination System using File Handling
5. Hospital Management System using File Handling
6. Railway Reservation System using File Handling
7. Payroll Management System using File Handling
8. Cooking Recipe Portal using File Handling
9. Art Gallery Management System using File Handling
10. Student Database Management System using File Handling
11. Restaurant Management Database System using File Handling
12. Electric Bill System using File Handling
13. Online Examination System using File Handling
14. Event Management System using File Handling
15. Attendance Management System using File Handling
16. Slam book using File Handling.

Textbooks:

1. B. W. Kernighan and D. M. Ritchi, “The C Programming Language”, Second Edition, PHI.
2. B. Gottfried, “Programming in C”, Second Edition, Schaum Outline Series.

Reference Books:

1. Herbert Schildt, “C: The Complete Reference”, Fourth Edition, McGraw Hill.
2. YashavantKanetkar, “Let Us C”, BPB Publications.

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

PRINCIPLES OF ELECTRICAL ENGINEERING

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED
Theory:3 Hours / Week	**End Semester Examination:**	**60 Marks**	**Theory:3 Credits**
Practical:2 Hours / Week	**Internal Assessment:**	**40 Marks**	**Practical:1 Credit**
	Term Work:	**25 Marks**	**Total:4 Credits**
	Total:	**125 Marks**	

Course Pre-requisites:

The students should have knowledge of Mathematics, physics.

Course Objectives:

The course introduces fundamental concepts of DC and AC circuits, Electrostatics electromagnetism, transformer, electrical wiring, and illumination.

Course Outcomes: After learning this course the students will be able to

1. Apply knowledge of basic concepts of work, power, energy for energy conversion and calculate current in electrical network using Kirchhoff's laws.
2. Calculate response of electrical circuit using network theorems.
3. Define basic terms of single phase and three phase ac circuits and supply systems.
4. Describe construction, principle of operation, specifications and applications of capacitors and batteries
5. Describe and apply fundamental concepts of magnetic and electro-mechanics for operation of single-phase transformer.
6. Describe illumination, types of wiring and earthing system.

UNIT – I **6 Hours**

Introduction: Concept of EMF, Potential difference, voltage, current, resistance. Fundamental linear passive and active elements to their functional current-voltage relation, Terminology and symbols in order to describe electric networks, voltage source and current sources, ideal and practical sources, concept of dependent and independent sources, Kirchhoff-s laws and applications to network solutions using mesh and nodal analysis, Concept of work, power, energy, and conversion of energy.

UNIT – II **6 Hours**

DC Circuits: Current-voltage relations of the electric network by mathematical equations to analyze the network (Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem) Simplifications of networks using series-parallel, Star/Delta transformation. Superposition theorem.

UNIT III **6 Hours**

AC Circuits: AC waveform definitions, form factor, peak factor, study of R-L, R-C,RLC series circuit, R-L-C parallel circuit, phasor representation in polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, 3 phase Balanced AC Circuits (Y-Δ & Δ-Y).

UNIT – IV **6 Hours**

Electrostatics: Electrostatic field, electric field strength, concept of permittivity in dielectrics, capacitor composite, dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors, Principle of batteries, types, construction and working, application.

UNIT – V **6 Hours**

Electro-Mechanics: Electricity and Magnetism, magnetic field and Faraday's law, self and mutual inductance, Ampere's law, Magnetic circuit, Magnetic material and B-H Curve, Single phase transformer, principle of operation, EMF equation, voltage ratio, current ratio, KVA rating, losses in transformer, efficiency and regulation, Determination of Efficiency & Regulation by direct load test, Electromechanical energy conversion

UNIT – VI **6 Hours**

Measurements and Sensors: Introduction to measuring devices/sensors and transducers (Piezoelectric and thermo-couple) related to electrical signals, Elementary methods for the measurement of electrical quantities in DC and AC systems(Current & Single-phase power), Basic concept of indicating and integrating instruments, Electrical Wiring and Illumination system: Basic layout of the distribution system, Types of Wiring System & Wiring Accessories, Different types of lamps (Incandescent, Fluorescent, Sodium Vapour, Mercury Vapour, Metal Halide, CFL, LED),Necessity of earthing, Types of earthing, Safety devices & system.

List of Assignments:

Respective subject teacher shall design minimum six assignments on above units.

List of Laboratory Exercises:

1. Familiarization of electrical Elements, sources, measuring devices and transducers related to electrical circuits.
2. Determination of resistance temperature coefficient
3. Verification of Superposition Theorem
4. Verification of Thevenin's Theorem
5. Verification of Norton's Theorem
6. Verification of Kirchhoff's Laws
7. Verification of Maximum power transfer Theorem
8. Simulation of Time response of RC circuit
9. Study of R-L-C series circuits for $X_L > X_C$, $X_L < X_C$ & $X_L = X_C$
10. Verification of relation in between voltage and current in three phase balanced star and delta connected loads.
11. Direct loading test on Single phase transformer
12. a) Voltage and current ratios.
    b) Efficiency and regulations.
13. Demonstration of measurement of electrical quantities in DC and AC systems.

List of Project Based Learning Topics:

Student shall demonstrate minimum one concept based on syllabus topic.

1. Demonstration of conversion of energy.
2. Study and understand practical specifications of transformer.
3. Demonstration of electrostatics and understand practical specifications of batteries.
4. Demonstration of phenomenon of electromagnetic induction.
5. Demonstration of electromagnetism, electro mechanics and their applications by using professional software tool.

6. Development of practical kits for understanding different theorems related to electrical circuits. (Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem, Superposition theorem etc.)
7. Demonstration of illumination system.

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

8. Demonstration of distribution system.
9. Study and understand safety practices in electrical system.
10. Study and understand electrical earthing system.

Textbooks:

1. Electric Machinery,(Sixth Edition) A.E. Fitzgerald, KingselyJr Charles, D. Umans Stephen, Tata McGraw Hill.
2. A Textbook of Electrical Technology,(vol. I),B. L. Theraja, Chand and Company Ltd., New Delhi.
3. Basic Electrical Engineering, V. K. Mehta, S. Chand and Company Ltd., New Delhi.
4. Theory and problems of Basic Electrical Engineering, (Second Edition), J. Nagrath and Kothari, Prentice Hall of India Pvt. Ltd.

Reference Books:

1. Basic of Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. Introduction to Electrodynamics, D. J. Griffiths, (Fourth Edition), Cambridge University Press.
3. Engineering Circuit Analysis, William H. Hayt& Jack E. Kemmerly, McGraw-Hill Book Company Inc.
4. Fundamentals of Electrical and Electronics Engineering,Smarjith Ghosh, Prentice Hall (India) Pvt. Ltd.
5. Edward Hughes – "Electrical Technology"- Seventh Edition, Pearson Education Publication
6. H. Cotton – "Elements of Electrical Technology", C.B.S. Publications
7. John Omalley Shawn – "Basic circuits analysis" McGraw Hill Publications
8. Vincent Del Toro – "Principles of Electrical Engineering", PHI Publications

PRINCIPLES OF ELECTRICAL ENGINEERING

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED
Theory:3 Hours / Week	**End Semester Examination:**	**60 Marks**	**Theory:3 Credits**
Practical:2 Hours / Week	**Internal Assessment:**	**40 Marks**	**Practical:1 Credit**
	Term Work:	**25 Marks**	**Total:4 Credits**
	Total:	**125 Marks**	

Course Pre-requisites:

The students should have knowledge of Mathematics, physics.

Course Objectives:

The course introduces fundamental concepts of DC and AC circuits, Electrostatics electromagnetism, transformer, electrical wiring, and illumination.

Course Outcomes: After learning this course the students will be able to

7. Apply knowledge of basic concepts of work, power, energy for energy conversion and calculate current in electrical network using Kirchhoff's laws.
8. Calculate response of electrical circuit using network theorems.
9. Define basic terms of single phase and three phase ac circuits and supply systems.
10. Describe construction, principle of operation, specifications and applications of capacitors and batteries
11. Describe and apply fundamental concepts of magnetic and electro-mechanics for operation of single-phase transformer.
12. Describe illumination, types of wiring and earthing system.

UNIT – I **6 Hours**

Introduction: Concept of EMF, Potential difference, voltage, current, resistance. Fundamental linear passive and active elements to their functional current-voltage relation, Terminology and symbols in order to describe electric networks, voltage source and current sources, ideal and practical sources, concept of dependent and independent sources, Kirchhoff-s laws and applications to network solutions using mesh and nodal analysis, Concept of work, power, energy, and conversion of energy.

UNIT – II **6 Hours**

DC Circuits: Current-voltage relations of the electric network by mathematical equations to analyze the network (Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem) Simplifications of networks using series-parallel, Star/Delta transformation. Superposition theorem.

UNIT III **6 Hours**

AC Circuits: AC waveform definitions, form factor, peak factor, study of R-L, R-C,RLC series circuit, R-L-C parallel circuit, phasor representation in polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor, 3 phase Balanced AC Circuits (Y-Δ & Δ-Y).

UNIT – IV **6 Hours**

Electrostatics: Electrostatic field, electric field strength, concept of permittivity in dielectrics, capacitor composite, dielectric capacitors, capacitors in series and parallel, energy stored in capacitors, charging and discharging of capacitors, Principle of batteries, types, construction and working, application.

UNIT – V **6 Hours**

Electro-Mechanics: Electricity and Magnetism, magnetic field and Faraday's law, self and mutual inductance, Ampere's law, Magnetic circuit, Magnetic material and B-H Curve, Single phase transformer, principle of operation, EMF equation, voltage ratio, current ratio, KVA rating, losses in transformer, efficiency and regulation, Determination of Efficiency & Regulation by direct load test, Electromechanical energy conversion

UNIT – VI **6 Hours**

Measurements and Sensors: Introduction to measuring devices/sensors and transducers (Piezoelectric and thermo-couple) related to electrical signals, Elementary methods for the measurement of electrical quantities in DC and AC systems(Current & Single-phase power), Basic concept of indicating and integrating instruments, Electrical Wiring and Illumination system: Basic layout of the distribution system, Types of Wiring System & Wiring Accessories, Different types of lamps (Incandescent, Fluorescent, Sodium Vapour, Mercury Vapour, Metal Halide, CFL, LED),Necessity of earthing, Types of earthing, Safety devices & system.

List of Assignments:

Respective subject teacher shall design minimum six assignments on above units.

List of Laboratory Exercises:

1. Familiarization of electrical Elements, sources, measuring devices and transducers related to electrical circuits.
2. Determination of resistance temperature coefficient
3. Verification of Superposition Theorem
4. Verification of Thevenin's Theorem
5. Verification of Norton's Theorem
6. Verification of Kirchhoff's Laws
7. Verification of Maximum power transfer Theorem
8. Simulation of Time response of RC circuit
9. Study of R-L-C series circuits for $X_L > X_C$, $X_L < X_C$ & $X_L = X_C$
10. Verification of relation in between voltage and current in three phase balanced star and delta connected loads.
11. Direct loading test on Single phase transformer
12. a) Voltage and current ratios.
    b) Efficiency and regulations.
13. Demonstration of measurement of electrical quantities in DC and AC systems.

List of Project Based Learning Topics:

Student shall demonstrate minimum one concept based on syllabus topic.

1. Demonstration of conversion of energy.
2. Study and understand practical specifications of transformer.
3. Demonstration of electrostatics and understand practical specifications of batteries.
4. Demonstration of phenomenon of electromagnetic induction.
5. Demonstration of electromagnetism, electro mechanics and their applications by using professional software tool.

6. Development of practical kits for understanding different theorems related to electrical circuits. (Thevenin's theorem, Norton's Theorem, Maximum Power Transfer theorem, Superposition theorem etc.)
7. Demonstration of illumination system.

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

8. Demonstration of distribution system.
9. Study and understand safety practices in electrical system.
10. Study and understand electrical earthing system.

Textbooks:

1. Electric Machinery,(Sixth Edition) A.E. Fitzgerald, KingselyJr Charles, D. Umans Stephen, Tata McGraw Hill.
2. A Textbook of Electrical Technology,(vol. I),B. L. Theraja, Chand and Company Ltd., New Delhi.
3. Basic Electrical Engineering, V. K. Mehta, S. Chand and Company Ltd., New Delhi.
4. Theory and problems of Basic Electrical Engineering, (Second Edition), J. Nagrath and Kothari, Prentice Hall of India Pvt. Ltd.

Reference Books:

1. Basic of Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. Introduction to Electrodynamics, D. J. Griffiths, (Fourth Edition), Cambridge University Press.
3. Engineering Circuit Analysis, William H. Hayt& Jack E. Kemmerly, McGraw-Hill Book Company Inc.
4. Fundamentals of Electrical and Electronics Engineering,Smarjith Ghosh, Prentice Hall (India) Pvt. Ltd.
5. Edward Hughes – "Electrical Technology"- Seventh Edition, Pearson Education Publication
6. H. Cotton – "Elements of Electrical Technology", C.B.S. Publications
7. John Omalley Shawn – "Basic circuits analysis" McGraw Hill Publications
8. Vincent Del Toro – "Principles of Electrical Engineering", PHI Publications

BUSINESS COMMUNICATION & VALUE SCIENCE-I

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Lectures:2 Hrs./Week	**Term work: 25 Marks**	**Theory: 2 Credits**
Practical:2 Hrs./Week	**Oral: 25 Marks**	**Practical: 1 Credit**
	Total: 50 Marks	**Total: 3 Credits**

Course Prerequisites: -

1. Students should have knowledge of Basic English grammar
2. Students should have basic information of sound system of English language
3. Basics of written communication

Course Objective: -

The course objective of Business Communication & Value Science-I aims to augment student's overall communication and interpersonal skills by engaging them in group activities and thus aid in helping them to emerge as professionals. The English language topics for this semester focus on the development of basic fluency in English, usage of words and introduce them to the concept and importance of interpersonal skills so as to effectively present their personalities. Understand what life skills are and their importance in leading a happy and well-adjusted life. Motivate students to look within and create a better version of self.

Course Outcomes: -

Graduates will be able to:

1. Recognize the need for life skills, values and own strengths and opportunities and apply the life skills to different situations
2. Understand and apply applications of sounds of English language for correct pronunciation
3. Construct the error free sentences of English language and do implementation of it in the spoken and written business communication
4. Understand communication process and principles to do applications in professional communication
5. Build up the ability to study employment professional communication skills and its proper implications
6. Recognize the core of professional skills and apply them for future venture through activities

Unit 1 Skills and Values and Basics of Grammar: 6 Hours

Recognize the need for life skills and values, **Overview of LOL** (include activity on introducing self), **Self-awareness** – identity, body awareness, forms of tense, articles, preposition, use of auxiliaries and modal auxiliaries, common errors.

Unit II Vocabulary/Phonetics/study of sounds in English: 6 Hours

Vocabulary development through GRAPS-PT, types of sentences voice, direct indirect speech, degree of comparison, Introduction to phonetics, study of speech organs, study of phonetic script, transcriptions of words, articulation of different sounds in English

Unit III Honing Spoken Communication: 6 Hours

Situational conversation, Law of nature- Importance of listening skills, Difference between listening and hearing, Types of listening, building team, team communication dynamics

Unit IV Communication Skills 6 Hours

Introduction, forms and function of communication process, non-verbal codes in communication, barriers to communication and overcoming them, digital communication

Unit V Mechanics of Written Communication 6 Hours

Principles of effective writing, Email writing, technical report writing, format, structure and its types, real time report writing, create a podcast on an interested topic, create a musical using the learnings from unit

Unit VI Skill allied to professionalism: 6 Hours

Introduction to professional skills, overview of leadership, dealing with ambiguity, Time management, Pareto Principle (80/20) Rule in time management, Time management matrix, creativity and result orientation, working under pressure, stress management.

List of Laboratory Exercises:

01. Presentation on favourite cricket captain in IPL and the skills and values they demonstrate
02. Learning Vocabulary through activity
03. Self-work with immersion – interviews a maid, watchman etc.
04. Write a newspaper report on an IPL match
05. Expressing self, connecting with emotions, visualizing and experiencing purpose
06. Evaluation on Listening skills – listen to recording and answer questions based on them
07. Written Communication: Summary writing, story writing
08. Understanding Life Skills: Movie based learning-**Pursuit of Happiness**.
09. Multiple Intelligences, Embracing diversity – Activity on appreciation of diversity
10. Life skill: Leadership, teamwork, dealing with ambiguity, managing stress, motivating people, creativity, result orientation etc.

Project: 01 Create a podcast on a topic that will interest college students

02 Create a musical using the learnings from the whole course

List of Project Based Learning Topics:

01. Communication Origami
02. Preparing a model for the LOL activity
03. Investigating values around you and imbibing
04. Vocabulary: play-way method by using cards
05. Investigating into linguistic by creating models
06. Interviewing your role model for situational conversation
07. Honing LSRW: Preparing a model on each skill
08. Knowing body language: Making a video of professional presentation
09. Preparing a model of report writing (preferably real time report)
10. Analysis of Pareto Principle for Time Management
11. Creating a model of Leadership styles and their functions
12. Analysis of Time Management Matrix for effective time Management

Reference Books:

1. Business Communication by Meenakshi Raman, Prakash Singh published by Oxford University press, second edition,
2. Spoken English- A manual of Speech and Phoonetics by R. K. Bansal, J. B. Harrison published by Orient Blackswan
3. Communication Skills by Sanjay Kumar, PushpLata, published by Oxford University press, second edition
4. Technical Communication by Meenakshi Raman, Sangeeta Sharma published by Oxford University press
5. Developing Communication Skills by Krishna Mohan, MeeraBanerji published by Macmillan India Pvt Ltd

Recommended web-links for enhancing English language and business communication

1. http://www.bbc.co.uk/worldservice/learningenglish
2. http://www.englishlearner.com/tests/test.html

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

COMPUTER AIDED DRAWING & DESIGN

TEACHING SCHEME		EXAMINATION SCHEME		CREDIT CHEME	
Practical:	**2 Hours/Week**	**Term Work:**	**25 Marks**	**Practical:**	**1**
		Practical:	**25 Marks**		
Total	**2 Hours/Week**	**Total:**	**50 Marks**	**Total:**	**1**

Prerequisite:
Basics of programming skill

Course Objective:
1. To have the knowledge of Orthographic and Isometric projections
2. To understand the basic principles of Engineering drawing
3. To have the knowledge of different AutoCAD commands
4. To understand the algorithm for generating different entities on the screen

Course Outcomes: On completion of the course, students will have the ability to:
1. Prepare and understand drawings
2. Use the principles of orthographic projections
3. Use the principles of Isometric projections
4. Able to draw simple drawing using AutoCAD
5. Generate the line by highlighting the pixels
6. Fill the polygon

Unit I **04 Hours**

Orthographic Projection

Dimensioning and conventions strictly as per SP 46:2003 (Revised). Orthographic projection of right regular solids such as cube and prism. Orthographic projection of simple machine blocks

Unit II **04 Hours**

Isometric Projections

Introduction, Isometric axes, Lines & planes, Isometric scale, Isometric projection and Isometric view, Conversion of Isometric to Orthographic Projections

Unit III **04 Hours**

Introduction to AutoCAD

Getting Started with AutoCAD. Line, polyline, Circle, arc Rectangle, polygon Ellipse, Elliptical arc, spline, Xline, Ray, Points Measure, Divide, Region Wipeout, Helix, Donut

Unit IV **04 Hours**

AutoCAD Modify Tools and Dimensioning

Move, copy, Rotate, scale Stretch, fillet, chamfer Erase, offset, explode Array, polar Array, path array Trim, extend, mirror. Annotations Dimensions, dimension setting Linear dimension, Aligned dimension Angular dimensions, arc length, Radius Diameter

Unit V **04 Hours**

Line Drawing Algorithm

The Digital Difference Analyser (DDA) algorithm to draw lines on a screen. Interpolation points based on the difference between the start and end points. Bresenham Line Drawing Algorithm. Numerical examples.

Unit VI **04 Hours**

Flood Fill Algorithm

Concept of seed point, four connected approaches and eight connected. Boundary colour and fill colour. Filling of different polygon.

Textbooks:

1. **"**Elementary Engineering Drawing" by Bhatt, N.D., Charotar publishing Co.
2. "Engineering Graphics" by K.L. Narayana and P.Kannaiah, SCITECH PUBLICATIONS (INDIA) PVT.LTD. October 2008
3. "Engineering Graphics with AutoCAD", D. M. Kulkarni, A. P. Rastogi, and A. K. Sarkar (2009), PHI Learning Private Limited, New Delhi.
4. "Engineering Drawing: With an Introduction to CAD," Jolhe, Dhananjay (2006), Tata Mc Graw Hill, India

List of Laboratory Exercise:

1. Drawing to half imperial size sheet with instruments. Drawing illustrating basic concepts of Orthographic projections and dimensioning.
2. From the given three views draw isometric
3. Introduction to AutoCAD. Student should get familiarise with the GUI of the software.
4. Commands for drawing basic entities
5. AutoCAD Modify Tools and Dimensioning
6. Digital Difference Analyser (DDA) algorithm
7. Bresenham Line Drawing Algorithm
8. Flood Fill Algorithm

B. TECH (Computer Science & Business Systems)

SEMESTER – II

COURSE SYLLABUS

LINEAR ALGEBRA

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Lectures:3Hrs./Week	**Semester Examination: 60 marks**	**Theory:3 Credits**
Practical:2Hr./Week	**Internal Assessment: 40 marks**	**Practical :1 credit**
	Term Work : 25 Marks	**Total:4 Credits**
	Total: 125 Marks	

Course Pre-Requisites:

The students should have basic Knowledge of high school math, Boolean Algebra, and calculus.

Course Objective:

Todevelop ability to use the mathematical techniques, skills, and tools necessary for computer science.

Course Outcomes:

At the end of the course, a student will be able to:

1. Apply knowledge of basics of Matrices, Determinants.
2. Solve the consistency of any type of systems.
3. Describe Vector space, Orthogonality and Projection.
4. Apply methods Gram-Schmidt orthogonalization and QR decomposition.
5. Calculate Eigenvalues and Eigenvectors.
6. Describe Singular value decomposition and Principal component analysis.

UNIT – I **6 Hours**

Introduction to Matrices and Determinants, Solution of Linear Equations, Cramer's rule, Inverse of a Matrix.

UNIT – II **6 Hours**

Vectors and linear combinations, Rank of a matrix, Gaussian elimination, LU Decomposition, Solving Systems of Linear Equations using the tools of Matrices.

UNIT – III **6 Hours**

Vector space, Dimension, Basis, Orthogonality, Projection.

UNIT – IV **6 Hours**

Gram-Schmidt orthogonalization and QR decomposition.

UNIT – V **6 Hours**

Eigenvalues and Eigenvectors, Positive definite matrices, Linear transformations, Hermitian and Unitary matrices.

UNIT – VI **6 Hours**

Singular value decomposition and Principal component analysis, Introduction to their applications in Image Processing and Machine Learning.

List of Assignments:

Assignments & tutorials covering the following: Vectors and linear combinations, Matrices, Determinants, Linear transformations, Complete solution to AX=b, Eigenvalues and Eigenvectors.

List of Project Based Learning Topics:

Students are expected prepare report on any one topic, write its definition, applications and illustrate with few examples. Also, write pseudo code for it, wherever applicable.

1. Cramer's rule
2. System of linear equations solution
3. Rank of matrix
4. Gauss elimination
5. LU-decomposition method
6. Dimension and basis
7. Gram Schmidt Orthogonalization
8. QR decomposition
9. Single value decomposition
10. Principal component analysis
11. Eigen values and eigen vectors
12. Hermitian and unitary matrices
13. Positive definite matrices
14. Image processing
15. Machine learning

Textbook:

1. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publication, Delhi.

Reference Books:

1. Advanced Engineering Mathematics, 7e, by Peter V. O'Neil.
2. Advanced Engineering Mathematics, 2e, by M. D. Greenberg, Pearson Education.
3. Introduction to linear algebra, 5^{th} Edition, Gilbert Strang.
4. Applied Mathematics (Volumes I and II) by P. N. Wartikar& J. N. Wartikar, Pune VidyarthiGrihaPrakashan, Pune.
5. Digital Image Processing,R C Gonzalez and R E Woods.
6. https://machinelearningmastery.com/introduction-matrices-machine-learning/

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

STATISTICAL METHODS& MODELLING

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED
Lectures:4 Hrs/Week	**Semester Examination:**	**60 marks**	**Theory:4 Credits**
Practical:2 Hrs/week	**Internal Assessment:**	**40 marks**	**Practical:1 Credit**
	Term Work:	**25 Marks**	**Total:5 Credits**
	Total:	**125 Marks**	

Course Pre-requisites:
Basic of statistics and probability, Basic programming experience (in any language).

Course Objective:
The course introduces fundamental concepts of linear statistical models, estimation methods, hypothesis testing and fundamental concepts of programming in R.

Course Outcomes:
The students completing this course will be able to

1. Understand the basic concepts of Statistical Inference,
2. Understand the basic concepts of Estimation methods,
3. Understand the basic concepts of Hypothesis Testing
4. Understand the basic concepts of linear statistical models.
5. Understand Introductory R language fundamentals, basic syntax and how to use R; what R is and how it's used to perform data analysis.
6. Understand major R data structures and create visualizations using R.

UNIT – I **6 Hours**

Sampling Techniques: Random sampling. Sampling from finite and infinite populations. Estimates and standard error (sampling with replacement and sampling without replacement), Sampling distribution of sample mean, stratified random sampling

UNIT – II **6 Hours**

Linear Statistical Models: Scatter diagram. Linear regression and correlation. Least squares method. Rank correlation. Standard multiple regression models with emphasis on detection of collinearity, outliers, non-normality and autocorrelation, Validation of model assumptions. Multiple correlation, Analysis of variance (one way, two way with as well as without interaction)

UNIT – III **6 Hours**

Estimation: Point estimation, criteria for good estimates (un-biasedness, consistency), Methods of estimation including maximum likelihood estimation.

UNIT – IV **6 Hours**

Test of hypothesis: Concept & formulation, Type I and Type II errors, Neyman Pearson lemma, Procedures of testing

UNIT – V **6 Hours**

Non-parametric Inference: Comparison with parametric inference, Use of order statistics. Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov-Smirnov test. Spearman's and Kendall's test**.**

UNIT – VI **6 Hours**

Basics of Time Series Analysis & Forecasting: Stationary, ARIMA Models: Identification, Estimation and Forecasting.

List of Assignments:
Problem sets to be shared by faculty covering the following topics:Estimation Methods: Parametric & Non – Parametric, Hypothesis Testing

List of Laboratory Exercises:

R statistical programming language: Introduction to R, Functions, Control flow and Loops, Working with Vectors and Matrices, Reading in Data, Writing Data, Working with Data, Manipulating Data, Simulation, Linear model, Data Frame, Graphics in R

List of Project Based Learning Topics:

Project Based learning topics:

Students are expected prepare report on any one topic, write its definition,applications and analyze the hypothetical data. Also, write pseudo code for it, wherever applicable.

1. Random Sampling
2. Stratified random sampling
3. Linear regression
4. Rank correlation
5. Method of least squares
6. Multiple correlation
7. One way analysis of variance
8. Two way analysis of variance
9. Estimation
10. Maximum likelihood estimation
11. Testing of hypothesis
12. Types of errors
13. Nonparametric tests
14. Time series
15. Forecasting

Textbooks:

1. Probability and Statistics for Engineers (4th Edition) - I.R. Miller, J.E. Freund and R. Johnson.
2. Fundamentals of Statistics (vol. I and vol. II) - A. Goon, M. Gupta and B. Dasgupta.
3. Hands-on Programming with R - Garrett Grolemund
4. R for Everyone: Advanced Analytics and Graphics - Jared P. Lander

Reference Books:

1. Statistical Theory with Engineering Application - A. Hald.
2. Statistical Methods - G.W. Snedicor and W.G. Cochran.
3. Statistical Concepts & Methods - G.K. Bhattacharyya and R.A. Johnson.
4. Introduction to Linear Regression Analysis - D.C. Montgomery &E.Peck
5. Introduction to the Theory of Statistics - A.M. Mood, F.A. Graybill& D.C. Boes.
6. Practical Non-Parametric Statistics - W.J. Conover
7. Applied Regression Analysis - N. Draper & H. Smith

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

DATA STRUCTURES AND ALGORITHMS

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED
Lectures:4 Hrs./ Week	**Semester Examination:**	**60 Marks**	**Theory:4 Credits**
Lab:2 Hrs./ Week	**Internal Assessment:**	**40 Marks**	**Practical:1 Credits**
	Term work:	**25 Marks**	**Total:5 Credits**
	Practical:	**25 Marks**	
	Total:	**150 Marks**	

Course Pre-Requisites:

Students should have knowledge of Fundamentals of data types and programming concepts

Course Objective:

The course is aimed to provide an understanding of key concepts underlying the choice and implementation of data structures, algorithms and step by step approach in solving problems with the help of these fundamental data structures.

Course Outcomes:

Students will be able to:

1. Understand the fundamentals and analysis of algorithms
2. Implement Linear data structures
3. Implement Non-Linear data structure of Trees.
4. Implement Non-Linear data structure of Graphs.
5. Implement the sorting algorithms
6. Understand the concepts of different file system organisation.

UNIT – I **6 Hours**

Basic Terminologies & Introduction to Algorithm and Data Organization: Algorithm specification, Recursion, Performance analysis, Asymptotic Notation - The Big-O, Omega and Theta notation, Programming Style, Refinement of Coding - Time-Space Trade Off, Testing, Data Abstraction

UNIT – II **6 Hours**

Linear Data Structure: Array, Stack, Queue, Linked list and its types, Various Representations, Operations & Applications of Linear Data Structures

UNIT – III **6 Hours**

Non-linear Data Structure Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, B & B+ Tree, AVL Tree, Splay Tree), Various Representations, Operations: search and traversal algorithms and complexity analysis Applications of Trees.

UNIT – IV **6 Hours**

Non-linear Data Structure Graphs: Graphs: Directed and Undirected, Various Representations

Operations: Search and traversal algorithms and complexity analysis

Applications of Graphs.

UNIT – V **6 Hours**

Searching and Sorting: Sequential Search, Binary Search, Breadth First Search, Depth First Search, Insertion Sort, Selection Sort, Shell Sort, Divide and Conquer Sort, Merge Sort, Quick Sort, Heap Sort, Introduction to Hashing

UNIT – VI **6 Hours**

File: Organisation (Sequential, Direct, Indexed Sequential, Hashed) and various types of accessing schemes

List of Assignments:

Respective subject teacher shall design any six assignments on above units.

List of Laboratory Exercises:

1. Towers of Hanoi using user defined stacks.
2. Reading, writing, and addition of polynomials.
3. Trees with all operations.
4. All graph algorithms.
5. Saving / retrieving non-linear data structure in/from a file

List of Project Based Learning Topics:

1.Create an appropriate data structure for student data and result representation. Provide operations on these structures.
2. Develop a string reverser using stack. The stack operations called herein should be defined in file other than the reverser.
3. Develop a polynomial multiplier. The polynomials should be stored using linked lists.
4. Develop a phonebook using double linked list.
5. Demonstrate the bubble sort technique on doubly linked list.
6. Develop a two way threaded binary tree with its traversals.
7. Develop a customer database using direct access file which provides functions to read, write, modify, add and search records.
8.Write students information to a sequential file. Extract these records and construct a binary search tree out of these records. Use any parameter of the information for search/arranging criteria.
9.Develop a file merge application. It should have provision to create new files or add records to existing files. Any selected two or more files should be merged into a single new one.
10. Convert a graph representation using adjacency matrix to represent the same using adjacency list.

Textbooks:

1. Fundamentals of Data Structures, E. Horowitz and S. Sahni, 1977.
2. Data Structures and Algorithms, Alfred V. Aho, John E. Hopperoft, Jeffrey D. UIlman

Reference Books:

1. The Art of Computer Programming: Volume 1: Fundamental Algorithms, Donald E. Knuth
2. Introduction to Algorithms, Thomas, H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.
3. Open Data Structures: An Introduction (Open Paths to Enriched Learning)), 31st ed. Edition , Pat Morin

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

PRINCIPLES OF ELECTRONICS ENGINEERING

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED
Lectures:3 Hrs/Week	Semester Examination:	60 Marks	Theory:3 Credits
Practical:2 Hrs/ Week	Internal Assessment:	40 Marks	Practical :1 Credit
	Term Work:	25 Marks	Total:4 Credits
	Oral :	25 Marks	
	Total:	150 Marks	

Course Pre-Requisites:

The students should have knowledge of Class XII level Electronics, Physics & Mathematics

Course Objective:

The course introduces fundamental concepts of electronics

Course Outcomes:

Students will be able to,

1. Identify semiconductor materials, draw band-diagrams and distinguish between intrinsic and extrinsic semiconductors.
2. Explain the phenomenon of rectification, draw the I-V characteristics and calculate ripple factor.
3. Explain the I-V characteristics of BJTs: Input and output, learn to bias transistors as an amplifier.
4. Describe FET and MOSFET and differentiate between BJT, FET and MOSFET.
5. Explain the fundamentals of feedback amplifiers, Oscillators and Operational Amplifier.
6. Demonstrate the knowledge of Boolean algebra including simplification techniques and operation of basic types of flip-flops.

UNIT – I **6 Hours**

Semiconductors: Crystalline material: Mechanical properties, Energy band theory, Fermi levels; Conductors, Semiconductors & Insulators: electrical properties, band diagrams. Semiconductors: intrinsic & extrinsic, energy band diagram, P&N-type semiconductors, drift & diffusion carriers.

UNIT –II **6 Hours**

Diodes and Diode Circuits: Formation of P-N junction, energy band diagram, built-in-potential, forward and reverse biased P-N junction, formation of depletion zone, V-I characteristics, Zener breakdown, Avalanche breakdown and its reverse characteristics; Junction capacitance and Varactor diode. Simple diode circuits, load line, linear piecewise model; Rectifier circuits: half wave, full wave, PIV, DC voltage and current, ripple factor, efficiency, idea of regulation.

UNIT – III **6 Hours**

Bipolar Junction Transistors: Formation of PNP / NPN junctions, energy band diagram; transistor mechanism and principle of transistors, CE, CB, CC configuration, transistor characteristics: cut-off active and saturation mode, transistor action, injection efficiency, base transport factor and current amplification factors for CB and CE modes. Biasing and Bias stability: calculation of stability factor.

UNIT – IV **6 Hours**

Field Effect Transistors: Concept of Field Effect Transistors (channel width modulation), Gate isolation types, JFET Structure and characteristics, MOSFET Structure and characteristics, depletion and enhancement type; CS, CG, CD configurations; CMOS: Basic Principles

UNIT – V **6 Hours**

Feed Back Amplifier, Oscillators and Operational Amplifiers: Concept (Block diagram), properties, positive and negative feedback, loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability; effect of positive feedback: instability and oscillation, condition of oscillation, Barkhausen criteria. Introduction to integrated circuits, operational amplified and its terminal properties; Application of operational amplifier; inverting and non-inverting mode of operation, Adders, Subtractors, Constant-gain multiplier, Voltage follower, Comparator, Integrator, Differentiator.

UNIT – VI **6 Hours**

Digital Electronics Fundamentals: Difference between analog and digital signals, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters.

List of Assignments: -

1. Describe applications of diodes as Clippers and Clampers.
2. Describe application of Zener diode as Voltage regulator.
3. Study of characteristic curves for CB configuration of BJT using Virtual Lab.
4. Simulation of BJT amplifier using Virtual Lab.
5. Design and Implementation of Various Arithmetic Circuits using Virtual Lab.
6. To design, built and test any electronic circuit (Group activity)/ Presentation on any Electronic circuit application.

List ofLaboratory Exercises:

1. To plot V-I characteristics of PN junction diode.
2. To plot regulation characteristics of half wave rectifier
3. To plot regulation characteristics of Full wave rectifier
4. To plot input-output characteristics of CE configuration of BJT.
5. To study Biasing techniques of BJT- to find stability factor of selfbias, collector to base bias, fixed bias circuits.
6. To plot frequency response of single stage FET amplifier (CS/CD configuration) and find its bandwidth.
7. To study Colpitts Oscillator.
8. Study of OP-AMP circuits: Inverting and Non-inverting Amplifier.
9. Implementation and verification of DeMorgan,s theorem .
10. Implementation and verification of half adder and full adder.

List of Project Based Learning Topics:

1. Water Level Indicator.
2. LED Emergency Light.
3. Security control System
4. AC to DC converter.
5. Automatic Street Light controller
6. Rain Alarm system.
7. Flashing LED
8. Dancing Light
9. Voltage regulator using Zener diode.
10. Amplifier using Op-Amp.

11. JFET as an analog switch.
12. BJTs as a digital switch.
13. Sine wave generator
14. Adder/ Subtractor circuit
15. Up/Down counter

Textbooks:

1. Microelectronics Circuits, Adel S. Sedra and Kenneth Carless Smith, Oxford University Press.
2. Millman's Integrated Electronics, Jacob Millman, Christos Halkias, Chetan Parikh, McGraw Hill Education.
3. Digital Logic & Computer Design, M. Morris Mano, Pearson

Reference Books:

1. Electronic Devices and Circuit Theory, Robert L. Boylestad, Louis Nashelsky.
2. Solid State Electronic Devices, 6th Edition, Ben Streetman, Sanjay Banerjee
3. Electronic Principle, Albert Paul Malvino.
4. Electronics Circuits: Discrete& Integrated, D Schilling C Belove T Apelewicz R Saccardi.
5. Microelectronics, Jacob Millman, Arvin Grabel.
6. Electronics Devices & Circuits, S. Salivahanan, N. Suresh Kumar, A. Vallavaraj
7. Electronic Devices & Circuit Theory, 11th Edition, Robert L. Boylestad, Louis Nashelsky

FUNDAMENTALS OF ECONOMICS

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Lectures:3 Hrs/Week	**Semester Examination:60 marks**	**Theory: 3 Credits**
	Internal Assessment: 40 marks	**Total: 3 Credits**
	Total: 100 Marks	

Course Pre-Requisites:

Knowledge of Class XII level Mathematics

Course Objective:

1. To impart knowledge, with respect to concepts, principles of Economics, which govern the functioning of a firm/organization.
2. To explain the students about concept of production, cost, national income, an aggregate supply and aggregate demand consumption.

Course Outcomes:

After completing this course, students should be able to:
1. Demonstrate an understanding of the methods and principles of microeconomic and macroeconomic theory, including tradeoffs, opportunity costs, and marginal decision making.
2. Explain how markets work and how market prices are determined using principles of supply and demand.
3. Assess the impact of market failure such as externalities, and public goods and evaluate possible public policy remedies.
4. Analyze financial markets and investments, including the stock market, and their relation to the economy.
5. Evaluate key economic indicators (including GDP, unemployment, inflation) and their use in evaluating macroeconomic conditions.
6. Understand major macroeconomic tools, including fiscal and monetary policies, and their use in managing the economy. Also apply ethical principles in a variety of economic contexts.

UNIT – I **6 Hours**

Microeconomics

Principles of Demand and Supply – Supply Curves of Firms – Elasticity of Supply Demand Curves of Households – Elasticity of Demand Equilibrium and Comparative Statics (Shift of a Curve and Movement along the Curve) Welfare Analysis – Consumers' and Producers' Surplus – Price Ceilings and Price Floors

UNIT –II **6 Hours**

Consumer Behaviour – Axioms of Choice – Budget Constraints and Indifference Curves Consumer's Equilibrium – Effects of a Price Change, Income and Substitution Effects – Derivation of a Demand Curve,Applications – Tax and Subsidies – Intertemporal Consumption – Suppliers' Income Effect

UNIT – III **6 Hours**

Theory of Production – Production Function and Iso-quants – Cost Minimization Cost Curves – Total, Average and Marginal Costs – Long Run and Short Run Costs, Equilibrium of a Firm Under Perfect Competition Monopoly and Monopolistic Competition

UNIT – IV **6 Hours**

Macroeconomics

National Income and its Components – GNP, NNP, GDP, NDP Consumption Function Investment Simple Keynesian Model of Income Determination and the Keynesian Multiplier

Government Sector – Taxes and Subsidies External Sector – Exports and Imports

UNIT – V **6 Hours**

Money – Definitions, Demand for Money – Transitionary and Speculative Demand

Supply of Money – Bank's Credit Creation Multiplier, Integrating Money and Commodity Markets – IS, LM Model, Business Cycles and Stabilization – Monetary and Fiscal Policy – Central Bank and the Government.

UNIT – VI **6 Hours**

The Classical Paradigm – Price and Wage Rigidities – Voluntary and Involuntary Unemployment.

List of Assignments: -

In the discussion topics mentioned above, students should be asked to prepare in advance in groups and present in class.

List of Project Based Learning Topics:

1. Types of markets (Monopoly, Monopolistic, Perfect Competition) and their real time examples in the economy.
2. Fiscal and Monetary Policy of India.
3. Concept of Price Ceilings and Price Floors and it's practical working in the economy.
4. Elasticity of Demand and it's types.
5. Elasticity of Supply and it's types.
6. Types of Costs in a Firm.
7. Money and it's demand
8. Understanding Credit Creation by banks using real time data from various banks.
9. Studying Unemployment and its types and the type of unemployment prevailing in India.

Textbooks:

1. Microeconomics- Pindyck, Robert S., and Daniel L. Rubinfeld Microeconomics
2. Macroeconomics- Dornbusch, Fischer and Startz

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

BUSINESS COMMUNICATION & VALUE SCIENCE – II

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Lectures:2 Hrs/Week	**Term work: 25 Marks**	**Theory: 2 Credits**
Practical:2 Hrs/ Week	**Oral: 25 Marks**	**Practical: 1 Credits**
	Total: 50 Marks	**Total: 3 Credits**

Course Prerequisites: -

Basic knowledge of the parts of speech in English.
Vocabulary covered in the previous semester along with basic knowledge of verbs & adverbs.
Basic awareness of the need of speaking skills within social circle.
The elements of team dynamics done during the previous semester with proper application and basic awareness of the concepts of feedback, criticism.
The various common conflicts that may arise at varied situations

Course Objective: -

The course objective of Business Communication & Value Science-I aims to augment student's overall communication and interpersonal skills by engaging them in group activities and thus aid in helping them to emerge as professionals. The soft skills topics for this semester are intended to develop student's expertise on public speaking skills and to deal positively with criticism and to effectively present their personalities

Course Outcomes: -

Graduates will able to:

1. To understand the concept of soft skills, Business Values and its implication at workplace
2. To construct the error free sentences of English language and develop proper reading Skills for Oral and written business communication
3. To develop team building and leadership skills by applying motivational factors
4. To construct effective business presentation and do effective implementation of it through activities
5. To inculcate appropriate business ethics and etiquettes for effective professionalism
6. To understand the concept of Diversity and Inclusion and its application at workplace

Unit I Importance of Soft skills and Values Sciences: 6 Hours

Soft skills, meaning, need and importance, difference between soft skills and hard skills, life skills and personal skills, applying soft skills across culture values of a good manager, Respect for Individual and Integrity. Importance of Ethics and Values in Business World.

Unit II Enhancing Writing and Reading Skills: 6 Hours

Good and Bad Writing. Common errors, punctuation rules, use of words Formation of an E-magazine, Blog writing, writing notice, agenda and Minutes of meeting, Introduction to skimming and scanning Techniques of Good Reading, Bad reading Habits

Unit III Developing interpersonal skills: 6 Hours

Team Building Skills, Team dynamics, Types of teams Classification of teams, Bruce Tuckman's Team Building Model, Challenges and Remedies of Team Development Belbin's 8 Team Roles and Lindgren's Big 5 personality traits. Belbin's 8 team player styles Leadership Skills: Good Leadership Skills, Difference between Leadership and Management Defining Qualities and Strengths of leadership

Unit IV Public Speaking and Presentation Skills: 6 Hours

Public Speaking: fundamentals of effective public speaking, types- Extempore speech, manuscript speech, and ways to enhance public speaking skills, storytelling, oral review Power Point presentations, Effective ways to structure the presentation, importance of body language Group discussion, interview skills

Unit V Corporate / Business Etiquettes: 6 Hours

Corporate grooming & dressing, etiquettes in social & office Setting-Understand the importance of professional behaviour at the workplace, Understand and Implement etiquettes in workplace, presenting oneself with finesse and making others comfortable in a business setting. Importance of first impression, Grooming

Unit VI Diversity and Inclusion: 6 Hours

Concepts**,** Advantages and Disadvantages, Different forms of Diversity in our society. Socio-Cultural and Cross-Cultural Sensitivities at the Workplace: PWD and LGBT at the workplace, learning disabilities at the workplace; Caste, class, regionalism, religion and poverty: the different identities of Indian employees and employers and how to include everyone; Global diversity identities of race, religion, nationhood; Appropriate Social Media Use

List of Laboratory Exercises:

1) Join Hands Movement'. Individual identification of social Issues
2) SATORI – Participants share the personal take away acquired from GD, writing and reading skills activities captured in their handbook
3) Form an NGO. Create Vision, Mission, Value statement, tagline and Design a logo.
4) Plan and design an E Magazine.
5) Lucid Writing, Catherine Morris and Joanie McMahon's writing techniques.
6) Speed Reading session: Introduction to skimming and scanning; practice the same.
7) Design a skit- a) write the script articulating the message of their respective NGOs. Read out the script. (Skit time-5 minutes).
8) Promote the play through a social media and gather your audience. Enact the play. Capture the numbers of likes and reviews
9) Team Falcon Practical to identify individual personality traits with Belbin's 8 team player styles
10) Ten minutes of your time – a short film on diversity. Play the video, Discuss the concept of empathy
11) Touch the target (Blind man) - Debriefing of the Practical. Film: "The fish and I'' by Babak Habibifar"
12) To create a story – 10 minutes of a person's life affected by the social issue groups
13) Research on a book, incident or film based on the topic of your respective NGO and Discuss
14) Interviews of people from diverse groups (Ask 5 questions). Share the recordings in FB
15) Prepared speech- Every student will narrate the challenges faced by a member of a diverse group in 4 minutes (speech in first person)
16) Discussion on TCS values, Respect for Individual and Integrity.

Project: 01 Form an NGO with a social cause in a group and make an awareness among people by doing different activities

List of Project Based Learning Topics:

1. Analysing difference between Soft Skills and Hard skills
2. Preparing a model for evaluating Values and Ethics of Good Managers
3. Developing Reading and writing Skills: Preparing a model on each skill
4. Form a model for communicative writing which avoid grammar mistakes and common errors
5. Develop Bruce Tuchman's Team Building Models with classmates/Teammates
6. Analysing difference between Leadership and Management skills
7. Watch and listen the best videos of Good Public Speaker s and list out their Qualities and Attributes
8. Knowing body language and Paralinguistic Features for the Presentation: Making a video of professional presentation

9. Visit one nearest origination/Firm and find out what etiquettes and mannerism are being used there that enhance the capacity of their work place
10. Preparing a model of dress codes and attire for different professional situations
11. Analysing the major aspects of diversity and inclusion in the workplace
12. Creating a good model for increasing diversity and enhancing the proper inclusion that will help in achieve the goal of the origination effectively
13. Analysing markers of global identities for inclusive work culture

Reference Books:

1. Business Communication Today by Bovee, Thill, Raina
2. Business Communication by Meenakshi Raman, Prakash Singh published by Oxford University press, second edition,
3. Spoken English- A manual of Speech and Phoonetics by R. K. Bansal, J. B. Harrison published by Orient Blackswan
4. Communication Skills by Sanjay Kumar, PushpLata, published by Oxford University press, second edition
5. Technical Communication by Meenakshi Raman, Sangeeta Sharma published by Oxford University press
6. Developing Communication Skills by Krishna Mohan, MeeraBanerji published by Macmillan India Pvt Ltd
7. Strategic Communication by Charles Marsh
8. English vocabulary in use – Alan Mc'carthy and O'dell
9. Business Communication – Dr.SarojHiremath

Web References:

01. Ethics fundamentals and approaches to ethics
    https://www.eolss.net/Sample-Chapters/C14/E1-37-01-00.pdf
02. A Framework for Making Ethical Decisions
    https://www.brown.edu/academics/science-and-technology-studies/framework-making-ethical-decisions
03. Five Basic Approaches to Ethical Decision-
    http://faculty.winthrop.edu/meelerd/docs/rolos/5_Ethical_Approaches.pdf

COMPUTER WORKSHOP TECHNOLOGY

TEACHING SCHEME		EXAMINATION SCHEME		CREDIT SCHEME	
Practical:	**2 Hours/Week**	**Term Work:**	**25 Marks**	**Practical:**	**1**
		Practical:	**25 Marks**		
Total	**2 Hours/Week**	**Total:**	**50 Marks**	**Total:**	**1**

Course Objective:
To acquire the knowledge of basic manufacturing processes used in computer engineering technology

Prerequisite:
Basics of Engineering materials. Basics of computer and laptop.

Course Outcomes: On completion of the course, students will have the ability to:

1. Understand the basics parts used in the computer and laptop.
2. Understand fundamental concepts of assembly of electronics components (PCB).
3. Understand the various joining processes
4. Develop plastic moulding component used in computer engineering.
5. Developing the component used in computer engineering by use of 3D printing technology.
6. Understand the knowledge of making fasteners used for computer and laptop.

Unit I **04 Hours**

Assembly of Computer: Introduction to hardware peripherals like RAM, ROM, keyboard, Mouse, processors, etc. Generation of processors. Working of SMPS. Study of various ports. Steps and precautions to assemble computer, Tools used in computer hardware

Unit II **04 Hours**

Printed Circuit Boards Assembly (PCB): Study of joining processes, Resistance welding and Soldering processes, why and how flux, tip tinner, solder wick, and post-soldering cleaners are used in the hand soldering process. Laser welding, orbital welding. Advantages and disadvantages of welding processes.

Unit III **04 Hours**

CPU Cabinet Manufacturing Process: Introduction to machines in sheet metal Industry: shearing machine, bending machine, circular profile cutting machines. Different types of sheet metal folds. Rivets and its different parts, selection of rivet heads, types of rivets and its uses. Punching, blanking, shearing, bending, and piercing.

Unit IV **04 Hours**

Plastic Molding Process: Introduction to plastic molding. Types of plastics. Types of plastic molding. Exercise on plastic molding machine ,manufacturing of plastic moulded job.

Unit V **04 Hours**

3D Printing Technology: Introduction to Additive Manufacturing, Need for Additive Manufacturing, Generic AM process, Classification of AM Processes, 3D Printing process. Steps in AM process, Advantages of AM, Major Applications

Unit VI **04 Hours**

Study of Machining Processes: Introduction to machining processes, Different types of turning and grinding operations, by using turning operations making of simple fastener used in computer engineering.

Textbooks:

1. Khanna O.P. and Lal. M., " Production Technology", Dhanpatrai Publications (P) Ltd., New Delhi.
2. Jain R.K., "Production Technology", Khanna Publishers, Delhi
3. The Complete Reference PC Hardware, Craig Zacker, John Rourke

Reference Books:

1. ChoudharyHajra S. k., ChoudharyHajra A. k. "Elements of Workshop Technology Vol 2 Machine Tools, Publisher: Media Publishers & Promoters, India.
2. Rajput R. K ., "Manufacturing Technology", Laxmi Publications (P)Ltd, New Delhi..

List of Laboratory Exercise:

1. Practical on introduction to hardware and different tools used in workshop technology for computer engineering.
2. Experiment and demonstration of soldering processes on electronics components such as PCB assembly.
3. Practical on resistance welding processes.
4. Practical demonstration on shearing machine, bending machine, circular profile cuttingmachines used in sheet metal operations for manufacturing of cabinet used in computer.
5. Practical demonstration on Punching, blanking, shearing, bending, and piercing.
6. Practical demonstration on plastic molding machine.
7. Practical demonstration on 3 D printing machine
8. Practical demonstration on making fastener for computer by machining processes .
9. Industrial visit to the manufacturing industry.

B. TECH (Computer Science & Business Systems)

SEMESTER – III

COURSE SYLLABUS

FORMAL LANGUAGE & AUTOMATA THEORY

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Lectures :3Hrs./Week	**Semester Examination :60 marks**	**Theory :3 Credits**
Tutorials :1Hr./Week	**Internal Assessment :40 marks**	**Tutorial :1 Credit**
	Term Work :25 Marks	**Total :4 Credits**
	Total :125 marks	

Course Pre-Requisites:

The students should have basic Knowledge Set algebra, elementary formal logic, constructing proofs, recurrence relations, Discrete Structures and Data structures and problem solving.

Course Objective:

1) To understand problem classification and problem solving by machines.
2) To understand the basics of automata theory and its operations.
3) To study computing machines by describing, classifying, and comparing different types of computational. models.
4) Encourage students to study theory of computability and complexity.
5) To understand the P and NP class problems and its classification.
6) To understand the fundamentals of problem decidability and reducibility.

Course Outcomes:

1) Understand the Graphs and Trees related concepts.
2) Design the Finite Automata Machines and its operations.
3) Understand Context Free Grammar and Context Free languages.
4) Construct Turing Machine for formal languages.
5) Identify and Design the equivalence of languages described by Pushdown Automata
6) Identify NP Hard and NP- Complete problems.

UNIT – I **6 Hours**

Introduction: Alphabet, Strings and languages, Graphs, Directed Graphs, Trees, FSM.

UNIT – II **6 Hours**

Regular Languages and Finite Automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, Keene's theorem, pumping lemma for regular languages, Myhill-Nerode theorem and its uses, minimization of finite automata.

UNIT – III **6 Hours**

Context-Free Languages and Pushdown Automata: Productions and Derivation, Context-free grammars (CFG) and languages (CFL), Chomsky hierarchy of languages, Chomsky Normal Forms and Greibach normal forms, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs.

Context-Sensitive Languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.

UNIT – IV **6 Hours**

Turing Machines: The basic model for Turing machines (TM), Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.

UNIT – V **6 Hours**

Push Down Automata (PDA): Introduction, Pushdown Automata (PDA), Transition Diagrams, Functions and Tables, Deterministic Push- down Automata (DPDA) - definition, Nondeterministic Pushdown Automata (NPDA), Equivalence of context-free grammars and PDA, properties of context-free languages.

UNIT – VI **6 Hours**

Basic Introduction to Complexity: Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines, P and NP, NP-completeness, Cook's Theorem, and other NP-Complete problems.

Undecidability: Church-Turing thesis, Universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages.

List of Assignments:

YACC, the parser-generating tool (Chapter 5 of Introduction to Automata Theory, Languages, and Computation (John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman.)

List of Project Based Learning Topics:

1. Design a FA for Vending Machine
2. Explain Pigeon hole Principle
3. Implement Push Down Automata
4. Implement Regular Expression
5. Implement lexical Analyzer
6. Implement Turing Machine for Mathematical Expression
7. Design an application to search a string from given text using FA
8. Implement a FSM for residing mod 3.
9. Provide solutions for Missionaries and Cannibals problems.

Textbooks:

1. Introduction to Automata Theory, Languages, and Computation John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman. Pearson Publication.

Reference Books:

1. Elements of the Theory of Computation, Harry R. Lewis and Christos H. Papadimitriou.
2. Automata and Computability, Dexter C. Kozen.
3. Introduction to the Theory of Computation, Michael Sipser.
4. Introduction to Languages and the Theory of Computation, John Martin.
5. Computers and Intractability: A Guide to the Theory of NP Completeness, M. R. Garey and D. S. Johnson.

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

COMPUTER ORGANIZATION & ARCHITECTURE

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Theory :3 Hours / Week	**End Semester Examination :60 Marks**	**Theory :3 Credits**
Lab : 2 Hours / Week	**Internal Assessment :40 Marks**	**Practical :1 Credit**
	Term work :25 Marks	
	Total :125 Marks	**Total :4 Credits**

Course Pre-Requisites:

The students should have basic Knowledge Digital electronics and computer system.

Course Objective:

To understand the design of the various functional units of computer system.

Course Outcomes:
After completion of this course students will be able to
1. Identify various components of a computer and their interconnection.
2. Explain the functions & organization of various blocks of CPU.
3. Understand CPU instruction characteristics, enhancement features of CPU.
4. Describe an assortment of memory types (with their characteristics) used in computer systems and basic principle of interfacing input and output devices.
5. Describe the I/O organization and interconnections.
6. Infer parallel processing and multiprocessor configuration.

UNIT – I **6 Hours**

Revision of basics in Boolean logic and Combinational/Sequential Circuits.

Functional Blocks of a Computer: CPU, memory, input-output subsystems, control unit.

Introduction to x86 Architecture

Instruction Set Architecture of a CPU: Registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Outlining instruction sets of some common CPUs.

UNIT – II **6 Hours**

Data Representation: Signed number representation, fixed and floating-point representations, character representation.

Computer Arithmetic: Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and-add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, IEEE 754 format.

UNIT – III **6 Hours**

CPU Control Unit Design: Hardwired and micro-programmed design approaches, design of a simple hypothetical CPU.

UNIT – IV **6 Hours**

Memory System Design: Semiconductor memory technologies, memory organization.

Memory Organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

UNIT – V **6 Hours**

Peripheral Devices and Their Characteristics: Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in process state transitions, I/O device interfaces – SCSI, USB

UNIT – VI **6 Hours**

Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards.

Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

List of Assignments:

Assignments covering the following topics should be given

1. Booth's algorithm for multiplication
2. Restoring and non-restoring division
3. Fixed point and floating-point representation
4. Programmer's model of 80386
5. Hardwired and micro-programmed design approaches.
6. Characteristics of Memory system
7. Cache organization and address mapping
8. Virtual memory and replacement algorithms
9. Calculating throughput and speed in pipelining
10. Multiprocessor architecture

List of Laboratory Experiments

1. Boolean Logic Gates Implementation: Design and simulate basic logic gates (AND, OR, NOT, etc.) using software like Logisim or Verilog.
2. Write assembly language program for simple tasks like arithmetic operations, control flow using x86 instructions.
3. Fixed and Floating-Point Representations: Study the representation of numbers in fixed-point and floating-point formats. Perform arithmetic operations on fixed-point and floating-point numbers.
4. Hardwired Control Unit Design: Design a hardwired control unit for a simple CPU architecture. Implement control signals for various instructions.
5. Semiconductor Memory Technologies: Study different semiconductor memory technologies (DRAM, SRAM, Flash, etc.) and their characteristics.
6. Cache Memory Simulation: Simulate cache memory with varying cache sizes, block sizes, mapping functions, and replacement algorithms. Analyse cache hit/miss rates and access time.
7. I/O Device Interface Implementation: Implement interfaces for different I/O devices (e.g., keyboard, mouse, display) using programming languages like C or Python.
8. Introduction to Parallel Processors: Study the architecture and organization of parallel processors. Analyze the benefits of parallelism in terms of performance and scalability.

List of Project Based Learning Topics:

1. Automatic night lamp with morning alarm
2. Traffic light with sensor + 7segment
3. Multi pattern running lights.
4. Washing machine
5. Simple Lock Using Keypad and 7 segment
6. Electronic quiz table
7. Electronic Digital Clock
8. Temperature controller
9. Plant Irrigation System
10. Car Parking Management
11. Customer counter for supermarket
12. Electronic queue management system in food stall
13. Safety box
14. Shop lot automatic door with 7segment display
15. Bank queue management system
16. Water level controller
17. Automatic home system
18. Commuter system
19. Automatic room light control
20. Elevator control system

Textbooks:

1. Computer System Architecture M. M. Mano: 3rd ed., Prentice Hall of India, New Delhi, 1993.
2. Computer Organization and Design: The Hardware/Software Interface, David A. Patterson and John L. Hennessy.
3. Computer Organization and Embedded Systems, Carl Hamacher.

Reference Books:

1. Computer Architecture and Organization, John P. Hayes.
2. Computer Organization and Architecture: Designing for Performance, William Stallings

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

SOFTWARE ENGINEERING

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Lectures :3 Hrs./Week	**Semester Examination :60 Marks**	**Theory :3 Credits**
Lab :2Hrs./Week	**Internal Assessment :40 Marks**	
	Term work :25 Marks	**Practical :1 Credit**
	Oral :25 Marks	
	Total :150 Marks	**Total :4 Credits**

Course Pre-Requisites:

The students should have sound knowledge of data structures, programming experience and an extensive hands-on experience of using software.

Course Objective:

The course introduces key aspects of software engineering processes for the development of a complex software system.

Course Outcomes:

1. Learn importance of software engineering process and its principles
2. Understand the software development life cycle with appropriate models
3. Understand software quality concepts
4. Document user requirements using suitable techniques
5. Analyze the software design from and Object-Oriented perspective.
6. Apply appropriate testing techniques on a software

UNIT – I **6 Hours**

Introduction: Programming in the small vs. programming in the large; software project failures and importance of software quality and timely availability; engineering approach to software development; role of software engineering towards successful execution of large software projects; emergence of software engineering as a discipline.

UNIT – II **6 Hours**

Software Project Management: Basic concepts of life cycle models – different models and milestones; software project planning –identification of activities and resources; concepts of feasibility study; techniques for estimation of schedule and effort; software cost estimation models and concepts of software engineering economics; techniques of software project control and reporting; introduction to measurement of software size; introduction to the concepts of risk and its mitigation; configuration management.

UNIT – III **6 Hours**

Software Quality and Reliability: Internal and external qualities; process and product quality; principles to achieve software quality; introduction to different software quality models like McCall, Boehm, FURPS / FURPS+, Dromey, ISO – 9126; introduction to Capability Maturity Models (CMM and CMMI); introduction to software reliability, reliability models and estimation.

UNIT – IV **6 Hours**

Software Requirements Analysis, Design and Construction: Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques; techniques for requirement modeling – decision tables, event tables, state transition tables, Petri nets; requirements documentation through use cases; introduction to UML, introduction to software metrics and metrics-based control methods; measures of code and design quality.

UNIT – V **6 Hours**

Object Oriented Analysis, Design and Construction: Concepts -- the principles of abstraction, modularity, specification, encapsulation and information hiding; concepts of abstract data type; Class Responsibility Collaborator (CRC) model; quality of design; design measurements; concepts of design patterns; Refactoring; object-oriented construction principles; object-oriented metrics.

UNIT – VI **6 Hours**

Software Testing: Introduction to faults and failures; basic testing concepts; concepts of verification and validation; black box and white box tests; white box test coverage – code coverage, condition coverage, branch coverage; basic concepts of black-box tests – equivalence classes, boundary value tests, usage of state tables; testing use cases; transaction-based testing; testing for non-functional requirements – volume, performance and efficiency; concepts of inspection.

List of Assignments:

Teaching faculty will design home assignment on following topics.

1. Software development Models
2. Software Requirement Specification
3. Data Flow Diagrams
4. Testing
5. Object Oriented Analysis, Design and Construction
6. Software project covering various software development methodology techniques will be implemented.

List of Laboratory Exercises:

1. Develop Flow-Charts for (any open-ended problem statement) to understand basic problem-solving technique using suitable tool.
2. Perform domain analysis for given problem.
3. Develop requirements specification document as per IEEE format for a given problem
4. Develop DFD model (level-0, level-1 DFD and Data dictionary) of the project under consideration.
5. Perform Structured design for the developed DFD model.
6. Calculate Cyclomatic complexity for given code snippet.
7. Identify the usage of regression testing.
8. Identify the different types of performance testing

List of Project Based Learning Topics:

1. Fingerprint voting system
2. Weather forecasting system
3. Android local train ticketing system
4. Railway tracking and arrival time prediction system
5. Android Patient Tracker
6. Opinion mining for social networking platforms
7. Automated payroll system with GPS tracking and image capture

8. Data leakage detection system
9. Credit card fraud detection
10. AI shopping system
11. Camera motion sensor system
12. Bug tracker
13. e-Learning platform
14. Smart health prediction system
15. Software piracy protection system

Text Books:

1. Software Engineering, Ian Sommerville
2. Object Oriented Software Engineering: A Use Case Driven Approach --Ivar Jacobson

Reference Books:

1. Fundamentals of Software Engineering, Carlo Ghezzi, Jazayeri Mehdi, Mandrioli Dino
2. Software Requirements and Specification: A Lexicon of Practice, Principles and Prejudices, MichaelJackson
3. The Unified Development Process, Ivar Jacobson, Grady Booch, James Rumbaugh
4. Design Patterns: Elements of Object-Oriented Reusable Software, Erich Gamma, Richard Helm,Ralph Johnson, John Vlissides
5. Software Metrics: A Rigorous and Practical Approach, Norman E Fenton, Shari Lawrence Pfleeger
6. Software Engineering: Theory and Practice, Shari Lawrence Pfleeger and Joanne M. Atlee
7. Object-Oriented Software Construction, Bertrand Meyer
8. Object Oriented Software Engineering: A Use Case Driven Approach --Ivar Jacobson
9. Touch of Class: Learning to Program Well with Objects and Contracts --Bertrand Meyer
10. UML Distilled: A Brief Guide to the Standard Object Modeling Language --Martin Fowler

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

COMPUTATIONAL STATISTICS

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Theory :3 Hours / Week	**End Semester Examination :60 Marks**	**Theory :3 Credits**
Lab :0 Hours / Week	**Internal Assessment :40 Marks**	
	Total : 100 Marks	**Total :3 Credits**

Course Pre-requisites: The Students should have knowledge of basics of statistics.

Course Objectives:

The aim of this course is to give graduate students knowledge of statistical concepts like factor analysis, regression analysis and Python programming. The course objective is to exercise students for data set handling, data wrangling, data visualization etc. using Python.

Course Outcomes:

1. Learn methods of Data Wrangling.
2. Understand importance of different Group Operations and Time series using real time datasets.
3. Apply knowledge of Normal Distribution and Design Simple and Multiple Linear Regression Models.
4. Create Multivariate Regression Model and Understand Discriminant Analysis
5. Understand and Demonstrate Dimension Reduction Techniques.
6. Demonstrate the use of Clustering on real time datasets.

UNIT – I **6 Hours**

Python Concepts, Data Structures, Classes: Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences and Class Definition, Constructors, Text & Binary Files - Reading and Writing.
Data Wrangling: Combining and Merging Datasets, Reshaping and Pivoting, Data Transformation, String Manipulation, Regular Expressions

UNIT – II **6 Hours**

Data Aggregation, Group Operations, Time Series: GroupBy Mechanics, Data Aggregation, Groupwise Operations and Transformations, Pivot Tables and Cross Tabulations, Time Series Basics, Data Ranges, Frequencies and Shifting.

UNIT – III **6 Hours**

Multivariate Normal Distribution: Multivariate Normal Distribution Functions, Conditional Distribution and its relation to regression model, Estimation of parameters.
Multiple Linear Regression Model: Standard multiple regression models with emphasis on detection of collinearity, outliers, non-normality and autocorrelation, Validation of model assumptions.

UNIT – IV **6 Hours**

Multivariate Regression: Assumptions of Multivariate Regression Models, Parameter estimation, Multivariate Analysis of variance and covariance.
Discriminant Analysis: Statistical background, linear discriminant function analysis, Estimating linear discriminant functions and their properties.

UNIT - V **6 Hours**

Principal Component Analysis: Principal components, Algorithm for conducting principal component analysis, deciding on how many principal components to retain, H-plot.
Factor Analysis: Factor analysis model, extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores.

UNIT – VI **6 Hours**

Clustering and Segmentation Analysis: Introduction, Types of clustering, Correlations and distances, clustering by partitioning methods, hierarchical clustering, overlapping clustering, K-Means Clustering-Profiling and Interpreting Clusters.

List of Assignments:
Respective subject teacher shall design any six assignments on above units.

Textbooks:

1. An Introduction to Multivariate Statistical Analysis, T.W. Anderson.
2. Applied Multivariate Data Analysis, Vol I & II, J.D. Jobson.
3. Statistical Tests for Multivariate Analysis, H. Kris.
4. Programming Python, Mark Lutz.
5. Python 3 for Absolute Beginners, Tim Hall and J-P Stacey.
6. Beginning Python: From Novice to Professional, Magnus Lie Hetland. Edition, 2005.

List of Project Based Learning Topics:

1. Design and development of Student management system using object-oriented approach and file structure.
2. Development of student performance analysis system (Use of file, OO Python and regression model, Graphical dashboard).
3. Development of multivariate predictive model for rain forecasting (use rainfall data for last 50 years).
4. Development of multivariate predictive model for gold rate. (Use daily gold rate data for last 10 years).
5. Development of multivariate predictive model for patrol rate. (Use daily patrol rate data for last 10 years).
6. Comparative analysis of predictions of single multivariate predictive model against multiple linear predictive models.
7. Comparative analysis of dimensionality reduction performance using principle component analysis (PCA) and linear discriminant analysis (LDA).
8. Comparative analysis of classification performance of principle component analysis (PCA) and linear discriminant analysis (LDA) techniques.
9. Study of effectiveness of analysis of variance (ANOVA) and analysis of covariance (ANCOVA) for predictive analysis.
10. Comparing operating differences of various clustering Techniques.
11. Comparative analysis of performance for parameter (variable/factors) selection using principal component analysis (PCA) and factor analysis (FA) for multivariate analysis.

Reference Books:

1. Regression Diagnostics , Identifying Influential Data and Sources of Collinearety, D.A. Belsey, E. Kuh and R.E. Welsch
2. Applied Linear Regression Models, J. Neter, W. Wasserman and M.H. Kutner.
3. The Foundations of Factor Analysis, A.S. Mulaik.
4. Introduction to Linear Regression Analysis, D.C. Montgomery and E.A. Peck.
5. Cluster Analysis for Applications, M.R. Anderberg.
6. Multivariate Statistical Analysis, D.F. Morrison.
7. Python for Data Analysis, Wes Mc Kinney.

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT –IV

OBJECT ORIENTED PROGRAMMING

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED
Theory :3 Hours / Week	**End Semester Examination**	**:60 Marks**	**Theory :3 Credits**
Lab :2 Hours / Week	**Internal Assessment**	**:40 Marks**	**Practical: 1 Credit**
	Termwork	**:25 Marks**	
	Practical	**:25 Marks**	**Total :4 Credits**
	Total	**: 150 Marks**	

Course Pre-Requisites:

The students should have basic Knowledge of "C" programming language.

Course Objective:

The course introduces fundamental concepts of Object-oriented programming.

Course Outcomes:

At the end of this course students will be able to:

1. Understand basic concepts of Procedural programming and the overview of C programming language.
2. Understand some basic differences between C and C++.
3. Understand basic concepts of Object-Oriented Programming, classes and objects in OOP.
4. Apply the concept of Access Specifier, friend function, constructor, destructor and Error Handling using C++ programs.
5. Implement the concept of polymorphism, virtual functions and inheritance using C++.
6. Develop OOP applications using Templates and file Handling.

UNIT – I **6 Hours**

Procedural Programming, An Overview of C: Types Operator and Expressions, Scope and Lifetime, Constants, Pointers, Arrays, and References, Control Flow, Functions and Program Structure, Namespaces, error handling, Input and Output (C-way), Library Functions (string, math, stdlib), Command line arguments, Pre-processor directive

UNIT – II **6 Hours**

Some Difference between C and C++: Single line comments, Local variable declaration within function scope, function declaration, function overloading, stronger type checking, Reference variable, parameter passing – value vs reference, passing pointer by value or reference, #define constant vs const, Operator new and delete, the typecasting operator, Inline Functions in contrast to macro, default arguments.

UNIT – III **6 Hours**

The Fundamentals of Object-Oriented Programming: Necessity for OOP, Data Hiding, Data Abstraction, Encapsulation, Procedural Abstraction, Class and Object.

UNIT – IV **6 Hours**

More Extensions to C in C++ to Provide OOP Facilities: Scope of Class and Scope Resolution Operator, Member Function of a Class, private, protected and public Access Specifier, this Keyword, Constructors and Destructors, friend class, error handling (exception)

UNIT – V **6 Hours**

Essentials of Object-Oriented Programming: overloading, Inheritance – Single and Multiple, Class Hierarchy, Pointers to Objects, Assignment of an Object to another Object, Polymorphism through dynamic binding, Virtual Functions, Overloading, overriding and hiding, Error Handling.

UNIT – VI **6 Hours**

Generic Programming: Template concept, class template, function template, template specialization
Input and Output: Streams, Files, Library functions, formatted output
Object Oriented Design and Modelling: UML concept, use case for requirement capturing, Class diagram, Activity diagram and Sequence Diagram for design, Corresponding C++ code from design

List of Assignments:

1. Define Procedural Oriented Programming. Explain basic concepts of procedural oriented programming.
2. Differentiate between C and C++ in detail with suitable example.
3. Explain basic concepts of Object-Oriented Programming in detail with suitable example.
4. Write short note on:
5. Scope Resolution Operator ii)Access Specifiers
6. Explain Virtual Function and Function Overloading in detail with Example.
7. Explain Concepts of Object-Oriented Design and Modelling.

List of Laboratory Exercises:

1. Parameter passing: passing parameter by value vs by reference, passing array as constant pointer
2. Function overloading: writing string operations like strcat and strncat, strcpy and strncpy as overloaded functions.
3. Dynamically allocating space for a pointer depending on input and doing this repeatedly, depending on different inputs and finally de-allocating the pointer.
4. Define class complex with all possible operations: constructor, destructor, copy constructor, assignment operator with the data members stored as pointer to integers.
5. Define class vector of integers with all possible operations like constructor, destructor, copy constructor and assignment operators
6. Define class matrix of integers with all possible operations like constructor, destructor, copy constructor and assignment operators
7. Define class matrix of integers using vector, with all possible operations like constructor, destructor, copy constructor and assignment operators
8. Define class stack, queue, linked-list, array, set using some data-type (int) with data members kept as private and functions kept in both protected and public sections.
9. Define class complex with all possible operators: constructor, destructor, copy constructor, assignment operator and operators >, <, >=, <=, ==, ++ (pre and post), +, +=, ( ), with the data members stored as pointer to integers.
10. Define class vector of integers with all possible operations like constructor, destructor, copy constructor and assignment operators>, <, >=, <=, ==, ++ (pre and post), +, +=, ( )
11. Define class matrix of integers with all possible operations like constructor, destructor, copy constructor and assignment operators>, <, >=, <=, ==, ++ (pre and post), +, +=, ( ).
12. Define class matrix of integers using vector, with all possible operations like constructor, destructor, copy constructor and assignment operators>, <, >=, <=, ==, ++ (pre and post), +, +=, ( ).
13. Define stack and queue inherited from array class, with standard functions and operators
14. Define a class called ‘array’ with data type passed as template type with constructor, destructor, copy constructor and assignment operators and index operator.
15. Define template functions for compare and use it in the algorithms like bubble sort, insertion sort, merge sort.
16. Formatted input-output examples
17. Input manipulators

18. Overriding operators <<, >>
19. Define class model for complex number, student class, book class and show it using UML diagram as
a. well as concrete class.
20. Show behavioural modelling through sequence diagram and activity diagram for workflow in a typical log-in, log-out situation.

List of Project Based Learning Topics:

1. Employee Management System.
2. Trading Software.
3. Billing System.
4. Intuitive Gadgets.
5. Traffic Management System
6. Security Systems.
7. Car Rental System.
8. Login and Registration System.
9. Bookshop inventory system.
10. Student Report Management System.
11. Calendar application.

Text Books:

1. The C++ Programming Language, BjarneStroustrup.
2. C++ and Object-Oriented Programming Paradigm, Debasish Jana

Reference Books:

1. Programming – Principles and Practice Using C++, BjarneStroustrup.
2. The Design and Evolution of C++, BjarneStroustrup.

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

SKILL LAB – III (DATA SCIENCE WITH PYTHON)

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED
Theory :0 Hours / Week	**Termwork**	**:25Marks**	**Practical :1 Credits**
Lab :2 Hours / Week	**Practical**	**:25 Marks**	
	Total	**: 50 Marks**	**Total :1 Credits**

Course Objective:

To develop analytical skills among the students using data analysis methods and Python.

Prerequisite:

The students should have knowledge of basics of statistics.

Course Outcomes: On completion of the course, students will have the ability to:

1. Understand and Demonstrate fundamentals of Python programming.
2. Demonstrate visualization in Python using different Packages and Libraries.
3. Understand and Visualize various distributions using real time datasets.
4. Design models for simple and multiple linear regression models.
5. Develop a model for PCA to understand the effects of dimension reduction.
6. Design various clusters using real time datasets.

Unit I : **04 Hours**

Python Basics: Python Programming Environment, Statements in Python, Data Structures, Expressions, Flow Controls, Functions, Numeric Types, Sequences and Class Definition, Constructors, Text & Binary Files- Reading and Writing.

Unit II : **04 Hours**

Packages and Libraries used for Plotting in Visualization: Various Packages and Libraries used for plotting, Plotting Graphs, Controlling Graph, Adding Text, Different types of Graphs, Getting and Setting values in Graph.

Unit III: **04 Hours**

Distributions: Type of data, Bernoulli Distribution, Uniform Distribution, Binomial Distribution, Normal Distribution, Poisson Distribution, Exponential Distribution. Visualization of Distribution.

Unit IV: **04 Hours**

Linear Regression: Linear Regression Model, Model Assumptions, Validation of model.

Multiple Linear Regression: Multiple Linear Regression Model, Model Assumptions, Validation of model.

Unit V: **04 Hours**

Principal Component Analysis: Principal Components, Algorithm for conducting Principal Component Analysis, Factors to decide retention of Principal Components.

Unit VI: **04 Hours**

Clustering: Introduction to Clustering, Types of Clustering, Correlations and Distance Measures, Hierarchical Clustering and Non-Hierarchical Clustering, Profiling and Interpreting Clusters.

Textbooks

1. Tim Hall and J-P Stacey “Python 3 for Absolute Beginners”, A press.
2. Wes Mc Kinney. “Python for Data Analysis”,O'Reilly Media, Inc.

Reference Books

1. Jake Vander Plas, “Python Data Science Handbook: Essential Tools for Working with Data”O'Reilly Media
2. David Spiegel halter “The Art of Statistics”Pelican

List of Laboratory Exercises

1. Introduction to python programming (String operation, Mathematical operation, loops, branching)
2. Write a program to perform basic operations using Python Functions.
3. Write a program to perform to read, write and modify text file data using OO Python.
4. Implement various pre-defined libraries in Python like Panda, NumPy, Cbor (Drawing of statistical graph)
5. Exercise different functionalities of Matplotlib package.
6. Write a program to measure central tendency and dispersion of given data.
7. Write a program to visualize different types of distributions.
8. Write a program to develop linear and multiple regression models using real time datasets
9. Implementation of clustering using real time datasets.

B. TECH (Computer Science & Business Systems)

SEMESTER – IV

COURSE SYLLABUS

OPERATING SYSTEM

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED
Lectures :3Hrs./Week	**Semester Examination**	**:60 Marks**	**Theory :3 Credits**
Lab :2Hrs./Week	**Internal Assessment**	**:40 Marks**	
	Term Work	**:25 Marks**	**Practical :1 Credit**
	Oral	**:25 Marks**	
	Total	**:150 Marks**	**Total :4 Credits**

Course Pre-Requisites:

Prerequisites for this course include thorough knowledge in some high-level programming language as C or C++ and UNIX / Linux operating system environment. As programs are to be implemented by writing C code during the course and will cover the details of C and its close relationship to UNIX and Linux in the case study in 6^{th}unit.

Course Objectives:

1. To learn the basic concepts of Operating Systems.
2. To learn the mechanisms of OS to handle processes and threads and their communication.
3. To learn the methods of process scheduling.
4. To gain knowledge on Mutual exclusion, deadlock detection algorithms.
5. To know the concept of memory management and virtual memory.
6. To learn programmatically file management techniques.

Course Outcomes:

1. To learn and apply the basic concept of operating system.
2. To infer the concept of process and process state transition and concept of thread and multithreading.
3. Understand the importance of scheduling and types of scheduling algorithms.
4. To gain the knowledge of inter process communication strategies, concept of deadlock along with its avoidance.
5. To analyse the memory management techniques, paging, and segmentation.
6. To understand the file management and disk management techniques.

UNIT – I **6 Hours**

Introduction: Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS.

UNIT – II **6 Hours**

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching.
Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.

UNIT – III **6 Hours**

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.
Scheduling Algorithms: Pre-emptive and non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

UNIT – IV **6 Hours**

Inter-process Communication: Concurrent processes, precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Semaphores, Strict Alternation, Peterson's Solution, The Producer / Consumer Problem, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem, Barber's shop problem.
Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.
Concurrent Programming: Critical region, conditional critical region, monitors, concurrent languages, communicating sequential process (CSP); Deadlocks - prevention, avoidance, detection and recovery.

UNIT – V **6 Hours**

Memory Management: Basic concept, Logical and Physical address maps, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction.
Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page allocation, Partitioning, Paging, Page fault, Working Set, Segmentation, Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

UNIT – VI **6 Hours**

I/O Hardware: I/O devices, Device controllers, Direct Memory Access, Principles of I/O. File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed),Free-space management (bit vector, linked list, grouping), directory implementation(linear list, hash table), efficiency and performance.
Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks.
Case Study: UNIX OS file system, shell, filters, shell programming, programming with the standard I/O, UNIX system calls.

List of Assignments:

1. To learn evolution and structure of operating system.
2. To understand the concept of Real Time scheduling.
3. To analyse the problem of process synchronization.
4. To implement the shell programming in UNIX OS.

List of Laboratory Exercises:

1. Unix commands (files directory, data manipulation, network communication etc), shell programming and vi editor
2. C program implementation of the following:
    a. Scheduling Algorithms
    b. Shared memory
    c. Thread and Multi Thread
    d. Inter Process Communication
    e. Deadlock Avoidance and Deadlock Detection
    f. Semaphore
    g. Memory Management
    h. Indexing and Hashing

List of Project Based Learning Topics:

1. Virtual traffic management system using threads with semaphore to control traffic.
2. Virtual memory management system.
3. File system handling.
4. A Client -Server application, use of IPC.
5. A simple web browser.
6. Device driver for some device.
7. Design of mail system project.
8. Design of RTOS for embedded system.
9. Mini project on Linux Shell.
10. Railway reservation system using scheduling.

Textbooks:

1. Operating System Concepts Essentials. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne.

Reference Books:

1. Operating Systems: Internals and Design Principles. William Stallings.
2. Operating System: A Design-oriented Approach. Charles Patrick Crowley.
3. Operating Systems: A Modern Perspective. Gary J. Nutt.
4. Design of the Unix Operating Systems. Maurice J. Bach.
5. Understanding the Linux Kernel, Daniel Pierre Bovet, .*Marco Cesati*

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT – III
Unit Test -2	UNIT – IV, UNIT – V, UNIT – VI

DATABASE MANAGEMENT SYSTEMS

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Lectures :3 Hrs./Week	**Semester Examination :60 marks**	**Theory :3 Credits**
Lab :2 Hrs./Week	**Internal Assessment :40 marks**	
	Term work :25 Marks	**Practical :1 credit**
	Practical :25 Marks	
	Total :150 Marks	**Total :4 Credits**

Course Prerequisites:

Students should have knowledge of

1. Basic understanding of data and data structure
2. Basic understanding of programming language

Course Objectives:

1. Identify various techniques to communicate with database.
2. Relate relevant data for effective processing of data.
3. Construct a database to maintain data adroitly.
4. Study various queries and tools to deal with the data.
5. Understand the relation between data set and respective means to access it.
6. Understand the influence of data in the effective development of software.

Course Outcomes:

After successful completion of this course students will be able to:

1. Model an application's data requirements using conceptual modeling tools.
2. Demonstrate concepts of relational algebra and queries
3. Demonstrate concepts of relational database design
4. Interpret the query processing and optimization activities in database.
5. Interpret the transaction activities in database.
6. Recognize the emerging database applications and security concerns.

UNIT – I **6 Hours**

Introduction: Introduction to Database. Hierarchical, Network and Relational Models. Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.

UNIT – II **6 Hours**

Relational Query Languages: Relational algebra, Tuple and domain relational calculus,SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL,ORACLE, DB2, SQL server.

UNIT – III **6 Hours**

Relational Database Design: Domain and data dependency, Armstrong's axioms, Functional Dependencies, Normal forms, Dependency preservation, Lossless design.

UNIT – IV **6 Hours**

Query Processing and Optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.

Storage strategies: Indices, B-trees, Hashing.

UNIT – V **6 Hours**

Transaction Processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp-based schedulers, multi-version and optimistic Concurrency Control schemes, Database recovery.

UNIT – VI **6 Hours**

Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.
Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.

List of Assignments:

Respective subject teacher shall design any six assignments on above units.

List of Laboratory Exercises:

Assignments & tutorials covering the relational database design and operations in SQL and PL/SQL

List of Project Based Learning Topics:

1. Make a project to maintain employee data using files and dynamic object/structure. The project should be able to read, write, modify, add and search records. Also demonstrate the effect of performing change in employer data definition after few records have been added.
2. Make an extended ER diagram for insurance management system. Transform this into relation design and implement these relations with appropriate domain and integrity constraints.
3. Employ various data control restrictions on databases, relations and attributes of relations.
4. Create a phonebook which enables user to save contacts with additional information and provides various retrieval mechanisms. Provisions should be made to view data in multiple ways.
5. Design and develop a library management system. The relations in the system should be normalized up to BCNF
7. Design and develop a inventory management system and create multiple views on the relations so that users not authorised to edit the relations should be able to views the data.
8. Implement of audit trails and backup on relations.
9. Create a student result calculation system. However when updating final results after calculation should be only of students who paid complete fees, such that transaction of each row is executed separately. Hint- use explicit cursor
10. Develop a student data management system using hash files.
11. Installation of a NoSQL database and implementing a simple student database to compare with SQL database.

Textbooks:

1. Database System Concepts. Abraham Silberschatz, Henry F. Korth and S. Sudarshan.

Reference Books:

1. Principles of Database and Knowledge – Base Systems, Vol 1 by J. D. Ullman.
2. Fundamentals of Database Systems. R. Elmasri and S. Navathe.
3. Foundations of Databases. Serge Abiteboul, Richard Hull, VictorVianu.

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT – III
Unit Test -2	UNIT – IV, UNIT – V, UNIT – VI

INTRODUCTION TO INNOVATION, IP MANAGEMENT & ENTREPRENEURSHIP

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED	
Lectures : 2 Hrs./Week	Semester Examination	:60 marks	Theory	:2 Credits
	Internal Assessment	:40 marks		
	Total	:100 Marks	Total	:2 Credits

Course Pre-Requisites:

Good knowledge of Fundamentals of Management.

Course Objective:

The major emphasis of the course will be on creating a learning system through which management students can enhance their innovation and creative thinking skills, acquaint themselves with the special challenges of starting new ventures and use IPR as an effective tool to protect their innovations and intangible assets from exploitation.

Course Outcomes:

1. Learn to be familiar with creative and innovative thinking styles.
2. Learn opportunity reorganization and entrepreneurship skills.
3. Learn to investigate, understand and internalize the process of founding a startup.
4. Understand financial aspects of Entrepreneurship.
5. Learn to manage various types of IPR to protect competitive advantage.
6. Understand the types of IP.

UNIT – I **4 Hours**

Innovation: What and Why?
Innovation as a core business process, Sources of innovation, Knowledge push vs. need pull innovations.
Class Discussion- Is innovation manageable or just a random gambling activity?

UNIT – II **4 Hours**

Building an Innovative Organization
Creating new products and services, exploiting open innovation and collaboration, use of innovation for starting a new venture
Class Discussion- Innovation: Co-operating across networks vs. ‘go-it-alone’ approach.

UNIT – III **4 Hours**

Entrepreneurship:
Opportunity recognition and entry strategies, Entrepreneurship as a Style of Management, Maintaining Competitive Advantage- Use of IPR to protect Innovation.

UNIT – IV **4 Hours**

Entrepreneurship- Financial Planning: Financial Projections and Valuation. Stages of financing, Debt, Venture Capital, and other forms of Financing

UNIT – V **4 Hours**

Intellectual Property Rights (IPR): Introduction and the economics behind development of IPR: Business Perspective, IPR in India – Genesis and Development, International Context, Concept of IP Management, Use in marketing.

UNIT – VI **4 Hours**

Types of Intellectual Property: Patent- Procedure, Licensing and Assignment, Infringement and Penalty, Trademark- Use in marketing, example of trademarks- Domain name, Geographical Indications- What is GI, Why protect them? Copyright- What is copyright, Industrial Designs- What is design? How to protect?
Class Discussion- Major Court battles regarding violation of patents between corporate companies.

List of Assignments:

1. Case study materials book will be given to students. Students are required to meet in groups before coming to class and prepare on the case for the day. Instructor may ask the student groups to present their analysis and findings to the class.
2. Further, the topic for class discussion will be mentioned beforehand and students should be ready to discuss these topics (in groups) in class. Students are required to meet in groups before coming to class and prepare on the topic. Few topics are mentioned below as examples. Instructor can add or change any topic as per requirement.
3. Topic 1- Is innovation manageable or just a random gambling activity?
4. Topic 2- Innovation: Co-operating across networks vs. 'go-it-alone' approach.
5. Topic 3- Major Court battles regarding violation of patents between corporate companies.

List of Project Based Learning Topics:

Design case studies for based on any of the following technologies.

1. Artificial intelligence
2. Machine Learning
3. Cloud Computing
4. IOT
5. HCI
6. Brain Computer Interface
7. Web Designing
8. Blockchain

Textbooks:

1. Joe Tidd, John Bessant. Managing Innovation: Integrating Technological, Market and Organizational Change
2. Case Study Materials: To be distributed for class discussion

Syllabus for Unit Test:	**Unit**
Unit Test -1	UNIT – I, UNIT – II, UNIT – III
Unit Test -2	UNIT – IV, UNIT – V, UNIT – VI

DESIGN THINKING

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED	
Lectures :3 Hrs./Week	**Semester Examination**	**:60 marks**	**Theory**	**:3 Credits**
Lab :2 Hrs./Week	**Internal Assessment**	**:40 marks**	**Practical/Oral**	**:1 Credit**
	Term Work	**:25 Marks**		
	Total	**:125 Marks**	**Total**	**:4 Credits**

Course Pre-Requisites:
Students should be well versed Completion of all units from Semesters 1, 2, 3 and 4

Course Objective:

1. Recognize the importance of DT
2. Explain the phases in the DT process
3. List the steps required to complete each phase in DT process
4. Apply each phase in the DT process
5. Use doodling and storytelling in presenting ideas and prototypes
6. Create value proposition statements as part of their presentations
7. Recognize how DT can help in functional work
8. Recognize how Agile and DT complement each other to deliver customersatisfaction

Course Outcomes:

After successful completion of this course students will be able to:

1. Understand and Implement the Phases in the DT process
2. Analyze the steps required to conduct an immersion activity
3. Evaluate the personas to create problem statements in the define phase of DT
4. Apply the steps in the ideate phase of DT
5. Implement a prototype to create a value proposition statement
6. Develop and Test a prototype through a DT process

UNIT – I **6 Hours**

Introduction: Recognize the importance of Design Thinking why is Design Thinkingimportant for business? Why is Design Thinking important for you? , Identify the steps in the DT process What is DT? Empathize (search for rich stories and find some love), Define (user need and insights – their POV), Ideate (ideas, ideas, ideas), Prototype (build to learn), Test (show, don't tell)

UNIT – II **6 Hours**

Empathy Phase: Recognize the steps in the empathize phase of DT, What is empathy? Ask What? How? Why?, Different types to developing Empathy towards People Identify the steps required to conduct an immersion activity, How to empathize?, Intro to Immersion Activity, Conduct an immersion activity and fill up the DT question template, Immersion activity

UNIT – III **6 Hours**

Define Phase: Creating personas: Recognize the steps to create personas in the definephase of DT, What is a persona and how do I create one? Four Different Perspectives on Personas 1)Goal-directed Personas 2)Role-Based Personas 3) Engaging Personas 4) Fictional Personas, 10 steps to Creating Your Engaging Personas and Scenarios Recognize the steps to create problem statements in the define phase of DT, Problem statements, Defining problem statements, Define the problem statements in the define phase of DT

UNIT – IV **6 Hours**

Ideate Phase: How to Ideate?, Recognize the steps in the ideate phase of DT, Apply the steps in the ideate phase of DT, Ideation games: Game 1: Six Thinking Hats, Game 2: Million-dollar idea, Ideate to find solutions, Characteristics Required for Successful Ideation, Recognize how doodling can help to express ideas, Recognize the importance storytelling in presenting ideas and prototypes, What is Storytelling in DT?

UNIT – V **6 Hours**

Prototype Phase: Recognize the importance of the prototype phase in DT, Prototype your idea, Create a prototype: Types of Prototyping 1)Low-Fidelity Prototyping 2) High-Fidelity Prototyping , Guidelines for Prototyping, Recognize the importance of service value proposition, Create a value proposition statement

UNIT – VI **6 Hours**

Testing Phase: Testing in Design Thinking, Test the Prototype, Role of DT in your work, discuss How DT can help me to become a better coder?, Agile and DT complement each other to deliver customer satisfaction, Share your Satori.

Text Books:

Design Thinking by Mr.Sambhrant Srivastava, Mr.Vijay Kumar, Dr.Pramod Kumar Srivastava.

Reference Books:

Hooked by Nir Eyal. The Art of Creative Thinking by Rod JudkinsStart-Up nation by Dan Senor and Saul singerStart with Why by Simon Sinek

List of Laboratory Exercises:

1. Foundations of DT, Course outline, Group roles
2. Intro and Problem Definition of project (phase 1 – Hear)
3. Idea Generation of project (phase 2 - Create)
4. Concept Development and Design project (phase 3 - Create)
5. Project Teams meet to discuss and continue to prepare their work
6. Testing and Project Documentation on project (phase 4 - Deliver)
7. Final group project presentation

List of Project-Based Learning:

1. Case study on Airbnb
2. Case study on Pill pack
3. Case study on Clean Team
4. Case study on IBM
5. Case study on Stanford hospital
6. Case study on Uber eats
7. Case study on Bank of America

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

OPERATION RESEARCH

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Lectures :3 Hrs./Week	**Semester Examination :60 marks**	**Theory :3 Credits**
Lab :2 Hrs./Week	**Internal Assessment :40 marks**	**Practical :1 Credit**
	Term Work :25 Marks	
	Total :125 Marks	**Total :4 Credits**

Course Pre-Requisites:

Good knowledge of mathematics.

Course Objective:

The students will be able to understand various models in operations research used in industries to solve problems.

Course Outcomes:

As a part of this course, students will:

1. Understand OR problem and associated models.
2. Understand Linear Algebra.
3. Use transportation and assignment problems.
4. Use PERT for modeling.
5. Use Inventory Control System.
6. Apply queuing theory and modulation techniques.

UNIT – I **6 Hours**

Introduction to OR:
Origin of OR and its definition. Concept of optimizing performance measure, Types of OR problems, Deterministic vs. Stochastic optimization, Phases of OR problem approach – problem formulation, building mathematical model, deriving solutions, validating model, controlling and implementing solution.

UNIT – II **6 Hours**

Linear Programming:
Linear programming – Examples from industrial cases, formulation & definitions, Matrix form. Implicit assumptions of LPP. Some basic concepts and results of linear algebra – Vectors, Matrices, Linear Independence/Dependence of vectors, Rank, Basis, System of linear eqns., Hyperplane, Convex set, Convex polyhedron, Extreme points, Basic feasible solutions.
Geometric method: 2-variable case, Special cases – infeasibility, unboundedness, redundancy &degeneracy, Sensitivity analysis.
Simplex Algorithm – slack, surplus & artificial variables, computational details, big-M method, identification and resolution of special cases through simplex iterations.
Duality – formulation, results, fundamental theorem of duality, dual-simplex and primal-dual algorithms.

UNIT – III **6 Hours**

Transportation and Assignment Problems:
TP - Examples, Definitions – decision variables, supply & demand constraints, formulation, Balanced & unbalanced situations, Solution methods – NWCR, minimum cost and VAM, test for optimality (MODI method), degeneracy and its resolution.
AP - Examples, Definitions – decision variables, constraints, formulation, Balanced &unbalanced situations, Solution method – Hungarian, test for optimality (MODI method), degeneracy & its resolution.

UNIT – IV **6 Hours**

PERT – CPM:
Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off.

UNIT – V **6 Hours**

Inventory Control:
Functions of inventory and its disadvantages, ABC analysis, Concept of inventory costs, Basics of inventory policy (order, lead time, types), Fixed order-quantity models – EOQ, POQ & Quantity discount models. EOQ models for discrete units, sensitivity analysis and Robustness, Special cases of EOQ models for safety stock with known/unknown stock out situations, models under prescribed policy, Probabilistic situations.

UNIT – VI **6 Hours**

Queuing Theory:
Definitions – queue (waiting line), waiting costs, characteristics (arrival, queue, service discipline) of queuing system, queue types (channel vs. phase). Kendall's notation, Little's law, steady state behavior, Poisson's Process & queue, Models with examples - M/M/1 and its performance measures; M/M/m and its performance measures; brief description about some special models.
Simulation Methodology:
Definition and steps of simulation, random number, random number generator, Discrete Event System Simulation – clock, event list, Application in Scheduling, Queuing systems and Inventory systems.

List of Assignments:

Respective subject teacher shall design any six assignments on above units.

List of Laboratory Exercises:

1. Formulation of linear programming problems.
2. Solution of linear programming problem using graphical method with:
    i. Multiple constraints
    ii. Unbounded solution
    iii. Infeasible solution
    iv. Alternative or multiple solution
3. Enumeration of all basic solutions for linear programming problem.
4. Solution of linear programming problem with simplex method.
5. Problem solving using Big M method.
6. Problem solving using two phase method.
7. Solution on primal problem as well as dual problem.
8. Solution based on dual simplex method.
9. Verification of weak duality, strong duality and complementary slackness property.
10. Solution of transportation problem.
11. Solution of assignment problem.
12. Solution of integer programming problem using Branch and Bound method.
13. Solution of integer programming problem using Gomory's cutting plane method.
14. Simulation: Random number generation.
15. Monte Carlo method.
16. Performance measures for M/M/1 queuing model.
17. ABC analysis.
18. Inventory model.

List of Project Based Learning Topics:

1. Students must work on one of the projects listed below (but not limited to) during the semester
2. Find the companies that used OR as a tool to sort a problem successfully and unsuccessfully. Compare them and analyze as to why certain strategies worked and others failed.
3. Visit any industry and choose one of their products. Develop a LPP for maximizing profits on the sale of that product considering the various constraints on it. Solve the LPP and make suggestions of the same for the company.
4. Develop a software that helps in making timetable for the department by making and solving an LPP.
5. Visit a small departmental store/hotel, collect data, and make an LPP for optimum use of space. Solve the LPP and make relevant suggestions
6. Write a research paper on how LPP helps companies to solve problems referencing latest papers.
7. Write a research paper on how assignment tools help companies to solve problems referencing latest papers.
8. Write a research paper on how transportation tools help companies to solve problems referencing latest papers.
9. Visit a small-scale industry. Collect data and make WBS and a network diagram. Solve it by CPS and PERT methods ad make relevant suggestions
10. Write a research paper on how network analysis tools help companies to solve problems referencing latest papers.
11. Write a research paper on how queuing models help companies to solve problems referencing latest papers.
12. Go to a nearby petrol pump, bank, departmental store, hotel. Record the arrival and service rates for multiple day. Analyze the data and make relevant suggestions
13. Write a research paper on how inventory models help companies to solve problems referencing latest papers.
14. Go to a nearby petrol pump, departmental store, hotel. Record inventory levels and inventory practices for multiple day. Analyze the data and make relevant suggestions.

Textbooks:

1. Operations Research: An Introduction. H.A. Taha.

Reference Books:

1. Linear Programming. K.G. Murthy.
2. Linear Programming. G. Hadley.
3. Principles of OR with Application to Managerial Decisions. H.M. Wagner.
4. Introduction to Operations Research. F.S. Hiller and G.J. Lieberman.
5. Elements of Queuing Theory. Thomas L. Saaty.
6. Operations Research and Management Science, Handbook: Edited By A. Ravi Ravindran.
7. Management Guide to PERT/CPM. Wiest& Levy.
8. Modern Inventory Management. J.W. Prichard and R.H. Eagle.

Syllabus for Unit Test:	**Unit**
Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

SKILL LAB – IV (SOFTWARE DESIGN WITH UML)

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED
Lectures :0 Hrs./Week	**Term work**	**: 25 Marks**	**Theory :0 Credits**
Lab :2 Hrs./Week	**Practical**	**: 25 Mark**	**Practical :1 Credit**
Tutorial: 1 Hrs./Week			**Tutorial :1 Credit**
	Total	**:50 Marks**	**Total :2 Credits**

Course Pre-Requisites:

The students should have sound knowledge software engineering and programming experience using data structures.

Course Objective:

To model software solutions, application structures, system behaviour and business processes using UML.

Course Outcomes:

1. Apply Unified Modelling Language (UML) for representation of an object-oriented system using different modelling views.
2. Analyse requirements to represent logical design that is recognized by various object relationships.
3. Identify interaction among structural elements to translate analysis model into design model.
4. Model dependencies among packages and package able element ownership.
5. Model dynamic behavior of the system and message flow from one object to other.
6. Envision the topology of the physical components of a system where the software components are utilized.

UNIT – I **4 Hours**

Introduction to on Object Oriented Technologies and the UML Method: Software development process: The Waterfall Model vs. The Spiral Model; The Software Crisis, description of the real world using the Objects Model; Classes, inheritance and multiple configurations; Quality software characteristics; Description of the Object-Oriented Analysis process vs. the Structure Analysis Model. UML Language: Standards; Elements of the language; General description of various models; The process of Object-Oriented software development; Description of Design Patterns; Technological Description of Distributed Systems.

UNIT – II **4 Hours**

Requirements Analysis Using Case Modeling AND The Logical View Design: Analysis of system requirements; Actor definitions; Writing a case goal; Use Case Diagrams; Use Case Relationships. **The Static** Structure Diagrams: The Class Diagram Model; Attributes descriptions; Operations descriptions; Connections descriptions in the Static Model; Association, Generalization, Aggregation, Dependency, Interfacing, Multiplicity.

UNIT – III **4 Hours**

Transfer from Analysis to Design in the Characterization Stage: Interaction Diagrams: Description of goal; Defining UML Method, Operation, Object Interface, Class; Sequence Diagram; Finding objects from Flow of Events; Describing the process of finding objects using a Sequence Diagram; Describing the process of finding objects using a Collaboration Diagram.

UNIT – IV **4 Hours**

Package Diagram Model: Description of the model; White box, black box; Connections between packagers; Interfaces; Create Package Diagram; Drill Down.

UNIT – V **4 Hours**

Dynamic Model: State Diagram / Activity Diagram: Description of the State Diagram; Events Handling; Description of the Activity Diagram; Exercise in State Machines.

UNIT – VI **4 Hours**

Component Diagram Model: Physical Aspect; Logical Aspect; Connections and Dependencies; User face; Initial DB design in a UML environment. Deployment Model: Processors; Connections; Components; Tasks; Threads; Signals and Events.

List of Assignments:

Teaching faculty will take assignment on following topic for internal assessment.

1. Study of UML notations
2. Class diagram
3. Interaction diagrams
4. Activity diagram
5. State diagram
6. Software project covering various software development methodology techniques will be implemented.

List of Laboratory Exercises:

1. For Object Oriented Modelling, choose a hypothetical system of significant complexity (on your project topic) and write an SRS.
2. Draw one or more Use Case diagrams for capturing and representing requirements of the system. Use case diagrams must include various scenarios as per template.
3. Draw basic class diagrams to identify and describe key concepts like classes, types in your system and their relationships.
4. Draw sequence diagrams with advanced notation for your system to show objects and their message exchanges.
5. Draw activity diagrams to display either business flows or activity flow.
6. Draw component diagrams assuming that you will build your system reusing existing components along with a few new ones.
7. Draw deployment diagrams to model the runtime architecture of your system.
8. Implement Singleton Pattern, Abstract Factory Pattern and Singleton Pattern using Java.

List of Project Based Learning Topics:

1. Implementation level UML class diagram to illustrate usage of Android Camera API
   Deployment diagram for Android application deployment.
2. Online shopping UML diagrams
3. Ticket vending machine UML diagrams
4. Bank ATM UML diagrams.
5. Hospital management UML diagrams
6. Airport check-in and security screening Use case modelling and Requirement analysis
7. e-Library online public access UML
8. Coffee vending machine UML diagrams.
9. Online order Processing UML diagrams.

Textbooks:

1. Object-Oriented Software Engineering: using UML, Patterns, and Java. Bernd Bruegge and Allen H. Dutoit.
2. The Unified Modelling Language User Guide. Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Education.

Reference Books:

1. Design Patterns: Elements of Reusable Object-Oriented Software. Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlassises.

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT – III
Unit Test -2	UNIT – IV, UNIT – V, UNIT – VI

DESIGN AND ANALYSIS OF ALGORITHMS

TEACHING SCHEME		EXAMINATION SCHEME		CREDITS ALLOTTED	
Lectures	**:3 Hrs./Week**	**Semester Examination**	**:60 marks**	**Theory**	**:3 Credits**
Lab	**:2 Hrs./Week**	**Internal Assessment**	**:40 marks**	**Practical/Oral**	**:1 Credit**
		Term Work	**:25 Marks**	**Total**	**:4 Credits**
		Practical	**:25 Marks**		

Course Pre Requisites: Students should be well versed with algorithms and operations on basic data structures stacks, queues, linked lists, trees, graphs. Students should have knowledge of searching sorting algorithms.

Course Objective: Understand and compare important algorithmic design paradigms and methods of analysis. To choose and extend efficient algorithms required for designs.

Course Outcomes:

After successful completion of this course students will be able to:

1. Interpret the performance of algorithms using analysis techniques.
2. Examine the fundamental algorithmic strategies.
3. Compare the fundamental algorithmic strategies.
4. Implement Graphs and trees algorithms.
5. Interpret the tractable or intractable problem.
6. Summarize the advance types of algorithms.

UNIT – I **6 Hours**

Introduction: Characteristics of Algorithm. Analysis of Algorithm: Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behaviour, Performance Measurements of Algorithm, Time and Space Trade-Offs, Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem.

UNIT – II **6 Hours**

Fundamental Algorithmic Strategies: Brute-Force technique, Heuristics, Greedy algorithms, Illustrations of these techniques for Problem-Solving

UNIT – III **6 Hours**

Fundamental Algorithmic Strategies: Dynamic Programming, Branch and Bound algorithms, Backtracking methodologies; Illustrations of these techniques for Problem-Solving.

UNIT – IV **6 Hours**

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.

UNIT – V **6 Hours**

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

UNIT – VI **6 Hours**

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE, Introduction to Quantum Algorithms.

Text Books:

1. Fundamental of Computer Algorithms, E. Horowitz and S. Sahni, Orient Black Swan
2. Introduction to Algorithms, T. H. Cormen, C. E. Leiserson and R. L. Rivest, PHI Learning Pvt. Ltd. (Originally MIT Press)

Reference Books:

1. The Design and Analysis of Computer Algorithms, A. Aho, J. Hopcroft and J. Ullman, Pearson Education India
2. Computer Algorithms: Introduction to Design and Analysis, S. Baase, Pearson Education India
3. The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3, .D. E. Knuth, Addison Wesley
    1. ElitzHorowith and SartajSahani, S. Rajasekaran, "Fundamentals of Computer Algorithms", Galgotia Publications.

List of Laboratory Exercises:

1. Calculate the space complexity of various algorithms.
2. Implement Knapsack Algorithm.
3. Implement Prim's Algorithm
4. Implement Kruskal's Algorithms
5. Study and analysis of 8-Queens Problem.
6. Implement Optimal Binary Search Tree.

Project Based Learning

1. Design a Sudoku using Recursion
2. Design a Phonebook
3. Simulate 15 Puzzle Problem
4. Design Tic Tac Toe
5. Travelling Salesman Problem
6. Design a board for simulating N-Queen Problem
7. Implement Multistage Graphs
8. Prime Number Generator
9. Random Number Generator
10. Devise and algorithm for large sparse matrix multiplication

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

COMPUTER NETWORK

TEACHING SCHEME		EXAMINATION SCHEME		CREDITS ALLOTTED	
Lectures	**:3 Hrs./Week**	**Semester Examination**	**:60 marks**	**Theory**	**:3 Credits**
Lab	**:2 Hrs./Week**	**Internal Assessment**	**:40 marks**	**Practical/Oral**	**:1 Credit**
		Term Work	**:25 Marks**	**Total**	**:4 Credits**
		Oral	**:25 Marks**		

Course Pre requisites: The prerequisite for this class is successful completion of Object Oriented Design, Data Structures, Data Communications.

Course Objective:

1. Become familiar with layered communication architectures (OSI and TCP/IP).
2. Understand the client/server model and key application layer protocols.
3. Learn sockets programming and how to implement client/server programs.
4. Understand the concepts of reliable data transfer and how TCP implements these concepts.
5. Know the principles of congestion control and trade-offs in fairness and efficiency.
6. Learn the principles of routing and the semantics and syntax of IP.

Course Outcomes

1. Have a good understanding of the OSI Reference
2. Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies;
3. Specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols;
4. Have an understanding of the issues surrounding Mobile and Wireless Networks.
5. Have a working knowledge of datagram and internet socket programming
6. Have a basic knowledge of the use of cryptography and network security

UNIT – I **6 Hours**

Introduction: Computer networks and distributed systems, Classifications of computer networks, Preliminaries of layered network structures. **Data communication Components:** Representation of data and its flow, Various Connection Topology, Protocols and Standards, OSImodel, Transmission Media. **LAN:** Wired LAN, Wireless LAN, Virtual LAN

UNIT – II **6 Hours**

Data Link Layer and Medium Access Sub Layer: Fundamentals of Error Detection and Error Correction, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go- back–N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols - Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA\

UNIT – III **6 Hours**
Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP,BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

UNIT – IV **6 Hours**
Application Layer: DNS, DDNS, TELNET, EMAIL, FTP, WWW, HTTP, SNMP, Bluetooth, Firewalls.

UNIT – V **6 Hours**
Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division andWave division, Concepts on spread spectrum.

UNIT – VI **6 Hours**
Network Security: Electronic mail, directory services and network management, Basic conceptsof Cryptography.

Text Books:

1. *Computer Networks*, A. Tannenbaum.
2. *Data and Computer Communication*, William Stallings

Reference Books:

1 Network Security, Kaufman, R. Perlman and M. Speciner.
2 UNIX Network Programming, Vol. 1,2 & 3, W. Richard Stevens

List of Laboratory Exercises

1. Setup a wired LAN using Switch, Router and then IP switch of minimum four computers, configuration machine using IP addresses, testing using PING utility using Network Simulation tool Cisco Packet Tracer.
2. Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes and CRC.
3. Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in peer to peer mode.
4. Write a program to demonstrate subnetting and find the subnet masks
5. Configure RIP/OSPF/BGP using packet Tracer
6. Write a program for DNS lookup. Given an IP address input, it should return URL and vice-versa
7. Write a program using TCP socket for wired network.

8. Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines
9. Use network simulator NS2 to implement: Monitoring traffic for the given topology
10. Study of Installation and configuration of DHCP server

List of Project Based Learning

1. IP based patient monitoring system:
2. Secondary Authorization Server.
3. Security issues with Mobile IP.
4. Chat Application.
5. Network monitoring System.
6. Intruder Detection System.
7. Computing shortest path between nodes.
8. Dynamic search algorithm for intelligent message routing.
9. Controlling Network usage.
10. Enterprise network using cisco packet tracer

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

BUSINESS STRATEGY

TEACHING SCHEME		EXAMINATION SCHEME		CREDITS ALLOTTED	
Lectures :	2 Hrs./Week	Semester Examination	:60 marks	Theory	:2 Credits
Lab	:0 Hrs./Week	Internal Assessment	:40 marks	Practical/Oral	:0 Credit
		Term Work	:00 Marks	Total	:2 Credits

Course Pre Requisites: Introductory awareness of Business terminologies and functions

Course Objective: Familiarize the fundamental principles and practices of business development

Course Outcomes:
This course will help students,

1. To summarize the important concepts of strategic management
2. To identify the process and capabilities for internal environment of a firm.
3. To understand the strategies applicable for external environments of firm
4. To examine corporate strategies
5. To compare the various business growth strategies
6. To understand the process of strategy implementation

UNIT – I **4 Hours**

Introduction to Strategic Management: Importance of Strategic Management**,** Vision and Objectives**,** Schools of thought in Strategic Management**,** Strategy Content, Process, and Practice**,** Fit Concept and Configuration Perspective in Strategic Management

UNIT – II **4 Hours**

Internal Environment of Firm- Recognizing a Firm's Intellectual Assets: Core Competence as the Root of Competitive Advantage**,** Sources of Sustained Competitive Advantage**,** Business Processes and Capabilities-based Approach to Strategy

UNIT – III **4 Hours**

External Environments of Firm- Competitive Strategy: Five Forces of Industry Attractiveness that Shape Strategy**,** The concept of Strategic Groups, and Industry Life Cycle**,** Generic Strategies**,** Generic Strategies and the Value Chain

UNIT – IV **4 Hours**

Corporate Strategy: The Motive for Diversification**,** Related and Unrelated Diversification**,** Business Portfolio Analysis

UNIT – V **4 Hours**

Growth Strategies: Expansion, Integration and Diversification**,** Strategic Alliances, Joint Ventures, and Mergers & Acquisitions

UNIT – VI **4 Hours**

Strategy Implementation: Structure and Systems: The 7S Framework**,** Strategic Control and Corporate Governance

Project Based Learning:

1. Choose an organization and do analysis of Vision Mission and Objectives
2. Case study of an organization through the lens of ten school of thoughts
3. Select an organization and do analysis of it from the perspective of fit concepts and configuration.
4. Study a research paper related to core competencies and build your opinion related to taking advantage of core competencies
5. Analyse the process of Business Processes and Capabilities-based Approach to Strategy
6. Case study on Porter's Five forces
7. Do generic study of different strategies and prepare a research paper on them
8. Do a case study on motives of diversifications
9. Choose an organization and prepare a business portfolio
10. Make an analysis of different expansion strategy and prepare a research paper on it.

Text Books:

1. Robert M. Grant (2012). Contemporary Strategic Management, Blackwell, 7th Edition.

Reference Books:

1. M.E. Porter, Competitive Strategy, 1980. M.E. Porter,
2. Competitive Advantage, 1985 Richard Rumelt (2011).
3. Good Strategy Bad Strategy: The Difference and Why It Matters.

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

ARTIFICIAL INTELLIGENCE

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED	
Lectures :3 Hrs./Week	Semester Examination	:60 marks	Theory	:3 Credits
Lab :2 Hrs./Week	Internal Assessment	:40 marks	Practical/Oral	:1 Credit
	Term Work	:25 Marks	Total	:4 Credits
	Oral	:25 Marks		

Course Pre-Requisites: Discrete mathematics, Data structures,

Course Objective:

To provide the insight to the students the about basic knowledge representation, problem solving, and learning methods of artificial intelligence.

Course Outcomes:

After completion of the course the students will able to,

1. Describe the concept of Artificial Intelligence, Intelligent agents and Learning agents
2. Identify issues in problem solving and apply the appropriate search methods.
3. Use the appropriate search method and identify the constraints
4. Describe and select the different knowledge representation methods
5. Identify the components of planning for a particular System
6. Use appropriate domain knowledge and develop an Expert system

UNIT – I **6 Hours**

Introduction, Overview of Artificial intelligence: Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.

UNIT – II **6 Hours**

Problem Solving, Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.

Search techniques: Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies Greedy best-first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search

UNIT – III **6 Hours**

Constraint satisfaction problems: Local search for constraints Satisfaction problems. Adversarial search, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.

UNIT – IV **6 Hours**

Knowledge & reasoning: Knowledge representation issues, representation & mapping, approaches to knowledge representation. Using predicate logic, representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.

UNIT – V **6 Hours**

Probabilistic reasoning: Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques.

UNIT – VI **6 Hours**

Expert Systems: Representing and using domain knowledge, expert system shells, and knowledge acquisition.

Home Assignments:

Assignments should include problems related to the topics covered in lectures, like heuristics, optimal search, and graph heuristics. Constraint satisfaction problems, k-nearest neighbors, decision trees, etc. can be included in home assignments.

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach
2. Artificial Intelligence, Russel, Pearson

Reference Books:

1. Artificial Intelligence, Ritch & Knight, TMH
2. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
3. Logic & Prolog Programming, Saroj Kaushik, New Age International
4. Expert Systems, Giarranto, VIKAS

List of Laboratory Exercises

1. Implement Water jug problem.
2. Implement Tic-Tac-Toe game for 3×3 grid.
3. Implement concept of Breadth First Search Technique
4. Implement concept of Depth First Search Technique
5. Implement Best first search for given Problem
6. Implementation of A* algorithm (Always gives optimal solution) for solving Puzzle
7. problems
8. To solve Travelling Salesman Problem (TSP) using Hill climbing Algorithm
9. To implement graph colouring algorithm using Constraint Satisfaction problem. OR
10. Implementation of Constraint Satisfaction Problem for solving Crypt-arithmetic Problem
11. Implementation of MinMax Search Procedure with alpha beta pruning for finding the solutions of games.
12. To design a simple expert system using decision trees.

Project Based Learning

1. Expert system
2. Game development
3. NLP
4. Solving problem with AI
5. Voice-based Virtual Assistant for Windows
6. Heart Disease Prediction Project
7. Stock Price Prediction
8. Predict Housing Price
9. Facial Emotion Recognition and Detection
10. Banking Bot

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

PEC-I

IMAGE PROCESSING

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		Marks		Credits
Lecture:	03	End Semester Examination :	60 Marks	Lecture	03
Tutorial:	Hours/Week 01	Internal Assessment:	40 Marks		01
	Hour/Week	Term work:	25 Marks		
		Total		Total	04

Course Objective:

To introduce fundamental concepts of image processing, covering image representation, enhancement, restoration, segmentation, compression, and feature extraction, along with practical applications in computer vision and AI.

Prerequisite:

Basic knowledge of linear algebra, probability and statistics, and signal processing.
Familiarity with programming (Python, MATLAB, or OpenCV).

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. Understand traditional and AI-driven approaches to Image Processing
2. Apply spatial and frequency domain techniques for image enhancement.
3. Analyze image degradations and implement restoration and denoising techniques.
4. Perform image segmentation and morphological processing for feature extraction.
5. Implement image compression and key feature extraction methods.
6. Develop AI and computer vision applications in face recognition, OCR, and medical imaging.

Unit I: Fundamentals of Digital Image Processing and Recent Trends **06 Hours**

Introduction to Image Processing, Digital Image Representation, Image Formation and Acquisition, Sampling and Quantization: Nyquist Theorem, Aliasing, Interpolation Techniques, Image Histogram and Statistical Properties: Probability Density Function, Cumulative Density Function, Histogram Equalization and Specification, Recent Trends: Hyperspectral & Multispectral Imaging for remote sensing & agriculture, HDR (High Dynamic Range) Imaging for enhanced visualization, Computational Photography

Unit II: Image Enhancement Techniques **06 Hours**

Spatial Domain Techniques: Point Processing: Log Transform, Power-Law Transform, Contrast Stretching, Histogram Equalization, Image Smoothing: Averaging, Gaussian, Median Filters, Image Sharpening: Laplacian, High-Boost Filtering, Frequency Domain Techniques: Fourier Transform and Frequency Spectrum, Low-pass and High-pass Filtering, Homomorphic Filtering for Dynamic Range Compression Adaptive Image Enhancement: Adaptive Histogram Equalization (AHE), Contrast Limited Adaptive Histogram Equalization (CLAHE), Deep Learning for Image Enhancement, Neural Style Transfer for artistic transformations, AI-based Image Upscaling

Unit III: Image Restoration and Noise Removal **06 Hours**

Types of Image Degradations: Motion Blur, Defocus Blur, Noise Models: Gaussian, Salt & Pepper, Speckle Noise, Restoration Techniques: Inverse Filtering, Wiener Filtering, Blind Deconvolution, Denoising Techniques: Spatial Filtering: Mean, Median, Adaptive Filters, Frequency Filtering: Notch Filters for Periodic Noise Removal, Non-Local Means and Total Variation Denoising, Image Interpolation & Reconstruction: Super-Resolution using Deep Learning, Image Inpainting, Deep Learning-Based Denoising Neural Radiance Fields (NeRF) for Image Reconstruction, Self-Supervised Learning for Denoising.

Unit IV: Image Segmentation & Morphological Processing **06 Hours**

Edge Detection, First Order Derivative Operators: Sobel, Prewitt, Roberts, Second Order Derivative Operators: Laplacian, LoG, Canny Edge Detector, Thresholding Techniques: Global & Adaptive Thresholding, Otsu's Method, Region-Based Segmentation: Region Growing, Region Splitting and Merging, Watershed Algorithm, Morphological Image Processing: Basic Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss Transform, Applications: Noise Removal, Skeletonization, Boundary Extraction, Deep Learning for Segmentation, Self-Supervised Learning for Object Detection, Superpixel-Based Segmentation.

Unit V: Image Compression & Feature Extraction and Emerging AI Techniques **06 Hours**

Lossless Compression: Huffman Coding, Run-Length Encoding, LZW, Lossy Compression: JPEG, Wavelet Transform, Fractal Compression, Feature Extraction Techniques, Shape Features, Texture Features, Color Features, Keypoint Detection and Feature Matching: SIFT, SURF, ORB, Object Detection Basics: Haar Cascades, HOG + SVM Classifier, Introduction to Deep Learning-based Object Detection (YOLO, Faster R-CNN), Deep Learning-Based Image Compression, Vision Transformers (ViTs) for Feature Learning, Self-Supervised Learning for Feature Extraction

Unit VI: Applications of Image Processing in AI & Computer Vision **06 Hours**

Face Recognition & Biometric Applications: Eigenfaces, Fisherfaces, Deep Learning-based Face Recognition (FaceNet, OpenFace), Tesseract OCR, Handwritten Character Recognition using CNN, Medical Image Processing, Autonomous Vehicles & Satellite Imaging, Neural Radiance Fields for 3D Scene Reconstruction, Deep Learning for Image Processing, Quantum Image Processing

Textbooks:

1. Rafael C. Gonzalez, Richard E. Woods. *Digital Image Processing*, 4th Edition, Pearson, 2018
2. Richard Szeliski, Computer Vision: Algorithms and Application, 2nd Edition, Springer, 2022
3. Mohmed Elgendy, deep Learning for Vision System, Manning Publications,2020

Reference Books:

1. William K. Pratt – *Digital Image Processing: PIKS Scientific Inside*, 4th Edition, Wiley, 2007 Bernd Jähne – Digital Image Processing, 6th Edition, Springer, 2005
2. Milan Sonka, Vaclav Hlavac, Roger Boyle – Image Processing, Analysis, and Machine Vision, Cengage Learning, 2014.
3. Richard Hartley and Andrew Zisserman, Multiple view Geometry in Computer Vision, 2nd Edition Cambridge University Press, 2004
4. Christoper M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

List of Practical Assignments:

1. Implement a contrast enhancement algorithm by applying histogram equalization to a grayscale image. Then, perform spatial domain filtering using a Gaussian filter to smooth the image and reduce noise. Display the original, enhanced, and filtered images.
2. Impelemt HDR imaging using explosure fusion technique.
3. Use Super Resolution GANs to upscale low-resolution images.
4. Implemnt Neural Style Transfer to transform an image's style using deep learning
5. Image Denosing using Traditional &AI based methods.
6. AI- Based Image Segmentation
   - Training U-Net or DeepLabV3+Model for medical image segmentation
   - Implement Mask R-CNN for Object Detection and instance segmentation.
7. Implement an OCR system using Tesseract OCR on a scanned document image. Extract text from the image and evaluate the accuracy of the text extraction compared to the original document.
8. Implement a face detection system using Haar Cascade Classifiers or a Convolutional Neural Network (CNN) model. Detect faces in real-time from a live webcam feed or pre-captured image.
9. Implement vision Transformer (ViTs) for feature Extraction.
10. Implement NeRF- based AI for reconstructiong 3D scencde from 2D Images.

Project Based Learning:

1. Image Super-Resolution
2. Satelllite Image Processing and change Detection
3. Automated Medical Imaging Diagnosis
4. Object Detection and Tracking in Videos
5. Image-to-Text (Optical Character Recognition - OCR) System
6. Augmented Reality (AR) for Object Recognition
7. Traffic Sign Recognition for Autonomous Vehicles
8. Image-Based Age and Gender Prediction
9. Colorization of Black and White Images
10. Real-Time Image Filtering and Enhancement for Mobile Apps

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PEC-I

DATA MINING AND ANALYTICS

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED	
Lectures :3 Hrs./Week	Semester Examination	:60 marks	Theory	:3 Credits
Lab :2 Hrs./Week	Internal Assessment	:40 marks	Practical/Oral	:1 Credit
	Term Work	:25 Marks	Total	:4 Credits
	Oral	:25 Marks		

Course Pre Requisites: Student should possess a strong mathematical background in Probability and Statistics. Also should have programming proficiency with algorithmic approach.

Course Objective: is to make statistical foundation, followed by various machine learning and data mining algorithms. This course will also give coverage to practical systems and software used in data analytics.

Course Outcomes:

1. Understand basic concepts and techniques of Data Mining
2. Evaluate different models used for OLAP and data preprocessing.
3. Classify and differentiate between situations for applying data-mining techniques such as frequent pattern mining, association, correlation, classification, prediction, cluster, and outlier analysis.
4. Apply knowledge for understanding data and select suitable linear, nonlinear data modeland time series analysis model.
5. Develop skills of using data mining software for solving practical problems.
6. Understand and apply several statistical analysis techniques: regression, ANOVA, data reduction

UNIT – I **6 Hours**

Introduction to Data Mining: What is data mining? Related technologies - Machine Learning, DBMS, OLAP, Statistics, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Applications

UNIT – II **6 Hours**

Data pre-processing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies, Installing Weka 3 Data Mining System, Experiments with Weka - filters, discretization **Data mining knowledge representation:** Task relevant data, Background knowledge, Representing input data and output knowledge, Visualization techniques
Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures

UNIT – III **6 Hours**

Data mining algorithms - Association rules: Motivation and terminology, Example: mining weather data, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis
Data mining algorithms - Classification: Basic learning/mining tasks, Inferring rudimentary rules: 1R, algorithm, Decision trees, covering rules
Data mining algorithms – Prediction: The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), linear models

.

UNIT – IV **6 Hours**

Descriptive analytics: Data Modeling, Trend Analysis, Simple Linear Regression Analysis
Forecasting models: Heuristic methods, predictive modeling and pattern discovery, Logistic Regression: Logit transform, ML estimation, Tests of hypotheses, Wald test, LR test, score test, test for overall regression, multiple logistic regression, forward, backward method, interpretation of parameters, relation with categorical data analysis. Interpreting Regression Models, Implementing Predictive Models

UNIT – V **6 Hours**

Generalized Linear model: link functions such as Poisson, binomial, inverse binomial, inverse Gaussian, Gamma.
Non Linear Regression (NLS): Linearization transforms, their uses & limitations, examination of non- linearity, initial estimates, iterative procedures for NLS, grid search, Newton-Raphson, steepest descent, Marquardt's methods. Introduction to semiparametric regression models, additive regression models. Introduction to nonparametric regression methods

UNIT – VI **6 Hours**

Time Series Analysis: Auto - Covariance, Auto-correlation and their properties. Exploratory time series analysis, Test for trend and seasonality, Exponential and moving average smoothing, Holt – Winter smoothing, forecasting based on smoothing
Linear time series models: Autoregressive, Moving Average, Autoregressive Moving Average and Autoregressive Integrated Moving Average models; Estimation of ARMA models such as Yule-Walker estimation for AR Processes, Maximum likelihood and least squares estimation for ARMA Processes, Forecasting using ARIMA models

Prescriptive Analytics: Mathematical optimization, Networks modeling-Multi-objective optimization-Stochastic modelling, Decision and Risk analysis, Decision trees.

Text Books:

1. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 3rd ed, 2010.
2. Lior Rokach and Oded Maimon, "Data Mining and Knowledge Discovery Handbook", Springer, 2nd edition, 2010
3. Box, G.E.P and Jenkins G.M. (1970) Time Series Analysis, Forecasting and Control, Holden-Day.

Reference Books:

1. Draper, N. R. and Smith, H. (1998). Applied Regression Analysis (John Wiley) Third Edition.

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

PEC-I
COMPILER DESIGN

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Lectures :3 Hrs./Week	Semester Examination :60 marks	Theory :3 Credits
Lab :2 Hrs./Week	Internal Assessment :40 marks	Practical/Oral :1 Credit
	Term Work :25 Marks	Total :4 Credits
	Oral :25 Marks	

Course Pre-Requisites:

1. The students should have learnt Theory of Computation.
2. Basic of the structure of any Programming Language and Grammars.
3. Know the basics of Computer organization and Assembly Language Programming.

Course Objective:

1. To study the Compiler Design Tools.
2. To understand the Compiler for various Programming Languages.

Course Outcomes:

1. Understands compiler and various phases in compilation.
2. Understand Parser and its various techniques.
3. Understands Syntax Directed Translation, Symbol Tables and their applications.
4. Learn the techniques of Code Optimization.
5. Learn the techniques of Code improvement.
6. Understands compilation of Object-Oriented features.

UNIT – I **6 Hours**

Introduction: Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, relating regular expressions and finite automata, scanner generator (lex, flex).

UNIT – II **6 Hours**

Syntax Analysis (Top-down Parser): Context-free languages and grammars, push-down automata, Elimination of Left recursion, Elimination of Left factoring, Top down parsing, FIRST and FOLLOW, Non-Recursive Predictive Parsing, LL (1) grammars.

UNIT – III **6 Hours**

Syntax Analysis (Bottom Up Parser): Operator grammars, Bottom-up parsing, Shift Reduce Parser, LR(O), SLR (1), LR(1), CLR,LALR(1) grammars, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison)

UNIT – IV **6 Hours**

Semantic Analysis: Attribute grammars, syntax directed definition, evaluation, and flow of attribute in a syntax tree.

Symbol Table: Basic structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory allocation, scope.

UNIT – V **6 Hours**

Intermediate Code Generation: Translation of different language features, different types of intermediate forms

Code Improvement (optimization): Control-flow, data-flow dependence etc.; local optimization, global optimization, loop optimization, peep-hole optimization etc.

UNIT – VI **6 Hours**

Architecture dependent code improvement: Instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation.

Advanced topics: Type systems, data abstraction, compilation of Object-Oriented features and non-imperative programming languages.

Textbooks:

1. Compilers: Principles, Techniques and Tools, V. Aho, R. Sethi and J. Ullman.
2. Lex & Yacc, Levine R. John, Tony Mason and Doug Brown

Reference Books:

The Design and Evolution of C++, Bjarne Stroustrup.

List of Laboratory Exercises:

Subject teacher would give suitable list of experiments.

Topics for Project Based Learning

1. Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states

that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C language.

2. Design an application to recognize strings under 'a*', 'a*b+', 'abb'.
3. Develop an application to test whether a given identifier is valid or not.
4. Develop an application to simulate lexical analyzer for validating operators.
5. Implement the lexical analyzer using JLex, flex or other lexical analyzer generating tools.
6. Translation of different language features
7. Implement operator precedence parsing.

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

Skill Based Course V (Programming in Java)

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED	
Theory :-	**Term Work**	**:25 Marks**	**Practical/Oral :2 Credit**	
Practical :4 Hrs./Week	**Practical**	**:25 Marks**	**Total**	**:2 Credit**
	Total	**:50 Marks**		

Course Objective:

- To introduce fundamentals of object-oriented concepts and programming.
- To apply the concepts of object-oriented paradigm.
- To design graphical user interfaces (GUIs) using Java for desktop applications.
- To enable students to connect Java applications to relational databases.
- To understand network programming concepts and implement client-server communication

Prerequisite: Paradigms of Object-Oriented Programming.

Course Outcomes: On completion of the course, students will have the ability to:

1. Understand the basics of object-oriented programming with Java.
2. Implement exception handling and demonstrate multithreading concepts for concurrent programming.
3. Design graphical user interfaces (GUIs) using Java AWT and Swing components.
4. Develop Java applications to access and manipulate databases using Java Database Connectivity (JDBC).
5. Apply server-side technologies such as Servlets and JSP to build dynamic web applications.
6. Build client-server communication programs using Java networking classes for distributed systems.

Unit I : **06 Hours**

Introduction to Java Programming: Overview of Java and Java Virtual Machine (JVM),Basics of Java Language-Data Types, Variables, and Operators, Control Statements (Loops, Decision-making)

Object-Oriented Programming in Java : Classes, Objects, and Methods, Constructors and Overloading, Inheritance (Single, Multilevel, Hierarchical), Polymorphism and Method Overriding, Abstract Classes and Interfaces, Packages and Access Modifiers

Unit II : **06 Hours**

Exception Handling and Multithreaded programming: Exception Handling: try and catch block, catch block, Nested try, finally block, throw keyword, Exception Propagation, throws keyword. Introduction to threads, methods in Threads and Runnable, setting priority of threads, synchronization and inter thread communication.

Unit III : **06 Hours**

GUI Programming with AWT and Swing : Introduction to Abstract Window Toolkit (AWT), Event Handling and Listeners, Swing Components (JButton, JLabel, JTextField, JTable, JComboBox, etc.), Layout Managers (BorderLayout, FlowLayout, GridLayout), Dialogs and Menus

Unit IV **06 Hours**

Database Programming using JDBC : JDBC Introduction, JDBC Architecture, Types of JDBC Drivers, The Connectivity Model, The java.sql package, Navigating the ResultSet object's contents, Manipulating records of a ResultSet object through User Interface , The JDBC Exception classes, Database Connectivity, Data Manipulation (using Prepared Statements, Joins, Transactions, Stored Procedures), Data navigation.

Unit V **06 Hours**

Servlets: Introduction, Web Application Architecture, Http Protocol & Http Methods, Web Server & Web Container, Servlet Interface, Genericservlet, Httpservlet, Servlet Life Cycle, Servletconfig, Servletcontext, Servlet

Communication Session Tracking Mechanisms
JSP: Introduction, JSP Lifecycle, JSP Implicit Objects & Scopes, JSP Directives, JSP Scripting Elements, JSP Actions: Standard Actions And Customized Actions.

Unit VI **06 Hours**

Networking With JAVA: Overview Of Networking, Working With URL, Connecting To A Server, Implementing Servers, Serving Multiple Clients, Sending E-Mail, Java Networking APIs (java.net package),Socket Programming, Internet Addresses, URL Connections. Overview Of Understanding The Sockets Direct Protocol.

RMI : Overview of Distributed Computing and RMI, RMI Architecture (Stub, Skeleton, and RMI Registry), Developing RMI-based Applications: Creating Remote Interface, Implementing Remote Class, Registering and Invoking Remote Methods

Textbooks

1. E. Balaguruswamy, "Object Oriented Programming Using C++ and Java", Tata McGrawHill
2. Advanced Java Programming, Uttam K. Roy, Oxford University Press.
3. JDBC, Servlets, And JSP, New Edition, Santhosh Kumar K , Kogent Learning Solutions Inc, Dreamtech Press

Reference Books :

1. Java The complete reference, Herbert Schildt, McGraw Hill Education (India) Pvt. Ltd. 9th edition, 2014, ISBN: 978-0-07-180856-9 (E-book).
2. Object-Oriented Design Using Java, Dale Skrien, McGraw-Hill Publishing, 2008, ISBN - 0077423097, 9780077423094.
3. Cay S. Horstmann, Gary Cornell, Core Java™ 2: Volume II–Advanced Features
   Prentice Hall PTR,9th Edition
4. Herbert Schildt, Java2: The Complete Reference, Tata Mcgraw-Hill,5th Edition
   Joe Wigglesworth And Paula Mcmillan, Java Programming: Advanced Topics,

List of Laboratory Exercises:

1. Write a program that describes a class person. It should have instance variables to record name, age and salary. Create a person object. Set and display its instance variables.
2. Write a program that counts the number of objects created by using static variable.
3. Write a program to demonstrate the constructor overloading.
4. Write a program to implement Class and Inheritance Concept.
5. Write an application that creates an interface' and implement it.
6. Write a program to implement the concept of Multithreaded Programming.
7. Write A Program to Demonstrate the Use of AWT Components.
8. Write A Program Using Swing to Display a Scrollpane And Jcombobox In An Japplet With The Items- English, Marathi, Hindi, Sanskrit.
9. Write A Database Application That Uses Any JDBC Driver
10. Write A Simple JSP Program for User Login Form with Static & Dynamic Database
11. Write A Program to Implement Chat Server Using Server Socket and Socket Class.
12. Develop a servlet that reads data from an HTML form and displays it on the response page.
13. Create a multicast chat application where multiple clients can receive messages from a single sender.
14. Develop an RMI-based calculator application that performs basic arithmetic operations (addition, subtraction, multiplication, division).

B. TECH (Computer Science & Business Systems)
SEMESTER – VI
COURSE SYLLABUS

CLOUD, MICROSERVICES AND APPLICATION

TEACHING SCHEME		EXAMINATION SCHEME		CREDITS ALLOTTED	
Lectures	**:3 Hrs./Week**	**Semester Examination**	**:60 marks**	**Theory**	**:3 Credits**
Lab	**:2 Hrs./Week**	**Internal Assessment**	**:40 marks**	**Practical/Oral**	**:1 Credit**
		Term Work	**:25 Marks**	**Total**	**:4 Credits**
		Oral	**:25 Marks**		

Course Objective: The course intends to introduce students to the fundamentals of developing application on Cloud, specifically public clouds such as AWS, AZURE and Google.

Students would be able to
1. esign applications for Cloud
2. Develop applications using various services
3. Deploy applications on Cloud by using cloud native services

Prerequisite:
Good knowledge of Basics of Programming concepts(OOP) covered through a course prior to this semester

Course Outcomes: On completion of the course, students will have the ability to:
1. Understand the fundamental concepts of cloud
2. Learn the principles of cloud computing
3. Apply the concepts of cloud computing
4. Learn the concepts of microservices
5. Implement the application of API and microservices
6. Analyse different cloud security and monitoring tools

Unit I **6 Hours**

Cloud Fundamentals: Cloud Service Components, Cloud service/Deployment Models. Application of Cloud Computing, Cloud components Guiding Principle with respect to utilization/Security/Pricing, Public Cloud Platforms overview and their usage.

Unit II **6 Hours**

Principles of Cloud Computing: Cloud Computing Fundamentals, Cloud Computing terminologies and comparison of service Types, Cloud Computing terminologies and comparison of service Types, Cloud Security Challenges and Solutions, zscaler cloud Security

Unit III **6 Hours**

Public cloud platform overview and usage: Tools and Applications, Azure Virtual Machines, Azure App Service, Azure Kubernetes Service, Azure SQL, Google Compute Engine, Google Kubernetes Engine, AWS Virtual Machines

Unit IV **6 Hours**

Fundamentals of Microservices: Characteristics of Microservice Architecture, Cloud Native design Patterns, Architecting .Net applications for Azure, Cloud Native Applications- Fundamental, Insights, Cloud Native Landscape, Spring Boot Features. Spring Cloud and Advantages

Unit V **6 Hours**

API Fundamentals and Application of API and Microservice

API lifecycle, Spring Boot Rest API example using Swagger2, Postman, Introduction to Swagger (OpenAPI) complete tools, Cloud Native DevOps With Kubernetes, Introduction to Docker

Unit VI **6 Hours**

Cloud Security and Monitoring Tool: Application Security Fundamentals, Azure Security, AWS Security , Google Cloud Infrastructure security

Textbooks

1. Cloud Computing Architecture (IBM ICE)
2. Cloud Native Microservices with Spring and Kubernetes
3. George Reese Cloud Application Architectures, First Edition, O‟Reilly Media 2009

Reference Books

1. Cloud computing for Dummies (November 2009) Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper
2. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi from TMH 2013.
3. Cloud Computing 2 nd Edition by Dr. Kumar Saurabh from Wiley India 2012
4. Cloud Computing and SOA Convergence in Your Enterprise A Step-by-Step Guide by David S. Linthicum from Pearson 2010.

List of Laboratory Exercises

The subject teacher will decide the list of practical.

Project Based Learning:

1. Cloud-enabled Attendance System
2. Online Blood Bank System
3. Online, cloud-enabled book store system
4. Data Redundancy Removal System
5. Detecting Data Leaks using SQL injection
6. Cloud based Bus Pass System
7. Making a Chatbot
8. Secure Text Transfer using Cloud Computing

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

FINANCE AND COST ACCOUNTING

TEACHING SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:
Lectures: 3 Hrs/Week	**Semester Examination: 60 marks**	**Theory: 3 Credits**
Tutorials: NIL	**Continuous Assessment: 40 marks**	**Term Work and Practical credit: -- NIL**
Lab: NIL	**Term Work and Practical: -- NIL**	

Course Pre Requisites: familiarity with common concepts and terminologies in economics and accounts.

Course Objective:

1. To impart knowledge about different ways of accounting process
2. Understanding and interpreting financial statements.

Course Outcomes:

After successful completion of this course students will be able to

1. Understand the important concepts of accounting and their importance in management
2. Interpret the accounting process
3. Analyze financial statements
4. Review the cash flow and fund flow techniques
5. Interpret the costing systems
6. Infer the accounts and reports

UNIT – I [6 Hours]

Accounting Concept: Introduction, Techniques and Conventions, Financial Statements- Understanding & Interpreting Financial Statements

UNIT – II [6 Hours]

Accounting Process:

- Book Keeping and Record Maintenance
- Fundamental Principles and Double Entry
- Journal, Ledger, Trial Balance, Balance Sheet, Final Accounts
- Cash Book and Subsidiary Books

- Rectification of Errors

UNIT – III [6 Hours]

Financial Statements: Form and Contents of Financial Statements, Analyzing and Interpreting Financial Statements, Accounting Standards.

Class Discussion: Corporate Accounting Fraud- A Case Study of Satyam

.UNIT – IV [6 Hours]

Cash Flow and Fund Flow Techniques: Introduction, How to prepare, Difference between them

UNIT – V [6 Hours]

Costing Systems:

- Elements of Cost
- Cost Behavior, Cost Allocation, OH Allocation
- Unit Costing, Process Costing, Job Costing
- Absorption Costing, Marginal Costing, Cost Volume Profit Analysis
- Budgets
- ABC Analysis

Class Discussion: Application of costing concepts in the Service Sector

UNIT – VI [6 Hours]

Company Accounts and Annual Reports:

- Audit Reports and Statutory Requirements
- Directors Report
- Notes to Accounts
- Pitfalls

Home Assignments: Case study materials book will be given to students. Students are required to meet in groups before coming to class and prepare on the case for the day. Instructor may ask the student groups to present their analysis and findings to the class.

Further, the topic for class discussion will be mentioned beforehand and students should be prepared to discuss these topics in class. Few topics are mentioned below as examples. Instructor can add or change any topic as per requirement.

1. Topic: Corporate Accounting Fraud: A Case Study of Satyam
2. Topic: Application of costing concepts in the Service Sector

Text Books:

1. Robert N Anthony, David Hawkins, Kenneth Marchant, *Accounting: Texts and Cases*, McGraw- Hill
2. Case Study Materials: To be distributed for class discussion

Reference Books:

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

MACHINE LEARNING

TEACHING SCHEME	EXAMINATION SCHEME		CREDITS ALLOTTED	
Lectures :3 Hrs./Week	Semester Examination	:60 marks	Theory	:3 Credits
Lab :2 Hrs./Week	Internal Assessment	:40 marks	Practical/Oral	:1 Credit
	Term Work	:25 Marks	Total	:4 Credits
	Oral	:25 Marks		

Course Pre-Requisites: Basic concepts of statistics, Knowledge of fundamentals of AI.

Course Objective:

1. To simulate decision making and thinking in machine.
2. To understand standard Machine Learning practices.
3. To apply algorithms for precise result.

Course Outcomes: Students will be able to

1. Learn relationship between human and machine.
2. Implement basic classification algorithms
3. Implement enhanced classification algorithms
4. Implement HMM in detail
5. Apply concepts of regression for various application
6. Apply expectation maximization techniques for optimization.

UNIT – I **6 Hours**

Introduction to Machine Learning (ML): Relationship between ML and human learning; A quicksurvey of major models of how machines learn; Example applications of ML

UNIT – II **6 Hours**

Classification: Supervised Learning; The problem of classification; Feature engineering; Training and testing classifier models; Cross-validation; Model evaluation (precision, recall, F1- measure, accuracy, area under curve); Statistical decision theory including discriminant functions and decision surfaces.

UNIT – III **6 Hours**

Naive Bayes classification; Bayesian networks; Decision Tree and Random Forests; k-Nearest neighbor classification; Support Vector Machines; Artificial neural networks including backpropagation; Applications of classifications; Ensembles of classifiers including bagging and boosting.

UNIT – IV **6 Hours**

Hidden Markov Models (HMM) with forward-backward and Vierbi algorithms; Sequence classification using HMM; Conditional random fields; Applications of sequence classification such as part-of-speech tagging.

UNIT – V **6 Hours**

Regression: Multi-variable regression; Model evaluation; Least squares regression; Regularization; LASSO; Applications of regression Association rule mining algorithms including apriori.

UNIT – VI **6 Hours**

Expectation-Maximization (EM) algorithm for unsupervised learning Clustering: average linkage; Ward's algorithm; Minimum spanning tree clustering; K-nearest neighbors clustering; BIRCH; CURE; DBSCAN Anomaly and outlier detection methods.

Text Books:

1. [1] R.O. Duda, P.E. Hart, D.G. Stork, **Pattern Classification**, 2/e, Wiley, 2001.

Reference Books:

1. C. Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
2. E. Alpaydin, Introduction to Machine Learning, 3/e, Prentice-Hall, 2014.
3. A. Rostamizadeh, A. Talwalkar, M. Mohri, Foundations of Machine Learning, MIT Press.
4. A. Webb, Statistical Pattern Recognition, 3/e, Wiley, 2011.

List of Laboratory Exercises:

1. Predict the price of the Uber ride from a given pickup point to the agreed drop-off location. Perform tasks such as: Pre-process the dataset, identify outliers, check the correlation, implement linear regression and random forest regression models, evaluate the models and compare their respective scores like R2, RMSE, etc. Dataset link: https://www.kaggle.com/datasets/yasserh/uber-fares-dataset

2. Classify the email using the binary classification method. Email Spam detection has two states: a) Normal State – Not Spam, b) Abnormal State – Spam. Use K-Nearest Neighbors and Support Vector Machine for classification. Analyze their performance. Dataset link: The emails.csv dataset on the Kaggle https://www.kaggle.com/datasets/balaka18/email-spam-classification-dataset-csv

3. Given a bank customer, build a neural network-based classifier that can determine whether they will leave or not in the next 6 months. Dataset Description: The case study is from an open-source dataset from Kaggle. The dataset contains 10,000 sample points with 14 distinct features such as CustomerId, CreditScore, Geography, Gender, Age, Tenure, Balance, etc. Link to the Kaggle project: https://www.kaggle.com/barelydedicated/bank-customer- churn-modeling Perform following steps: Read the dataset, Distinguish the feature and target set and divide the data set into training and test sets. Normalize the train and test data. Initialize and build the model. Identify the points of improvement and implement the same. Print the accuracy score and confusion matrix (5 points).

4. Implement Gradient Descent Algorithm to find the local minima of a function. For example, find the local minima of the function $y=(x+3)^2$ starting from the point x=2.

5. Implement K-Nearest Neighbors algorithm on diabetes.csv dataset. Compute confusion matrix, accuracy, error rate, precision and recall on the given dataset. Dataset link : https://www.kaggle.com/datasets/abdallamahgoub/diabetes

6. Implement K-Means clustering/ hierarchical clustering on sales_data_sample.csv dataset. Determine the number of clusters using the elbow method. Dataset link : https://www.kaggle.com/datasets/kyanyoga/sample-sales-data

List of Project Based Learning

1. Zillow Home Value Prediction ML Project ...
2. BigMart Sales Prediction ML Project – Learn about Unsupervised Machine Learning Algorithms
3. Music Recommendation System ML Project
4. Iris Flowers Classification ML Project
5. Stock Prices Predictor using TimeSeries

6. Predicting Wine Quality using Wine Quality Dataset
7. MNIST Handwritten Digit Classification
8. Build a Movie Recommender System Movielens Dataset

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI

NATURAL LANGUAGE PROCESSING

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		Marks		Credits
Lecture:	03 Hours/Week	University Examination:	60 Marks		
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Lecture	03
		Term Work	25 Marks	Practical	01
		Oral	25 Marks		
		Total	150 Marks	Total	04

Course Objective:

1. To understand the concepts of morphology, syntax, semantics and pragmatics of the language
2. To give an introduction of knowledge acquisition, information retrieval and machine translation.
3. To relate mathematical foundations, Probability theory with Linguistic essentials such as syntactic and semantic analysis of text.

Prerequisite:

Students should have knowledge of:
1) Probabilities and statistics.
2) Algorithms and programming experience.

Course Outcomes: On completion of the course, students will have the ability to:

1. Understand the models, methods, and algorithms of statistical Natural Language Processing (NLP)
2. Understand the basic NLP techniques, including syntactic parsing, semantic interpretation, lexical and morphological analysis.
3. Apply machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars.
4. Choose appropriate solutions for solving typical NLP sub problems (tokenizing, tagging, parsing)
5. Understand basics of knowledge representation.
6. Understand resources of natural language data – corpora.

Unit I **06 Hours**

Introduction of NLP: Knowledge in Speech and Language processing, Various stages of NLP-ambiguity, and models and algorithm, language and understanding, brief history, Why NLP Is Difficult Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure. Statistics Essential Information Theory: Entropy, perplexity, The relation to language, Cross Entropy NLP-Language and Grammar-Processing: Origins and challenges, Language models: Uni-gram, N-gram –Statistical Language Model, NLP Applications.

Unit II **06 Hours**

Natural Language and Formal Language: Text Pre-processing, Regular Expressions, patterns, FA, Formal Language, NFSA, Regular Language and FSAs, Raw Text Extraction and Tokenization, Extracting Terms from Tokens, Vector Space Representation and Normalization, Similarity Computation in Text, lexicon. Phrases and idioms, word order, agreement, tense, aspect and mood and agreement, Context Free Grammar, spoken language syntax.

Unit III **06 Hours**

Part-of-Speech Tagging, Speech recognition and Hidden Markov Models: Speech Recognition Architecture The concept of parts-of-speech, Tagging, Tagsets, and Morphology, The Penn Treebank and Brown Corpus. Probabilistic (weighted) finite state

automata. Overview of Hidden Markov models (HMMs). The Viterbi Algorithms Revisited, Advanced Methods for Decoding, Acoustic Processing of Speech, Computing Acoustic Probabilities, Training a Speech Recognizer, Waveform Generation for Speech Synthesis, Human Speech Recognition

Unit IV **06 Hours**

Grammars & Parsing Algorithms: Context-free Grammars, Context-Free Rules and Trees, Sentence-Level Constructions, The Noun Phrase, Coordination, Agreement and The Verb Phrase and Subcategorization, Auxiliaries, Spoken Language Syntax, Parsing Regular Grammars, Parsing Context Free Grammars, Example Toy NL Grammar, Shift-Reduce Parsers, Probabilistic Parsing: Introduction, Grammars & Human Processing

Unit V **06 Hours**

Matrix Factorization and Topic Modeling: Vector space model, Matrix factorization, Singular Value Decomposition, Nonnegative Matrix Factorization, Probabilistic Latent Semantic Analysis, Latent Dirichlet Allocation, Word2Vec and Doc2Vec, Word-character and sentence embedding, Topic modelling term weighting, homonymy, polysemy, synonymy, Improving user queries. Machine Translation– Overview, Applications of NLP- Spell-checking, Summarization.

Unit VI **06 Hours**

Linguistics resources: Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. Resource management with XML, Management of linguistic data with the help of GATE, The Semantic Web technologies, ontologies, OWL, NLTK.

Textbooks

1. Allen, J. “Natural Language Understanding”, The Benjamin/Cummings Publishing Company,Inc. 1994. ISBN 0-8053-0334-0.
2. Daniel Jurafsky and James H Martin. “Speech and Language Processing”, 2e, Pearson Education, 2009

Reference Books

1. James A, “Natural language Understanding” 2e, Pearson Education, 1994
2. Bharati A., Sangal R., Chaitanya V.”Natural language processing: a Paninian perspective”, PHI, 2000.
3. Siddiqui T., Tiwary U. S. “Natural language processing and Information retrieval”, OUP, 2008 NLTK – Natural Language Tool Kit - http://www.nltk.org/
4. Journals: Computational Linguistics, Natural Language Engineering, Machine Learning, Machine Translation, Artificial Intelligence.

List of Assignments

1. Write a note on word normalization and stemming. Explain case folding with a suitable example.
2. What is the significance of a decision tree in sentence segmentation also give the implementation of decision tree for suitable example.
3. Discuss challenges of Machine translation. What are the classical approaches of machine translation?
4. Case study on IBM translation model.
5. Case study on WordVET and VerbNet
6. Study of Hidden Markov Model and POS tagging
7. Study assignment on Python—Analysing Text with the Natural Language.
8. Research paper reading, analysing and demonstrating.
9. Research paper reading, analysing and demonstrating.
10. Describe different techniques for removal of ambiguity.

List of Laboratory Exercises

1. Implement bottom-up parser for any given grammar.
2. Analysis of natural language using lexical analysis.
3. Case study of any parsing algorithm.
4. Study of clustering algorithm in NLP.
5. Case study: NLP in web mining or text mining
6. Case study of Viterbi Algorithm.
7. Study of Python features used in NLP
8. Study assignment of information retrieval techniques
9. Installation of NTLK Toolkit.
10. Implement program in Python to calculate frequency distribution.

Project Based Learning

1. Question Answering
2. Text Classification
3. Text Summarization
4. Sentiment Analysis
5. Sentence Similarity
6. Speech Recognition
7. Neural Machine Translation
8. Document Summarization
9. Conversational Bots: ChatBots
10. Grammar Autocorrector
11. Summary Writer
12. Image-Caption Generator

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PEC-II

INTRODUCTION TO IoT

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		Marks		Credits
Lecture:	02 Hours/Week	End Semester Examination :	60 Marks	Lecture	02
Practicals	02 Hour/Week	Internal Assessment:	40 Marks		01
		Term work:	25 Marks		
		Total	125 Marks	Total	03

Course Objective:

1. To understand fundamentals of Internet of Things (IoT).
2. To learn the IoT protocols, cloud platforms and security issues in IoT.
3. To understand advances in IoT.
4. To learn real world application scenarios of IoT along with its societal and economic impact using case studies and real time examples.

Prerequisite: MOM, COA.

Course Outcomes: On Completion of The Course, Students Will Have the Ability To:

1. Understand the fundamentals and need of Internet of Things
2. Apply design methodology for designing and implementing IoT applications
3. Analyze IoT protocols for making IoT devices communication
4. Illustrate cloud based IoT systems.
5. Understand & Analyze Security in IoT.
6. Outline the Concepts of IIOT.

Unit I: Introduction Internet of Things **04 Hours**

Introduction to Internet of Things (IoT): Definition, Characteristics of IoT, Vision, Trends in Adoption of IoT, IoT Devices, IoT Devices Vs Computers, Societal Benefits of IoT, Technical Building Blocks, Applications in IoT.

Unit II: IoT: Design Methodology **04 Hours**

IoT Design Methodology: Steps, Basics of IoT Networking, Networking Components, Internet Structure, Connectivity Technologies, IoT Communication Models and IoT Communication APIs, Sensor Networks, Four pillars of IoT: M2M, SCADA, WSN, RFID.

Unit III: IoT Protocols **04 Hours**

Protocol Standardization for IoT, M2M and WSN Protocols, RFID Protocol, Modbus Protocol, Zigbee Architecture. IP based Protocols: MQTT (Secure), 6LoWPAN, LoRa.

Unit IV: Cloud Platforms for IoT **04 Hours**

Introduction to Cloud Storage Models, Communication API, Python Web Application Framework: Django Architecture and application development with Django, Amazon Web Services for IoT, SkyNet IoT Messaging Platform, RESTful Web Service.

Unit V: Security in IoT **04 Hours**

Introduction, Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling. Key elements of IoT Security: Identity establishment, Access control, Data and message security, Security model for IoT, Challenges in designing IOT applications.

Unit VI: Introduction to Industrial IoT (IIoT) **04 Hours**

Evolution of Industrial IoT ,Key differences between IoT and Industrial IoT, Components of IIoT, IIoT Architecture, Benefits and Challenges of IIoT, Applications of IIoT in Various Industries.

Textbooks:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", 2nd Edition,Wiley Publication, ISBN: 978-1-119-99435-0

Reference Books:

1. Dawoud Shenouda Dawoud, Peter Dawoud, "Microcontroller and Smart Home Networks", ISBN: 9788770221566, e-ISBN: 9788770221559 Charles Crowell,
2. "IoT-Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT",ISBN-13 : 979-8613100194
3. David Hanes, Gonzalo Salgueiro, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press, ISBN-13: 978-1-58714-456-1 ISBN-10: 1-58714-456-5

List Of Experiments:

1. Case Study on IOT Smart Cities, Agriculture, Health and Lifestyle etc
2. Introduction to IoT & Arduino/Raspberry Pi(Installing Arduino IDE/Python for Raspberry Pi)
3. Writing a simple program to turn an LED on/off
4. Understanding Sending Sensor Data to Cloud (ThingSpeak, Firebase, MQTT)
5. Installation of Real Time Operating System

Project Based Learning:

1. Presentation of CaseStudies – Home Automation using IOT.
2. Presentation of CaseStudies – Smart Agriculture using IOT.
3. Presentation of CaseStudies – HealthCare Services using IOT.
4. Presentation of CaseStudies – Smart City using IOT.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PEC-II
EMBEDDED SYSTEMS

TEACHING SCHEME	EXAMINATION SCHEME	CREDITS ALLOTTED
Lectures :2 Hrs./Week	Semester Examination :60 marks	Theory :2 Credits
Lab :2 Hrs./Week	Internal Assessment :40 marks	Practical/Oral :1 Credit
	Term Work :25 Marks	Total :3 Credits
	Oral :25 Marks	

Course Prerequisites:

Students should have primary knowledge of

1 Good programming skills in C/C++. Basic knowledge of linear algebra. (for Robotics)

2. Basic knowledge of operating system
3. Basic knowledge of microprocessors and microcontrollers

Course Objectives:

During the course the students will: -

1) Learn the concepts of embedded system, its components and its application areas.
2) Learn the concepts of robotics and robot design components.

Course Outcome:

Students will be able to:

1 Acquire knowledge about microcontrollers embedded processors and their applications.
2 Understand the internal architecture and interfacing of different peripheral devices with Microcontrollers.
3 Understand the role of embedded systems in industry.
4 Understand the concepts of real time operating system.
5 Understand various applications of embedded system and various electronics parts usedin embedded system design.
6 Understand different concepts in robotics, various parts used in robotics.

UNIT-I **6 Hours**

Introduction to Embedded System Embedded system Vs General computing systems, History of Embedded systems, Purpose of Embedded systems, Microprocessor and Microcontroller, Hardware architecture of the real time systems.

UNIT-II **6 Hours**

Devices and Communication Buses: I/O types, serial and parallel communication devices, wireless communication devices, timer and counting devices, watchdog timer, real time clock, serial bus communication protocols, parallelcommunication network using ISA, PCI, PCT-X, Intrnet embedded system network protocols, USB, Bluetooth.

UNIT-III **6 Hours**

Program Modeling: Program Modeling Concepts; Fundamental issues in Hardware software co-design, Unified Modeling Language(UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system.

UNIT-IV **6 Hours**

Real Time Operating Systems: Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS. Real time scheduling: Clock Driven, Weighted Round Robin, Priority Driven Approach,RM,EDF algorithms

UNIT-V **6 Hours**

Examples of Embedded System: Mobile phones, RFID, WISENET, Robotics, BiomedicalApplications, Brain machine interface etc. Popular microcontrollers used in embedded systems, sensors, actuators, Design of microcontroller systems using ADC/DAC, LED/LCD, PWM, Keyboard, Stepper motor etc.

UNIT-VI **6 Hours**

Robotics: Introduction, Elements of robots -- joints, links, actuators,and sensors

Kinematics: Kinematics of serial robots, Kinematics of parallelrobots, Motion planning and control

Advanced Topics on Robotics: Sensing distance and direction, Line Following Algorithms, Feedback Systems, Other topics on advancerobotic techniques

List of Practical Assignments

1. Arithmetic Operations using 8051
2 Interfacing ADC and DAC
3 Interfacing LED and PWM
4 Interfacing real time clock and serial port
5 Interfacing keyboard and LCD
6 Flashing of LEDS
7 Interfacing stepper motor and temperature sensor.
8 Study of robotic arm and its configuration
9 Study the robotic end effectors

List of Assignments/Tutorials

1. Assignment on State machine programming model of Fibonacci sequence generator.
2. Assignment on actuator behavior.
3. Assignment on Real time scheduling algorithms.
4. Assignment on CAN protocol.
5. Assignment on microcontrollers used in embedded systems.
6. Assignment on Program Modeling concepts.

Project Based Learning

1. Line Follower Robot Using PID Algorithm
2. Cloud-Enhanced Robotic System for Smart City Crowd Control
3. Smartphone-based Robot Control for Localization
4. Hector Slam Mapping and Indoor Positioning ROBOT
5. Metal Detector Robotic Vehicle
6. Pick and Place Robotic Vehicle

Text Books:

1. Introduction to Embedded Systems : Shibu K. V. (TMH)

2.Embedded System Design – A unified hardware and software introduction: F. Vahid (John Wiley

3.Embedded Systems : Rajkamal (TMH)
4.Embedded Systems : L. B. Das (Pearson)
5. The 8051 Microcontroller and embedded systems by Muhammad Ali Mazidi, PHI.
6.Robotics: Fundamental Concepts and Analysis, Oxford University Press

Reference Books:

1) Embedded System design : S. Heath (Elsevier)
2) Embedded microcontroller and processor design: G. Osborn (Pearson)
3) Embedded systems design by Steve Heath, Newnes

Syllabus for Unit Test:

Unit Test -1	**Unit I , II and III**
Unit Test -2	**Unit IV, V and VI**

PEC-II

Machine Organization & Microprocessor

Teaching Scheme	Examination Scheme	Credit Scheme	Hours/Week	Marks	Credits
Theory: 02 Hours/Week	End Semester Examination	60 Marks		Theory	02
Practicals: 02 Hours/Week	Internal Assessment	40 Marks		Practicals	01
				Total	03

Course Objective:

The course would provide students with an understanding of the design of fundamental blocks used in organization of computer system and interfacing techniques of these blocks to achieve different configurations of Machine organization. Students will learn the basic operations of computing hardware and how it interfaces to software.

Prerequisite:
The students should have basic Knowledge Digital electronics and logic design.

Course Outcomes: On completion of the course, students will have the ability to:

1. Explain the architecture and functional blocks of Computer System.
2. List the functional requirements for implementing ALU.
3. Discuss design approaches implementing control unit.
4. Analyse the characteristics and hierarchy of memory system.
5. Describe Peripherals and Input-Output organization.
6. Describe the concepts of parallel processing and pipelining.

Unit I **04 Hours**

CPU:-Machine architecture and organization, Von Neumann architecture Structure of IAS machine, memory, input-output subsystems, control unit. Introduction to 80x86 microprocessor, Architecture, Register organization, Segmentation, Instruction execution cycle, Addressing modes, and Instruction set. Instruction Formats, Instruction Types.

Unit II **04 Hours**

ALU:-Computer arithmetic, Signed number representation, fixed and floating point representations, character representation. Integer addition and subtraction, signed number multiplication, Booth's multiplierit's Hardware Implementation, Restoring and Non-restoring Division techniques, floating point arithmetic, IEEE 754 format.

Unit III **04 Hours**

Control Unit :- Design approaches, Instruction cycle and micro operations, Control signals and timing sequence, design of Hardwired Control unit
Micro instructions and micro program, Organization and Optimization of micro- programmed Control unit, Microinstruction Sequencing, Sequencing Techniques, Address Generation, Microinstruction Execution, Microinstruction Encoding.

Unit IV **04 Hours**

Memory:- Characteristics of Memory system, Memory hierarchy, Cache memory, cache size and block size, mapping functions, replacement algorithms, cache coherency, Multilevel Caches, Cache Coherence, Snooping & MESI Protocols, Memory Segmentation & Interleaved Memory System.

Unit V

I/O organization: - I/O module, Peripheral devices and their characteristics, Input-output subsystems, I/O device interface, I/O transfers, interrupt driven and DMA transfer, I/O

04 Hours

device interfaces – SCSI, USB, Fire wire. **04 Hours**

Unit VI

Parallel Organization – Overview of Instruction Pipelining, Performance Improvement, Flynn's classification for Multiple Processor Organizations, Closely and Loosely Coupled Multiprocessors Systems, Symmetric Multiprocessor (SMP) Organization, Multithreading – Fine Grained, Coarse Grained & Simultaneous (SMT) Threading, Chip Multiprocessing, Cluster Configuration, UMA, NUMA & CC-NUMA. Multicore Architectures – Hardware & Software Issues in Multicore Organization.

Textbooks:

1. William Stallings. "Computer organization and architecture: designing for performance". Pearson Education India, 2010
2. Carl Hamacher, ZvonkoVranesic and SafwatZaky. "Computer Organization", McGraw Hill, 2011.
3. Computer System Architecture M. M. Mano:, 3rd ed., Prentice Hall of India, New Delhi, 1993.
4. Computer Architecture and Organization, John P. Hayes.

Reference Books:

1. Computer Organization and Design: The Hardware/Software Interface, David A. Patterson and John L. Hennessy.
2. David A. Patterson, John L. Hennessy. "Computer organization and design: the hardware/software interface". Elsevier, 2011

List of Assignments:

1. Describe the structure of IAS computer with neat block diagram.
2. Describe architecture of 8086 with neat block diagram.
3. Explain the concept of Segmentation and state its advantages and disadvantage.
4. Draw and explain working of Micro programmed Control Unit.
5. Describe structure of IAS computer with neat block diagram.
6. Describe architecture of 8086 with neat block diagram.

Project Based Learning

1. Automatic night lamp with morning alarm
2. Traffic light with sensor + 7segment
3. Multi pattern running lights.
4. .Washing machine
5. Simple Lock Using Keypad and 7 segment
6. Electronic quiz table
7. Electronic Digital Clock
8. .temperature controller
9. Plant Irrigation System
10. Car Parking Management
11. Customer counter for supermarket
12. Electronic queue management system in food stall
13. Safety box
14. Shop lot automatic door with 7segment display
15. Bank queue management system
16. Water level controller
17. Automatic home system
18. Commuter system
19. Automatic room light control
20. Elevator control system

(Note: -*Students in a group of 3 to 4 shall complete any one project from the above list)

Syllabus for Unit Tests:

Unit Test -1
Unit – I, Unit – II, Unit – III
Unit Test-2
Unit – IV, Unit – V, Unit – VI

Skill-Based Course V (Gen - AI)

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		Marks		Credits
Lecture:	00	End Semester Examination:	60 Marks	Lecture	00
Practicals:	02 Hour/Week	Internal Assessment:	40 Marks		01
		Term work:	25 Marks		
		Total	125Marks	Total	01

Course Objective:

1. Develop proficiency in Python and TensorFlow 2 for preprocessing and cleaning data in generative AI applications.
2. Implement and optimize GANs and VAEs for image generation, including training, fine-tuning, and advanced techniques.
3. Master text generation techniques using LSTM and Transformer models, with a focus on fine-tuning language models for various applications.
4. Explore music generation through different models like LSTM and Transformer, evaluating and fine-tuning compositions for diverse music applications.

Prerequisite: Prior knowledge of Calculus, Linear Algebra, Probability Theory, and Python programming, Introduction to Generative AI, AI models are essential.

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. Understand generative AI principles and word embeddings for text representation.
2. Apply Large Language Models effectively, including pre training and transfer learning.
3. Evaluate Generative AI models using appropriate metrics.
4. Implement Generative Adversarial Networks (GANs) for image generation tasks using TensorFlow.
5. Identify different types of generative AI models suitable for music generation.
6. Analyze ethical consideration for music composition using GenAI

Unit I: Python and TensorFlow 2 in Generative AI: **06 Hours**

Overview of Python and TensorFlow 2, Preprocessing and cleaning data for Generative AI applications. Visualizing data distributions and patterns in Generative AI datasets. Introduction to TensorFlow's computation graph and eager executAI
ion.

Unit II: Image Generation with Generative AI: **06 Hours**

Introduction to Image Generation, Implementing GANs for Image Generation Training and Fine-Tuning GANs , Generating Images with VAEs, Advanced Techniques in Image Generation, and Image and Video Generation Applications.

Unit III: Text Generation with Generative AI*:* **06 Hours**

Introduction to Text Generation, LSTM-based Text Generation, Transformer-based Text Generation, Fine-Tuning Language Models, and Text Generation Applications

Unit IV: Music Generation with Generative AI: **06 Hours**

Introduction to Music Generation, Music Representation, and LSTM-based Music Generation. Transformer-based Music Generation, Evaluation and Fine-Tuning, Music Composition Applications

Unit V: MuseGAN*:* **06 Hours**

Overview of MuseGAN architecture, Multi-track music generation using MuseGAN , Training MuseGAN on polyphonic music datasets, Generating complex music compositions with MuseGAN

06 Hours

Unit VI: Advanced Techniques and Applications

Transfer learning in music generation , Fine-tuning generative models for specific music genres or styles , Ethical considerations in AI-generated music, Future directions and emerging trends in AI-driven music composition.

Textbooks:

1. Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models" , Joseph Babcock and Raghav Bali , 2024
2. Generative AI for everyone: Understanding the essentials and applications of this breakthrough technology". Altaf Rehmani .
3. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
4. "Neural Networks and Deep Learning: A Textbook" by Charu C. Aggarwal

Reference Books:

1. Generative Adversarial Networks Cookbook: Over 100 recipes to build generative models using Python, TensorFlow, and Keras" by Josh Kalin.
2. "Generative AI in Software Development: Beyond the Limitations of Traditional Coding" Jesse Sprinter, 2024.

List Of Assignments:

1. Implement a Generative Adversarial Network (GAN) architecture using TensorFlow
2. Train the GAN model on a dataset such as MNIST or CIFAR-10 for image generation tasks.
3. Train a GAN model on a custom dataset for image generation. Experiment with hyperparameters, loss functions, and optimization techniques to optimize GAN training

4. Explore advanced techniques such as Wasserstein GANs, Progressive GANs, or StyleGANs for image generation. Implement and compare these techniques for generating high-quality images
5. Develop applications for image and video generation using trained Generative AI models. Use the models to generate art, create deep fakes, or synthesize video content.
6. **Text Generation: I**mplement a Long Short-Term Memory (LSTM) network using TensorFlow 2 for text generation tasks. Train the LSTM model on a dataset of text sequences and generate new text samples
7. **Text generation**: Implement a Transformer-based language model (e.g., GPT) using TensorFlow 2 for text generation. Fine-tune the model on a text corpus and generate coherent and contextually relevant text.
8. **Text generation**: Fine-tune a pre-trained language model (e.g., GPT, BERT) using transfer learning techniques. Fine-tune the model on a domain-specific dataset and evaluate its performance for text generation tasks
9. **Text generation**: Develop applications for text generation tasks such as story generation, dialogue generation, or code generation using trained Generative AI models

10. **Music Generation:** Preprocess music data and represent it in a suitable format for music generation tasks.Explore MIDI or audio representations for training Generative AI models.
11. **Music Generation:** Implement a Long Short-Term Memory (LSTM) network using TensorFlow 2 for music generation. Train the LSTM model on a dataset of music sequences and generate new musical compositions
12. **Generate Novel Music Compositions:** Transformer-based Music Generation: Implement a Transformer-based architecture (e.g., MusicBERT, MusicGPT) using TensorFlow 2 for music generation. Fine-tune the model on a music dataset and generate novel music compositions.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

B. Tech (Computer Science and Business Systems)

TRACK- I
COURSE SYLLABUS SEMESTER VII

IT PROJECT MANAGEMENT					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**3Hrs/Week**	**University Examination:**	**60**		
Practical:	**2Hrs/Week**	**Internal Assessment:**	**40**	**Lecture**	**3**
		Term Work	**25**	**Practical**	**1**
		Oral	**25**		
		Total	**150**	**Total**	**4**

Course Objective:

1. **Understand the fundamentals of IT Project Management** including project life cycle, project management processes, and knowledge areas.
2. **Apply project planning techniques** such as scope management, scheduling (Gantt charts, PERT/CPM), and cost estimation for IT projects.
3. **Analyze project risks and develop mitigation strategies** to ensure successful project execution.

Prerequisite:

Knowledge of Software Engineering Principles.

Course Outcomes: On completion of the course, students will have the ability to:

1. To understand project management principles in IT domain.
2. To apply planning, estimation, and scheduling techniques.
3. To implement Agile and hybrid methodologies.
4. To manage project risks, quality, and cyber security concerns.
5. Apply project scheduling and cost estimation techniques.
6. Use modern project management tools and techniques for project execution, monitoring, stakeholder communication, and closure.

Unit I **6 Hours**

Fundamentals of IT Project Management: Project vs Operations,Characteristics of IT Projects,Project Life Cycle Models,Process Groups (Initiation to Closing),Role & Skills of Project Manager,Overview of Knowledge Areas,AI in Project Management.

Unit II **6 Hours**

Project Initiation & Scope Management: Project Selection Methods (NPV, ROI, Payback)Business Case Development,Project Charter,Scope Planning & Scope Statement,Software Effort Estimation Models,Scope Verification & Control

Unit III **6 Hours**

Agile, DevOps & Hybrid Methodologies: Waterfall Model,Agile Manifesto,Scrum Framework (Roles, Artifacts, Events),Kanban & Lean,Hybrid (Agile + Traditional) Models,SAFe (Scaled Agile Framework)

Unit IV **6 Hours**

Risk, Quality & Security Management: Risk Identification & Risk Register,Qualitative & Quantitative Risk Analysis,Risk Mitigation Planning,Quality Planning & Assurance,Software Quality Standards (ISO, CMMI),Cybersecurity Risk in IT Projects,Compliance & Governance

Unit V **6 Hours**

Project Scheduling, Cost Estimation and Performance Control: Activity Identification & Work Breakdown Structure (WBS),Concept and Construction of Gantt Chart,Three Time Estimates (Optimistic, Most Likely, Pessimistic),Expected Time Calculation,Cost Performance Index (CPI),Schedule Performance Index (SPI),Estimate at Completion (EAC)

Unit VI	**6 Hours**
Project Execution, Monitoring & Stakeholder Management: Team Building & Leadership,Communication Management, Stakeholder Analysis,Performance Metrics (EVM – Earned Value Management),Change Management,Project Closure & Documentation	
Textbooks	
1. PMBOK Guide – Project Management Institute	
Reference Books	
1. Kathy Schwalbe – *Information Technology Project Management*	
2. Jack Meredith & Samuel Mantel – *Project Management*	
List of Assignments	
1. Differentiate between Project and Operations with examples.	
2. Describe Project Life Cycle models (Waterfall, Iterative, Agile).	
3. Prepare a sample Business Case for an IT project.	
4. Study Software Effort Estimation Models (COCOMO basics).	
5. Describe Scrum framework (Roles, Artifacts, Events).	
6. Write short note on SAFe (Scaled Agile Framework).	
7. Discuss Software Quality Standards (ISO, CMMI).	
8. Prepare a Work Breakdown Structure (WBS) for an E-commerce Website.	
9. Write steps involved in Project Closure.	
10. Case Study on Agile implementation in IT project.	
List of Laboratory Exercises	
1. Project Charter Preparation	
2. WBS Design	
3. Gantt Chart using MS Project	
4. PERT/CPM Network Diagram	
5. Risk Register Preparation	
6. Earned Value Analysis	
7. Agile Sprint Planning (Scrum Simulation)	
8. Jira / Trello Tool Implementation	
9. Case Study Analysis	
10. Mini Project – Complete IT Project Plan Documentation	
Project Based Learning	
1. Earned Value Management Analysis of a Real or Simulated IT Project	
2. Case study of Communications IT Project management	
3. Development of a Project Plan for a Cloud-Based ERP System	
4. Agile Project Management Implementation for a Mobile App Development Project	
5. Project Planning & Cost Estimation for an E-Commerce Website	
6. Risk Management Framework for a Cybersecurity Implementation Project	
7. Hybrid (Waterfall + Agile) Project Model for a Smart City IT Project	
8. IT Infrastructure Migration to Cloud – Project Execution Plan	
9. DevOps-Based Software Deployment Project Plan	
10. AI-Based Predictive Analytics for Project Risk Forecasting	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

MARKETING RESEARCH AND MARKETING STRATEGY					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**3 Hrs./Week**	**University Examination:**	**60**		
Practical:	**-**	**Internal Assessment:**	**40**	**Lecture**	**03**
Tutorial	**01 Hr/Week**	**Term Work**	**25**	**Practical**	**-**
		Oral	**-**	**Tutorial**	**01**
		Total	**125**	**Total**	**04**

Course Objective:

1. Understand core marketing principles and consumer behaviour.
2. Develop skills in marketing research methods.
3. Apply quantitative and data-driven decision-making techniques.
4. Learn strategic marketing management concepts.
5. Integrate technology with marketing practices.

Prerequisite:

Students should have basic knowledge about marketing skills.

Course Outcomes: On completion of the course, students will have the ability to:

1. Explain **t**he fundamental concepts, functions, and principles of marketing.
2. Describe and illustrate the stages of the Product Life Cycle and the process of new product
3. Explain and apply the basic principles of pricing, promotion, and distribution strategies in different market scenarios.
4. Analyse the dynamics of marketing systems and evaluate how various marketing components interact in real-world business environments.
5. Apply **m**arketing concepts and tools to design effective Internet/Digital marketing strategies.
6. Interpret and apply basic statistical tools for data analysis in marketing research and decision-making.

Unit I: Introduction to Marketing Concepts — **06 Hours**

Marketing Concepts and Applications: Introduction to Marketing & Core Concepts, Marketing of Services, Importance of marketing in service sector. Marketing Planning & Environment: Elements of Marketing Mix, Analyzing needs & trends in Environment - Macro, Economic, Political, Technical & Social. Understanding the consumer: Determinants of consumer behaviour, Factors influencing consumer behaviour. Market Segmentation: Meaning & Concept, Basis of segmentation, selection of segments, Market Segmentation strategies, Target Marketing, Product Positioning.

Unit II: Product Management — **06 Hours**

Product Life cycle concept, New Product development & strategy, Stages in New Product development, Product decision and strategies, Branding & packaging.

Unit III: Pricing, Promotion and Distribution Strategy — **06 Hours**

Policies & Practices –Pricing Methods & Price determination Policies. Marketing Communication– The promotion mix, Advertising & Publicity, 5 M's of Advertising Management. Marketing Channels, Retailing, Marketing Communication, Advertising.

Unit IV : Marketing Research and Data Analysis — **06 Hours**

Marketing Research: Introduction, Type of Market Research, Scope, Objectives & Limitations, Marketing Research Techniques, Survey Questionnaire design & drafting, Pricing Research, Media Research, Qualitative Research Data Analysis: Use of various statistical tools – Descriptive &

Inference Statistics, Statistical Hypothesis Testing, Multivariate Analysis - Discriminant Analysis, Cluster Analysis, Segmenting and Positioning, Factor Analysis.	
Unit V: Internet Marketing	**06 Hours**
Introduction to Internet Marketing. Mapping fundamental concepts of Marketing (7Ps, STP); Strategy and Planning for Internet Marketing.	
Unit VI: Business to Business Marketing	**06 Hours**
Fundamental of business markets. Organizational buying process. Business buyer needs. Market and sales potential. Product in business markets. Price in business markets. Place in business markets. Promotion in business markets. Relationship, networks and customer relationship management. Business to Business marketing strategy.	
Textbooks	
1.Marketing Management (Analysis, Planning, Implementation & Control) – Philip Kotler	
2.Fundamentals of Marketing – William J. Stanton & Others	
3.Marketing Research – Rajendra Nargundkar	
4. Marketing Management – V.S. Ramaswamy and S. Namakumari	
5. Market Research – G.C. Beri	
6. Market Research, Concepts, & Cases – Cooper Schindler	
Reference Books	
1. Marketing Management – Rajan Saxena	
2. Marketing Management – S.A. Sherlekar	
3.Service Marketing – S.M. Zha	
4.Journals – The IUP Journal of Marketing Management, Harvard Business Review	
5.Research for Marketing Decisions by Paul Green, Donald, Tull	
6. Business Statistics, A First Course, David M Levine at al, Pearson Publication	
Project Based Learning 1. Market Feasibility Study for a New Tech Product 2. Customer Segmentation Using Data Analytics 3. Digital Marketing Strategy for a Startup 4. Consumer Behavior Analysis for Online Platforms 5. Brand Positioning Analysis of Competing Tech Companies 6. Marketing Research for AI-Based Healthcare Solutions 7. Impact of Social Media Marketing on Purchase Decisions 8. Pricing Strategy Analysis for Subscription-Based Software 9. Customer Satisfaction and Loyalty Study Using Surveys 10. Market Entry Strategy for an International Tech Brand in India 11. Product Life Cycle Analysis of a Technology Product 12. Effectiveness of Online Advertising Using Web Analytics 13. Voice of Customer (VoC) Analysis Using Text Mining 14. Marketing Strategy for Sustainable or Green Technologies 15. Competitor Analysis Using Market Intelligence Tools	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PROGRAM ELECTIVE COURSE III: ADVANCED SOCIAL, TEXT AND MEDIA ANALYTICS					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hrs./Week**	**University Examination:**	**60**		
Practical	**02 Hrs./Week**	**Internal Assessment:**	**40**	**Lecture**	**3**
		Term Work	**25**	**Practical**	**1**
		Practical	**25**		
		Total	**150**	**Total**	**4**

Course Objective:

1. To introduce fundamental concepts and techniques of text mining and natural language processing.
2. To develop understanding of predictive modeling and sentiment analysis for social and media data.
3. To familiarize students with web analytics, web crawling, indexing, and ranking mechanisms.

Prerequisite: Machine Learning, Database and Data mining

Course Outcomes: On completion of the course, students will have the ability to:

1. Apply text mining techniques for pattern discovery and information extraction.
2. Apply NLP and predictive modeling techniques for sentiment and topic analysis
3. Analyze and evaluate keyword extraction methods using performance metrics
4. Apply web analytics tools and analyze web crawling, indexing, and ranking methods
5. Analyze social network structures to identify key actors and clusters
6. Analyze the evolution of web communities using dynamic network models.

Unit I **06 Hours**

Text Mining: Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction, Text mining applications.

Unit II **06 Hours**

Methods & Approaches: Content Analysis; Natural Language Processing; Clustering & Topic Detection; Simple Predictive Modeling; Sentiment Analysis; Sentiment Prediction

Unit III **06 Hours**

Text Extraction: Introduction, Rapid automatic keyword extraction: candidate keywords, keyword scores, adjoining keywords, extracted keywords, benchmark evaluation: precision and recall, efficiency, stop list, generation, Evaluation on new articles.

Unit IV **06 Hours**

Web Analytics: Web analytics tools, Clickstream analysis, A/B testing, onlinesurveys; Web search and retrieval, Search engine optimization, Web crawling and Indexing, Ranking algorithms, Web traffic models.

Unit V **06 Hours**

Social Media Analytics: Social network and web data and methods. Graphs and Matrices. Basic measures for individuals and networks. Information visualization; Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity; Social network analysis

Unit VI **06 Hours**

Extracting And Analyzing Web Social Networks: Extracting Evolution of Web Community from a Series of Web Archive, Temporal Analysis on Semantic Graphusing Three-Way Tensor, Decomposition, Analysis of Communities and Their Evolutions in Dynamic Networks.

Textbooks

1. GuandongXu,Yanchun Zhang, and Lin Li, “Web Mining and Social Networking Techniques andApplications”, Springer
2. Social Media Data Mining and Analytics by Gabor Szabo, Gungor Polatkan, P. Oscar Boykin & Antonios Chalkiopoulos

Reference Books

1. Text Mining and Analysis: Practical Methods, Examples, and Case Studies Using SAS® – Dr. Godfrey Liang, Mark Li, & Danny Zeng
2. Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics – Marshall Sponder
   Explains metrics and analytics for social platforms
3. Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer,2010.

List of Assignments

1. Explain and implement tokenization, stemming, lemmatization, and stop-word removal on a sample dataset.
2. Compare Naïve Bayes and SVM for sentiment classification.
3. Study and compare TF-IDF, RAKE, and TextRank methods.
4. Write a report on web crawling process and ranking algorithms (e.g., PageRank concept).
5. Implement Apriori algorithm on a sample transactional dataset and interpret rules.
6. Calculate degree, betweenness, and closeness centrality on a given network dataset.
7. Study clustering methods used in social networks and compare results.
8. Analyze evolution of a network over time and summarize findings.

List of Laboratory Exercises

1. Perform text preprocessing using Python (NLTK/spaCy).
2. Implement sentiment analysis on product review dataset.
3. Extract keywords from news articles and evaluate using precision & recall.
4. Perform topic modeling using LDA.
5. Simulate web crawling and indexing on sample webpages.
6. Analyze clickstream dataset and visualize traffic patterns.
7. Create and visualize social network graph using NetworkX/Gephi.
8. Compute centrality measures and identify influential nodes.
9. Perform community detection using clustering algorithms.
10. Analyze temporal network data and observe community evolution.

Project Based Learning

1. Perform sentiment analysis on Amazon / IMDb / Twitter reviews.
2. Develop a system to extract keywords from news articles.
3. Analyze website traffic dataset.
4. Visualize network graph using Gephi/NetworkX.
5. Compare Facebook, Instagram, and TikTok marketing strategies.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PROGRAM ELECTIVE COURSE III: MOBILE COMPUTING					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**3Hrs/Week**	**University Examination:**	**60**		
Practical	**2Hrs/Week**	**Internal Assessment:**	**40**	**Lecture**	**3**
		Term Work	**25**	**Practical**	**1**
		Practical	**25**		
		Total	**150**	**Total**	**4**

Course Objective:

1. To understand fundamentals of mobile computing and wireless communication.
2. To design and develop mobile applications.
3. To apply mobile networking protocols and architectures.
4. To integrate cloud, IoT and AI with mobile platforms.
5. To implement security and privacy mechanisms in mobile systems.

Prerequisite:

Knowledge of Computer Networks, Operating Systems, Object-Oriented Programming (Java/Kotlin), and Database Management Systems.

Course Outcomes: On completion of the course, students will have the ability to:

1. Explain architecture and components of mobile computing systems.
2. Analyze wireless communication technologies and mobile networks.
3. Design and develop mobile applications using modern frameworks.
4. Implement data storage, cloud integration, and APIs in mobile apps..
5. Apply mobile security, authentication, and privacy mechanisms.
6. Evaluate emerging trends such as 5G, Edge AI, and Mobile IoT.

Unit I : Introduction to Mobile Computing — **6 Hours**

Evolution of Mobile Computing, Mobile Computing Architecture, Mobile Communication Models, Mobile Hardware & Software Platforms, Comparison: Desktop vs Mobile Computing, Overview of Android & iOS architecture, Mobile OS features, Edge Computing basics

Unit II: Wireless Communication & Mobile Networks — **6 Hours**

Wireless Transmission Fundamentals, Cellular Systems (1G to 5G evolution),GSM, CDMA, LTE Architecture, Mobile IP, Mobile Ad hoc Networks (MANET),Wireless LAN (Wi-Fi), Bluetooth, NFC

Unit III: Mobile Application Development — **6 Hours**

Android Architecture, Activity Lifecycle, UI Design & Layouts, Intents and Services, Fragments, Data Storage (SQLite, Shared Preferences),RESTful API Integration, JSON Parsing.

Unit IV : Mobile Data Management & Cloud Integration — **6 Hours**

Mobile Databases, Firebase Integration, Cloud Storage & Sync, Web Services & API Integration, Location Based Services (GPS),Google Maps Integration, Edge AI on Mobile Devices

Unit V : Mobile Security & Privacy — **6 Hours**

Security Challenges in Mobile Computing, Mobile Malware, Authentication & Authorization, Secure Coding Practices, Data Encryption Techniques, Secure Communication (HTTPS, SSL/TLS),Biometric Authentication, Zero Trust Architecture

Unit VI : Advanced Topics & Emerging Trends — **6 Hours**

Mobile Commerce (M-Commerce), Mobile Payment Systems (UPI architecture overview),IoT and Mobile Integration, Augmented Reality in Mobile, Wearable Computing, AI & ML in Mobile Applications, Generative AI in Mobile Apps

Textbooks

1. Raj Kamal – Mobile Computing
2. Ashok Talukder – Mobile Computing Technology

Reference Books

1. **Jochen Schiller** – Mobile Communications

2. **William Stallings** – Wireless Communications and Networks	
List of Assignments	
1. Explain the architecture of a mobile computing system with neat diagram.	
2. Compare mobile computing and distributed computing.	
3. Explain GSM architecture with diagram.	
4. Describe MANET characteristics and challenges.	
5. Explain fragments and their advantages.	
6. Discuss advantages and limitations of cloud integration in mobile apps.	
7. Describe location-based services with architecture.	
8. Describe secure coding practices for mobile apps.	
9. Discuss security challenges in mobile computing.	
10. Discuss IoT and mobile integration architecture.	
List of Laboratory Exercises	
1. Install Android Studio and create basic UI app	
2. Activity lifecycle demonstration	
3. Intent and data passing between activities	
4. Simple Flutter cross-platform app	
5. REST API integration using Retrofit	
6. Firebase authentication	
7. Google Maps integration	
8. Location-based app development	
9. Push notifications implementation	
10. Secure login system implementation	
Project Based Learning	
1. AI-based Sales Prediction Mobile Dashboard	
2. Inventory & Supply Chain Tracking App (Cloud Integrated)	
3. Mobile CRM Application for SMEs	
4. Smart Expense & Budget Analyzer with Data Visualization	
5. Customer Feedback Sentiment Analysis Mobile App	
6. Digital Marketing Campaign Tracker App	
7. Face Recognition Attendance System (Mobile + Cloud)	
8. AI Chatbot Integration in Mobile App	
9. Plant Disease Detection using Mobile Camera	
10. Real-Time Object Detection App (TensorFlow Lite)	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PROGRAM ELECTIVE COURSE III: AUGMENTED AND VIRTUAL REALITY					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**3 Hrs./Week**	**University Examination:**	**60**		
Practical:	**2 Hrs./Week**	**Internal Assessment:**	**40**	**Lecture**	**3**
		Term Work	**25**	**Practical**	**1**
		Practical	**25**		
		Total	**150**	**Total**	**4**

Course Objective:

1. To understand fundamentals of augmented and virtual reality
2. To describe various elements and components used in AR/VR Hardware and Software
3. To understand the methods used for representing and rendering the virtual world
4. To create Augmented Reality application that allows users to interact with the immersive 3D world

Prerequisite: Computer Graphics, solid Modelling and Drafting, basic concepts of Human-Computer Interaction (HCI)

Course Outcomes: On completion of the course, students will have the ability to:

1. Understand the basics of Augmented and Virtual reality systems and list their application
2. Describe interface to the Virtual World with the help of input and output devices
3. Explain representation and rendering system in the context of Virtual Reality
4. Analyse manipulation, navigation and interaction of elements in the virtual world
5. Summarize the basic concepts and hardware of Augmented Reality system
6. Create Mobile Augmented Reality using Augmented Reality techniques and software

Unit I Introduction	**6 Hours**

Virtual Reality (VR): Definition and Scope, Key Elements of VR, Experience, History, Applications. Strong vs Weak AR, Challenges in AR, Applications of AR, the role of AI and machine learning in AR Augmented Reality (AR): Introduction, History, Key Aspects, and Applications.

Unit II Computer Graphics and Geometric Modelling	**6 Hours**

Computer graphics, Real-time computer graphics, The virtual world space, Positioning the virtual observer, Human vision, Stereo perspective projection, Colour theory, 2D to 3D conversion, 3D space curves, 3D boundary representation, Simple 3D modelling, Illumination models, Reflection models, Geometrical transformations: Introduction, Frames of reference, Modelling transformations, Rendering techniques for VR/AR (shading, textures, ray tracing).

Unit III Representing and Rendering the Virtual World	**6 Hours**

Representation of the Virtual World, Visual Rendering Systems: Methods, Types (Geometrically Based and Nongeometric based), Complex Visual Scenes. Computer Graphics System Requirements. Aural Rendering Systems: Visual Methods, Complex Sounds, Understanding GPU architecture, GPU's role in rendering and acceleration, GPU performance optimization techniques

Unit IV Interacting with the Virtual World and Virtual Reality Experience	**Hours**

Introduction to VR Interfaces: User Interface Metaphors in VR, Basic principles of interacting with virtual environments. Manipulating Virtual Objects: Picking, moving, rotating objects, Properties of manipulation (size, shape, behaviour), Common manipulation operations. Navigating the Virtual World: Finding your way in VR, Classes of travel methods, Smooth vs. discrete movement methods. Interaction with Others in VR. System Interaction and Immersion: Interacting with the VR system, Rules of the virtual world: physics, object behaviour.

Unit V Augmented Reality	**6 Hours**

Concepts: Computer Graphics, Dimensionality, Depth Cues, Registration and Latency, Working of Augmented Reality, Augmented Reality Hardware (Sensors, Processors, Displays), Ingredients of an AR Experience.

Unit VI Augmented Reality Software and Mobile Augmented Reality	**6 Hours**

Augmented Reality Systems, Software Components, Software Tools for Content Creation, Interaction in Augmented Reality, Augmented Reality Techniques: Marker-based and Markerless tracking, Mobile Augmented Reality.
Textbooks
1. Alan B Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann Publishers, ISBN:978-0240824086
2. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design", (The Morgan Kaufmann Series in Computer Graphics)", Morgan Kaufmann Publishers, San Francisco, CA, 2002
Reference Books
1. Sanni Siltanen, "Theory and applications of marker-based augmented reality", Julkaisija – Utgaard Publisher. 2012. ISBN 978-951-38-7449-0
2. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2016
List of Assignments
1. Study and compare Augmented Reality, Virtual Reality, and Mixed Reality with real-world applications.
2. Design and implement a basic AR application using marker tracking.
3. Create a mobile AR application using plane detection and surface tracking.
4.Implement object selection, movement, rotation, and scaling in a VR scene.
5.Study visual, aural, and haptic representation techniques used in VR systems.
6.Design a VR system that supports multi-user interaction and shared experience.
List of Laboratory Exercises
1. Create an app using image tracking (like Vuforia or ARKit) to display interactive 3D models (e.g., a solar system or engine part) over a physical marker.
2. Develop a mobile application that uses face tracking to allow users to try on glasses, makeup, or accessories.
3. Build an app that overlays arrows and information on a phone screen to guide users through a building.
4. Create a furniture or product placement application that allows users to place virtual, to-scale items in their room
5. Develop a VR simulation for industrial safety training (e.g., operating a forklift or factory machine) using the XR Interaction Toolkit.
6. Design a 3D virtual environment (e.g., a modern apartment or museum) and enable navigation with interactive, clickable objects.
7. Create a simple first-person shooter or puzzle game, focusing on user interaction and controller mechanics in Unity, optimized for VR headsets.
8. Build an application that displays complex data sets in a 3D space, allowing the user to walk through the data.
Project Based Learning
1. Design a mobile AR application to guide users inside a building (e.g., college campus or mall) using markers or plane detection.
2. Develop a VR environment to showcase products (e.g., furniture, gadgets) where users can interact with and manipulate items.
3. Create a VR scene that allows multiple users to collaborate on a task (e.g., designing a room, drawing together).
4. Design an AR-based learning app that teaches a concept (e.g., human anatomy, solar system) with interactive 3D models.
5. Develop a VR training module for a real-world scenario (e.g., fire safety, machine operation, medical procedure).
6. Create a simple AR game (e.g., treasure hunt, object collection) that responds to real-world markers or surfaces.
7. Build a VR experience where users can interact with objects using haptic feedback to feel textures or forces.

8. Integrate AR and VR components in a single experience (e.g., start with AR in real world, then transition to VR environment).	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PROGRAM ELECTIVE COURSE III: QUANTUM COMPUTATION & QUANTUM INFORMATION					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hrs./Week**	**University Examination:**	**60**		
Practical:	**02 Hrs./Week**	**Internal Assessment:**	**40**	**Lecture**	**03**
		Term Work	**25**	**Practical**	**01**
		Practical	**25**		
		Total	**150**	**Total**	**04**

Course Objective:

1. Understand mathematical and physical principles underlying quantum computation.
2. Analyze quantum computational models and circuit-based representations.
3. Apply quantum algorithms to solve computational and cryptographic problems.
4. Evaluate the impact of quantum computing on modern cryptography.
5. Explore emerging quantum technologies including QKD, QTRNG, and PQC..

Prerequisite: Basic Linear Algebra, Probability, Analysis and Design of Algorithms.

Course Outcomes: On completion of the course, students will have the ability to:

1. Explain postulates of quantum mechanics, Hilbert space formalism, and density matrices.
2. Model quantum systems using quantum gates and circuit representations.
3. Analyze and implement fundamental quantum algorithms such as Deutsch–Jozsa, Grover's, and Shor's algorithms.
4. Evaluate the implications of quantum algorithms on classical cryptographic schemes.
5. Analyze the working principles of Quantum Key Distribution protocols and Quantum Random Number Generators.
6. Compare post-quantum cryptographic approaches and assess their relevance in securing future communication systems.

Unit I Mathematical Foundations of Quantum Computing	**06 Hours**

Complex vector spaces and Hilbert spaces, Linear operators and matrices, Inner products, tensor products, Quantum states (pure states), Unitary evolution, Measurement postulates, Superposition and interference, Density operators and mixed states, Entanglement and correlation.

Unit II Quantum Information & Circuit Model	**06 Hours**

Qubits and Bloch sphere representation, multi-qubit systems, Quantum gates (Pauli, Hadamard, Phase, CNOT, Toffoli), Quantum circuits and universality, No-cloning theorem, Quantum teleportation, Superdense coding, CHSH game and non-locality

Unit III Quantum Algorithms & Complexity	**06 Hours**

Quantum parallelism, Deutsch–Jozsa algorithm, Simon's algorithm, Grover's search algorithm, Shor's factoring algorithm, Complexity comparison: Classical vs Quantum, Impact of Grover on symmetric cryptosystems, Impact of Shor on RSA & discrete logarithm-based cryptosystems

Unit IV Quantum Key Distribution (QKD) & Security	**06 Hours**

Principles of quantum cryptography, BB84 protocol, Ekert protocol, Semi-Quantum QKD, Entropic uncertainty relations, Device independence issues, Security proofs (conceptual), Commercial implementations.

Unit V Quantum True Random Number Generators (QTRNG)	**06 Hours**

Principles of quantum randomness, Measurement-based randomness, Design of QTRNG systems, Certification of randomness, Practical implementation challenges, Commercial QTRNG systems, Applications in cryptography & simulations.

Unit VI	**Post-Quantum Cryptography (PQC)**	**06 Hours**

(Refer to National Institute of Standards and Technology PQC Project)
Motivation for post-quantum cryptography, Lattice-based cryptography (e.g., CRYSTALS-Kyber – conceptual), Code-based cryptography, Hash-based signatures, Comparison with classical cryptography, Future directions in quantum-safe security.

Textbooks

1. "Quantum Computation and Quantum Information", M. A. Nielsen & I. L. Chuang, Cambridge University Press.
2. "Quantum Computer Science, N. David Mermin", Cambridge University Press.

Reference Books

1. "Introduction to Quantum Computing", P. Kaye, R. Laflamme, M. Mosca, Oxford University Press.
2. "Applied Cryptography", A. J. Menezes, P. C. van Oorschot, S. A. Vanstone, CRC Press.
3. Quantum Computer Science. N. David Mermin, Cambridge University Press.

List of Assignments

1. Prove that quantum evolution must be unitary.
2. Demonstrate Bloch sphere representation of a qubit.
3. Explain the No-Cloning theorem with a mathematical proof.
4. Design a quantum circuit for quantum teleportation.
5. Compare Grover's algorithm with classical search complexity.
6. Explain the working of Shor's algorithm with a flow diagram.
7. Discuss the impact of Shor's algorithm on RSA cryptosystem.
8. Analyze Simon's algorithm and its exponential speedup.
9. Compare BB84 and Ekert QKD protocols.
10. Explain entropic uncertainty principle in QKD security.
11. Study a commercial QTRNG and analyze its architecture.
12. Compare lattice-based and hash-based post-quantum cryptography.

Practical experiments:

The following practical exposure is strongly recommended using simulators like IBM Qiskit, Cirq, and Quantum simulators.

1. Implement and simulate single-qubit gates (X, Y, Z, Hadamard, Phase) and analyze state vector changes.
2. Demonstrate Bloch sphere visualisation of different qubit states.
3. Construct and simulate Bell states and verify quantum entanglement.
4. Implement multi-qubit quantum circuits using CNOT and Toffoli gates.
5. Simulate the quantum teleportation protocol and verify correctness through measurement.
6. Implement the Superdense Coding protocol and analyse the classical bit transmission efficiency.
7. Implement the Deutsch–Jozsa algorithm and compare with classical evaluation.
8. Implement Grover's Search Algorithm for a 2 or 3-qubit system and analyze probability amplification.
9. Simulate BB84 Quantum Key Distribution protocol and demonstrate detection of eavesdropping.
10. Implement a basic Quantum Random Number Generator circuit and statistically test randomness.
11. Analyze the effect of quantum noise models (bit-flip, phase-flip) on quantum states.
12. Compare classical brute-force search with Grover's algorithm using simulator-based experiments.

Project-Based Learning

1. Design and develop a modular quantum gate simulation library for educational use.
2. Comparative performance analysis of classical vs quantum search algorithms for small datasets.
3. Design a conceptual architecture of a practical Quantum Key Distribution (QKD) system.
4. Security analysis of BB84 and Ekert protocols under practical attack scenarios.
5. Implementation and analysis of Shor's algorithm (conceptual or partial simulation).
6. Study and compare selected Post-Quantum Cryptography algorithms from
7. National Institute of Standards and Technology PQC standardisation project.
8. Develop a mini research report on entropic uncertainty relations and their role in QKD security.
9. Simulation of noise-resilient quantum circuits and error mitigation techniques.
10. Design and simulate a small-scale quantum chemistry problem using quantum algorithms.
11. Study and evaluate commercial quantum computing platforms (IBM Quantum, Rigetti, IonQ) and compare hardware architectures.
12. Analyze the impact of Shor's algorithm on RSA-based systems and propose quantum-safe alternatives.
13. Develop a quantum-based secure communication prototype using simulation tools.

Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PROGRAM ELECTIVE COURSE IV: FINANCIAL MANAGEMENT					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hrs./Week**	**University Examination:**	**60**		
Practical	**02 Hrs./Week**	**Internal Assessment:**	**40**	**Lecture**	**03**
		Term Work	**25**	**Practical**	**01**
		Oral	**25**		
		Total	**150**	**Total**	**04**

Course Objective:

1. To understand financial management principles and apply time value of money concepts in IT and digital project evaluation.
2. To analyse valuation of securities and evaluate risk–return relationships in technology-sector investments.
3. To examine operating and financial leverage and their impact on startup and IT firm financing decisions.
4. To evaluate investment proposals using cost of capital and capital budgeting techniques for digital transformation projects.
5. To apply working capital and cash management strategies for efficient fund utilization in IT and SaaS firms
6. To assess credit policies and receivables management techniques for improving liquidity and financial performance.

Prerequisite: Software Engineering, Fundamentals of Economics, Design Thinking

Course Outcomes: On completion of the course, students will have the ability to:

1. Explain the goals of financial management and compute time value of money using interest and annuity concepts.
2. Analyse the valuation of securities and risk–return relationships using CAPM with reference to technology sector investments.
3. Evaluate leverage decisions in startup financing and digital business models.
4. Evaluate capital budgeting proposals (NPV, IRR, Payback) for digital transformation, cloud, or AI projects using structured financial analysis models.
5. Apply working capital estimation and cash management techniques to optimize liquidity in digital enterprises.
6. Develop analytical frameworks for credit policy evaluation and receivables management using structured financial metrics and risk assessment tools.

Unit I :Foundations of Financial Management in IT	**06 Hours**

Role of Financial Management in Digital Enterprises, Goals of the Firm in Technology-Driven Markets, Financial Environment & Digital Economy, **Time Value of Money:** Simple & Compound Interest, Annuities, Applications in IT project costing, Subscription-based revenue models.

Unit II :Valuation, Risk & Return in Technology Sector	**06 Hours**

Valuation of Securities: Bond Valuation**,** Preference & Equity Valuation**,** Yield & YTM**.** Risk & Return Concepts**,** Probability & Risk Measurement**,** Diversification in Tech Portfolios**,** Capital Asset Pricing Model (CAPM)**,** Risk Analysis in FinTech & Digital Investments.

Unit III: Leverage & Startup Financing	**06 Hours**

Operating Leverage in IT Services, Financial Leverage in Startups, Total Leverage & Business Risk, Indifference Analysis, Funding Sources for Tech Enterprises**:** Venture Capital, Angel Investment, Debt vs Equity in Digital Firms.

Unit IV: Cost of Capital & Capital Budgeting	**06 Hours**

Cost of Capital: Concepts, Cost of Equity, Preference, Debt, Weighted Average Cost of Capital

(WACC), Factors Affecting Cost of Capital in IT Firms, Capital Budgeting: Concepts, Estimation of After-Tax Cash Flows, Project Evaluation Techniques**:** NPV, IRR, Payback Period, Profitability Index.

Unit V :Working Capital & Cash Management | **06 Hours**

Working Capital Concepts, Financing Current Assets, Estimation of Working Capital, Cash Management**:** Motives for Holding Cash**,** Electronic Payments**,** Factoring**,** Outsourcing. Working Capital in SaaS & E-commerce Models.

Unit VI:Accounts Receivable & Credit Management | **06 Hours**

Credit & Collection Policies, Credit Risk Assessment, Digital Credit Scoring, Optimising Credit Period, Receivables Management in IT Services, Managing B2B vs B2C Credit

Textbooks

1. P. Chandra, Financial Management: Theory and Practice, 10th ed. New Delhi, India: McGraw-Hill Education, 2019.
2. E. F. Brigham and M. C. Ehrhardt, Financial Management: Theory & Practice, 16th ed. Boston, MA, USA: Cengage Learning, 2020.
3. J. C. Van Horne and J. M. Wachowicz Jr., Fundamentals of Financial Management, 13th ed. New Delhi, India: Pearson Education, 2009.

Reference Books

1. A. Damodaran, Applied Corporate Finance, 4th ed. Hoboken, NJ, USA: John Wiley & Sons, 2014.
2. S. A. Ross, R. W. Westerfield, and J. Jaffe, Corporate Finance, 11th ed. New York, NY, USA: McGraw-Hill Education, 2016.
3. P. Pignataro, Financial Modelling and Valuation: A Practical Guide to Investment Banking and Private Equity, Hoboken, NJ, USA: John Wiley & Sons, 2013.
4. F. Provost and T. Fawcett, Data Science for Business, Sebastopol, CA, USA: O'Reilly Media, 2013.

List of Lab Assignments

1. Analyse real-world scenarios (e.g., loan amortisation for an IT startup) using simple/compound interest, annuities, and multi-period computations. Calculate present/future values and discuss implications for project funding.
2. Evaluate bonds, preferred stocks, and common stocks for a tech company (e.g., TCS). Use probability distributions, CAPM, and diversification to assess risk-return trade-offs in a portfolio context.
3. Compute weighted average cost of capital (WACC) for equity/debt/preference shares in an IT firm. Estimate after-tax cash flows and apply techniques like NPV/IRR for project evaluation.
4. Examine short/long-term financing mixes for current assets in a software company. Analyse motives for holding cash, speeding receipts (e.g., via electronic commerce), and factoring to optimise balances.
5. Review credit/collection policies for a fintech business. Analyse credit applicants, references, and optimal credit periods to minimize bad debts
6. Choose an organisation (e.g., Reliance Jio) and perform a comprehensive analysis of its capital budgeting process, including proposal generation, cash flow estimation, and alternative evaluation methods.
7. Select a global tech firm (e.g., Google) and break down its investment proposals, incremental operating cash flows, and budgeting techniques to recommend improvements.
8. Apply the Capital Asset Pricing Model (CAPM) to analyze risk in a portfolio of IT stocks. Calculate beta, expected returns, and discuss attitudes toward risk/diversification.
9. Investigate policies in a retail/e-commerce company (e.g., Amazon India). Evaluate applicant analysis, credit references, and period optimization for effective receivables management.
10. Build a simulated investment portfolio (e.g., mixing tech stocks and bonds) for an individual. Incorporate yield to maturity (YTM), risk-return via CAPM, and leverage analysis to balance goals.

Project-Based Learning

Each task can be completed individually or in groups, utilising tools such as Excel or Python for

calculations and incorporating real-world data.

1. Analyse scenarios involving simple/compound interest, amortisation, and annuities (e.g., funding an IT project over time).
2. Evaluate bonds, stocks, YTM, and risk using probability distributions, CAPM, and diversification in a tech portfolio.
3. WACC, estimate cash flows, and apply NPV/IRR techniques for project evaluation.
4. Explore financing mixes, cash motives, electronic commerce, outsourcing, and factoring for maintaining balances.
5. Examine credit policies, applicant analysis, references, and optimal credit periods.
6. Choose an organisation of your choice and analyse it from the perspectives of capital budgeting: Select a firm and review its investment proposals, cash flows, and budgeting process.
7. Analysis of an organisation for capital budgeting: Break down proposals, incremental cash flows, techniques, and selection methods for a specific company.
8. Apply CAPM to assess beta, returns, and risk in a portfolio, discussing attitudes and diversification.
9. Credit and collection policies: Investigate policies, applicant evaluation, and credit optimisation in a business context.
10. Build and analyse a personal investment portfolio incorporating valuation, risk-return, and leverage.

Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PROGRAM ELECTIVE COURSE IV: COGNITIVE SCIENCE AND ANALYTIC					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hrs./Week**	**University Examination:**	**60**		
Practical:	**02 Hrs./Week**	**Internal Assessment:**	**40**	**Lecture**	**03**
		Term Work	**25**	**Practical**	**01**
		Oral	**25**		
		Total	**150**		**04**

Course Objective:

1. Understand the fundamentals of cognitive science and explain how human cognition influences intelligent system design.
2. Differentiate between traditional computing and cognitive computing systems, including their architectures and working principles.
3. Apply Natural Language Processing (NLP) techniques in cognitive systems for language understanding and text analytics.
4. Analyze and interpret data using cognitive analytics techniques to derive meaningful insights and predictions.
5. Design and evaluate cognitive-based solutions for real-world applications in domains such as healthcare, finance, education, and business intelligence.

Prerequisite:

Students should have prior knowledge of programming, basic statistics and linear algebra, data structures, database concepts, and introductory artificial intelligence or machine learning fundamentals.

Course Outcomes: On completion of the course, students will have the ability to:

1. Apply cognitive computing and design principles.
2. Understand and differentiate between NLP and cognitive systems.
3. Analyze advanced analytics techniques applied in cognitive platforms.
4. Discuss business applications of cognitive computing.
5. Illustrate real-world uses of cognitive analytics
6. Apply cognitive computing and design principles.

Unit I: Foundations of Cognitive Computing	**6 Hours**

Introduction to cognitive computing, Difference between traditional computing and cognitive systems, Foundations of human cognition and machine interpretation, Design principles and system models for cognition.

Unit II : Natural Language Processing & Cognitive Computing	**6 Hours**

NLP fundamentals in cognitive systems, Role of language understanding in cognitive computing, Text analytics and semantic processing, Interfaces between NLP and cognitive models

Unit III: Data Analytics with Cognitive Systems	**6 Hours**

Data integration for cognitive insights, Big data and analytics in cognitive computing, Patterns, associations, and predictive insights, Analytics pipeline and modelling

Unit IV: Business Implications	**6 Hours**

Application of cognitive computing to business problems, Disruptive models and strategic insights, Knowledge meaning and business intelligence, Use cases in enterprise, healthcare, finance, and automation	
Unit V: Building Cognitive Applications	**6 Hours**
Lifecycle of cognitive solution design, Integration of NLP, analytics, and cognitive workflows, Challenges in implementation, Case studies and real-world cognitive solution.	
Unit VI : Ethics, Emerging Trends and Future Directions	**6 Hours**
Ethical issues in cognitive computing and analytics, Bias, fairness, transparency, and explainable AI (XAI),Data privacy and security in cognitive systems, Human–AI interaction and responsible AI design, Emerging trends in cognitive analytics (Generative AI, cognitive robotics, adaptive systems),Future research directions and interdisciplinary application	
Textbooks	
1. Cognitive Science, Computational Intelligence, and Data Analytics: Methods and Applications with Python	
Reference Books	
1. Artificial Intelligence: A Modern Approach	
2. Data Science and Predictive Analytics — Ivo D. Dinov	
3. Cognitively Inspired Natural Language Processing — Abhijit Mishra & Pushpak Bhattacharyya	
4. Advances in Cognitive Informatics and Cognitive Computing — Yingxu Wang et al. (eds.)	
List of Laboratory Exercise	
1. Compare a traditional "if-else" system with a machine learning model for data classification.	
2. Use NLP to perform Named Entity Recognition (NER) and dependency parsing on a text corpus.	
3. Develop a system to detect specific human emotions (joy, anger, fear) from text or speech.	
4. Apply K-Means clustering or Association Rules to find hidden trends in a big data elective.	
5. Design a recommendation engine using semantic similarity or knowledge graphs.	
6. Create a conversational agent that uses an NLP engine to handle complex user intents.	
7. Develop a live analytics interface to visualize cognitive data streams (e.g., live social feeds).	
Project Based Learning	
1. Cognitive Chatbot with Sentiment Awareness	
2. Emotion Recognition System	
3. Cognitive Recommender System	
4. Fake News Detection using Cognitive Analytics	
5. Healthcare Decision Support System	
6. Cognitive Learning Analytics Dashboard	
7. Voice-Based Virtual Assistant	
8. Customer Behavior Prediction using Cognitive Models	
9. Explainable AI (XAI) Model for Decision Transparency	
10. Cognitive Fraud Detection System	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PROGRAM ELECTIVE COURSE IV: INFORMATION RETRIEVAL					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**3Hours/Week**	**University Examination:**	**60**		
Practical:	**2 Hours/Week**	**Internal Assessment:**	**40**	**Lecture**	**3**
		Term Work	**25**	**Practical**	**1**
		Oral	**25**		
		Total	**150**	**Total**	**4**

Course Objective:

1. To understand the fundamentals of Information Retrieval (IR) systems and their architecture.
2. To learn indexing, querying, and text processing techniques used in IR systems.
3. To analyze various retrieval models and ranking algorithms.
4. To explore web search, link analysis, and evaluation metrics.
5. To understand text mining and modern IR applications.

Prerequisite:Data Structures and Files, Database management systems

Course Outcomes: On completion of the course, students will have the ability to:

1. Explain the architecture and components of an Information Retrieval system.
2. Apply text processing and indexing techniques for document representation.
3. Compare and implement different retrieval models and ranking methods
4. Apply the concepts of multimedia and distributed information retrieval.
5. Use appropriate tools in analyzing the web information
6. Simulate the working of a search engine and recommender system

Unit I Introduction to Information Retrieval	**6 Hours**

Basic Concepts of IR, Data Retrieval & Information Retrieval, Text mining and IR relation, IR system block diagram, Automatic Text Analysis: Luhn's ideas, Conflation Algorithm, Indexing and Index Term Weighting, Probabilistic Indexing, Automatic Classification. Measures of Association, Different Matching Coefficients, Cluster Hypothesis, Clustering Techniques: Rocchio's Algorithm, Single pass algorithm, Single Link algorithm.

Unit II Indexing , Query Processing and Searching Techniques	**6 Hours**

Inverted Index Construction,Index Compression Techniques,Dictionary and Postings List,Query Processing and Optimization,Phrase Queries,Wildcard Queries,Spelling Correction (Edit Distance),Efficient Index Construction.Searching Techniques: Boolean Search, sequential search, Serial search, cluster-based retrieval, Query languages, Types of queries, Patterns matching, structural queries. IR Models: Basic concepts, Boolean Model, Vector Model, Probabilistic Model.

Unit III Retrieval Models	**6 Hours**

Vector Space Model,Term Frequency (TF), Inverse Document Frequency (IDF),Cosine Similarity,Probabilistic Retrieval Model,BM25 Model,Language Models for IR

Unit IV Distributed and Multimedia IR	**6 Hours**

Distributed IR: Introduction, Collection Partitioning, Source Selection, Query Processing, **Multimedia I**R: Introduction, Data Modeling, Query Language, Background-Spatial Access Method, A Generic Multimedia Indexing Approach, One Dimensional Time Series, Two-Dimensionalcolor Images, Automatic Feature Extraction, Trends and Research Iss**ue.**

Unit V Web Searching	**6 Hours**

Introduction, Challenges, Web Characteristics, Search Engines: Centralized Architecture, Distributed Architecture, User Interfaces, Ranking, Crawling the web, Indices, Browsing, Meta-searchers, Searching using Hyperlinks, Trends and Research Issues, Introduction to Web Scraping: Python for web scraping, Request, HTML parsing, Beautiful Soup.

Unit VI Advanced Information Retrieval	**6 Hours**

XML Retrieval: Basic XML concepts, Challenges in XML retrieval, Vector space model for XML retrieval, Evaluation of XML retrieval, Text-Centric vs. Data-Centric XML retrieval. Recommendation system: Collaborative Filtering and Content Based Recommendation of Documents and Products. Introduction to Semantic Web

Textbooks

1. Ricardo Baeza-Yates, Berthier Riberio–Neto, Modern Information Retrieval, Pearson Education, ISBN: 81- 297-0274-6.
2. C.J. Rijsbergen, Information Retrieval, (www.dcs.gla.ac.uk), Second Edition ISBN:978-408709293
3. Ryan Mitchell, Web Scraping with Python, O'reilly, second Edition, ISBN: 9781491985571.

Reference Books

1. ChabaneDjeraba, Multimedia mining: A highway to intelligent multimedia documents, Kulwer Academic Publisher, ISBN: 1-4020-7247-3.
2. V. S. Subrahamanian, Satish K. Tripathi, Multimedia information System, Kulwer Academic Publisher.
3. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schütze, An Introduction to Information Retrieval, Cambridge University Press, 2008. 4. Marek Kowalkiewicz, Maria E. Orlowska, Tomasz Kaczmarek, Witold Abramowicz, Web Information Extraction and Integration, Springer New York Publisher.

List of Lab Exercise

1. Implement a Conflation Algorithm (Stemming/Lemming) and Stop-word removal for a set of documents.
2. Build an Inverted Index for a small document collection and implement index compression.
3. Develop a Boolean Search engine to process AND, OR, and NOT queries.
4. Calculate Term Frequency (TF) and Inverse Document Frequency (IDF) for a set of text files.
5. Implement Cosine Similarity to find the rank of documents against a user query.
6. Implement the Single-Pass or Single-Link clustering algorithm for document grouping.

Project Based Learning

1. Design a basic search engine that:Indexes documents,Processes user queries.
2. Build a model to automatically classify documents into categories like: sports,Technology,Politics.
3. Create a tool that:Compares two or more documents,Displays similarity score.
4. Plagiarism Detection System Design a system that:Compares documents,Detects similarity percentage,Uses matching coefficients

Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PROGRAM ELECTIVE COURSE IV: ENTERPRISE SYSTEMS					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**3Hrs/Week**	**University Examination:**	**60**		
Practical:	**2 Hrs/Week**	**Internal Assessment:**	**40**	**Lecture**	**3**
		Term Work	**25**	**Practical**	**1**
		Oral	**25**		
		Total	**150**	**Total**	**4**

Course Objective:

1. Understand enterprise-wide systems and integrated business processes
2. Analyze ERP implementation strategies and challenges
3. Explore CRM, SCM, BI integration
4. Evaluate cloud-based and AI-driven enterprise systems
5. Develop managerial and technical perspective for enterprise transformation

Prerequisite:

Knowledge of Database Management Systems, Software Engineering, Management Information Systems, and basic business process concepts to effectively understand and apply Enterprise Systems.

Course Outcomes: On completion of the course, students will have the ability to:

1. Explain enterprise systems and business process integration
2. Analyze ERP architecture and implementation strategies
3. Evaluate CRM and SCM integration in organizations.
4. Apply analytics concepts for enterprise decision-making
5. Assess modern trends like cloud ERP, AI & RPA
6. Propose enterprise system solutions for real-world scenarios

Unit I: Enterprise Systems & Business Process Integration — **6 Hours**

Introduction to Enterprise Systems, Functional Silos vs Process-Oriented Organizations, Cross-functional Business Processes, Enterprise System Architecture (2-tier, 3-tier, SOA), Digital Transformation & Enterprise Integration, Evolution: Legacy Systems → ERP → Cloud ERP

Unit II : Enterprise Resource Planning (ERP) Systems — **6 Hours**

ERP Concepts & Characteristics, ERP Modules:Finance & Accounting, Human Resource Management, Production & Manufacturing, Sales & Distribution, Procurement & Inventory, ERP Vendors & Ecosystem, ERP Implementation Life Cycle

Unit III: Customer Relationship Management (CRM) & Supply Chain Management (SCM) — **6 Hours**

CRM-CRM Concepts & Objectives, Operational, Analytical & Collaborative CRM, Customer Data Platforms, Social CRM & Omnichannel Integration, SCM-Supply Chain Fundamentals, Demand Forecasting, Inventory Management, Logistics & Distribution, Integration of SCM with ERP

Unit IV: Business Intelligence, Analytics & Data in Enterprise Systems — **6 Hours**

Data Warehousing, OLAP & Reporting, KPIs & Dashboard Design, Predictive Analytics in ERP, AI & Machine Learning Integration, Data Governance & Data Quality

Unit V: Emerging Trends in Enterprise Systems — **6 Hours**

Cloud ERP & SaaS Models, Multi-cloud & Hybrid Architecture, Enterprise Mobility, Robotic Process Automation (RPA), Blockchain in Supply Chain, Cybersecurity in Enterprise Systems, ESG

Reporting & Sustainable Enterprise Systems, Industry 4.0 & Smart Enterprises	
Unit VI: Enterprise Solution Design and Digital Transformation Strategy	**6 Hours**
Designing integrated ERP–CRM–SCM solutions, multi-tier and cloud-based architecture design, Identifying business problems, Stakeholder analysis, Functional and non-functional requirements, Cloud migration roadmap, AI and analytics integration, Automation and RPA opportunities	
Textbooks	
1. Sharma & Sharma – Enterprise Resource Planning with SAP S/4HANA	
Reference Books	
1. Monk & Wagner – Concepts in Enterprise Resource Planning	
2. Leon – ERP Demystified	
3. Garg & Venkitakrishnan – Enterprise Resource Planning	
4. O'Brien & Marakas – Management Information Systems	
List of Laboratory Exercise:	
1. Use a modeling tool (like Lucidchart, Bizagi, or ARIS) to map a "Purchase-to-Pay" or "Order-to-Cash" process.	
2. Using an open-source ERP (like Odoo, ERPNext) or a trial version of SAP S/4HANA, create Master Data for a Product, Vendor, and Customer.	
3. Execute a complete procurement cycle: Create a Purchase Requisition → Purchase Order → Goods Receipt → Invoice Verification.	
4. Perform a standard sales cycle: Inquiry → Quotation → Sales Order → Delivery/Picking → Billing.	
5. Configure a Lead-to-Opportunity pipeline in a CRM tool (like Salesforce Trailhead or HubSpot).	
6. Use a dataset to perform demand forecasting using simple moving averages or exponential smoothing within an ERP or Excel-based tool.	
Project Based Learning	
1. Business Process Mapping Assignment	
2. ERP Vendor Comparative Study	
2. Case Study Analysis (ERP success/failure)	
3. CRM solution for banking sector	
4. Design a Cloud-based Enterprise Architecture	
5. Research Paper Review on AI in ERP	
6. CRM System Design for a Hospital	
7. SCM integration with ERP for manufacturing industry	
8. Cloud Migration Strategy for Legacy Enterprise Systems	
9. Business analytics solution for sales prediction	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

MAJOR PROJECT					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**- Hrs/Week**	**University Examination:**	**--**		
Practical:	**16 Hrs./Week**	**Internal Assessment:**	**--**	**Lecture**	**-**
		Term Work	**100**	**Practical**	**8**
		Oral	**50**		
		Total	**150**	**Total**	**8**

Course Objective:

1. To identify and analyze real-world problems through systematic literature review and gap analysis.
2. To design and architect innovative computing solutions by integrating core engineering principles with emerging technologies like AI and Cybersecurity.
3. To develop and implement a functional prototype or system using modern software development tools, platforms, and methodologies.
4. To validate and evaluate the system performance using empirical evidence, standard benchmarks, and rigorous testing.
5. To cultivate professional skills in technical documentation, research publication, and effective oral communication.

Prerequisite:

Basics of Software engineering, Software testing and knowledge of core computer subjects, Python, security & ML, knowledge of DevTools, Skill in handling datasets and reading IEEE/ACM papers, Basic Statistics to validate experimental results.

Course Outcomes: On completion of the course, students will have the ability to:

1. Analyze complex engineering problems and formulate a clear, measurable problem statement supported by a comprehensive literature survey.
2. Design a robust system architecture and methodology by selecting appropriate algorithms, data structures, and technological frameworks.
3. Build a functional software or hardware prototype using programming languages (e.g., Python), libraries, and specialized tools (e.g., LLMs, datasets).
4. Evaluate the developed solution using quantitative metrics and empirical data to demonstrate its effectiveness and accuracy.
5. Prepare a structured technical dissertation and present research findings effectively to an expert committee or through peer-reviewed publications.
6. Demonstrate the ability to work in a team, manage project timelines, and adhere to ethical standards regarding data privacy and intellectual property.

1. Problem Identification and Domain Research

- Identification of a real-world technical or business problem.
- Selection of a specific domain (e.g., Cybersecurity, Fintech, or AI).
- Formulation of a clear Problem Statement and set of measurable Research Objectives.

2. Literature Review and Feasibility Study

- Comprehensive survey of existing research papers, patents, and industry standards.
- Gap analysis to identify what current solutions are missing.
- Evaluation of technical feasibility, including required hardware (GPUs/TPUs), software libraries (Python, PyTorch, LangChain), and dataset availability.

3. System Design and Architecture

- Design of the high-level system architecture and data flow diagrams.

- Selection of algorithms or models (e.g., specific LLMs or Machine Learning classifiers).
- Planning the integration of different modules (e.g., Pre-processing, Analysis Core, and UI).

4. Implementation and Prototyping

- Data collection and cleaning (using datasets like EMBER or CIC IDS).
- Feature engineering and extraction.
- Development of the core logic, including prompt engineering strategies (Few-Shot/Chain-of-Thought) and model fine-tuning.
- Building a functional user interface for demonstration.

5. Testing, Validation, and Empirical Analysis

- Rigorous testing of the system against standard benchmarks.
- Collection of empirical evidence (Accuracy, Precision, Recall, and Latency).
- Comparative analysis of the proposed solution against existing state-of-the-art methods.

6. Documentation and Scientific Communication

- Maintenance of a project logbook or repository (e.g., GitHub).
- Preparation of a comprehensive Project Dissertation/Thesis following institutional formatting.
- Writing and submitting a research paper to a peer-reviewed journal or conference.
- Final technical presentation and viva-voce examination.

COURSE SYLLABUS SEMESTER VIII

CYBER AND INFORMATION SECURITY					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**3Hrs/Week**	**University Examination:**	**60**		
Practical:	**2 Hrs./Week**	**Internal Assessment:**	**40**	**Lecture**	**3**
		Term Work	**25**	**Practical**	**1**
		Oral	**25**		
		Total	**150**	**Total**	**4**

Course Objective:

1. To understand security parameters, cryptosystems, and access control models.
2. To identify and model various security threats including web and email threats.
3. To learn about digital forensics, incidence response, and enterprise security architecture.

Prerequisite:

Knowledge of OSI Model, TCP/IP, and common protocols like HTTP, DNS, and SSH.

The ability to run Virtual Machines (VMware/VirtualBox)

Course Outcomes: On completion of the course, students will have the ability to:

1. Analyze foundational security principles, modern threats, and cryptographic systems to design secure information frameworks.
2. Implement advanced access control models and trusted computing mechanisms to ensure identity and hardware integrity.
3. Apply global security standards and continuous monitoring tools to manage enterprise governance and compliance.
4. Perform risk assessments and threat modelling to mitigate sophisticated cyber-attacks and ransomware.
5. Execute intrusion detection, malware analysis, and digital forensic procedures for effective incident response and containment.
6. Design secure cloud and enterprise architectures using SASE, SSE, and container-specific security protocols.

Unit I: Security Foundations & Modern Cryptography — **6 Hours**

Confidentiality, Integrity, Availability (CIA), Security violation and threats; Security policy and procedure, Threat Landscape**:** Evolution of threats (APTs, Zero-day exploits); Security Policy vs. Governance.

Assumptions and Trust, zero trust architecture (ZTA); Security Life Cycle, Symmetric and Asymmetric Cryptosystems, Different Ciphers used for Information Security, Secure Cryptosystem.

Unit II : Access Control & Trusted Systems — **6 Hours**

Access Models: Discretionary (DAC), Mandatory (MAC), Role-based (RBAC), and Task-based models.

Authentication Policies, techniques, and Trusted Computing: Trusted Platform Modules and Secure Boot mechanisms.

Unit III : Security Policies & Auditing — **6 Hours**

Global Standards: ISO/IEC 27001:2022, National Institute of Standards and Technology Cybersecurity Framework(CSF 2.0), and General Data Protection Regulation/California Consumer Privacy Act.

Auditing: Continuous security monitoring, Security Information and Event Management
Security Awareness training and the role of the Chief Information Security Officer in board level risk management.

Unit IV : Cyber Threats & Risk Management — **6 Hours**

Threats: Insider threats, Cybercrime, E-mail and Web threats, Sophisticated Threats: Ransomware-

as-a-Service (RaaS), Social Engineering (Deep fakes/AI-phishing).

Risk Management: Risk Assessment, Threat Modelling, and Vulnerability Assessment tools., Threat Modelling: Using STRIDE or Process for Attack Simulation and Threat Analysis (PASTA) methodologies.

Unit V : Logic-based Systems & Digital Forensics | **6 Hours**

Detection: Intrusion detection , Intrusion Defense: From IDS/IPS to Extended Detection and Response (XDR), Malware Analysis: Static vs. Dynamic analysis; Analysing AI-generated malicious code.

Digital Forensics: Memory forensics, Mobile forensics, and Chain of Custody in a remote world. Incident Response: Playbook automation and the "Golden Hour" of breach containment.

Unit VI : Enterprise & Cloud Security | **6 Hours**

Cloud Models: Shared Responsibility Model in AWS/Azure/Google Cloud

Modern Architecture: SASE (Secure Access Service Edge) and SSE (Security Service Edge) featuring Container Security: Securing Docker, Kubernetes, and Serverless functions.

Textbooks

1. Computer Security: Principles and Practice by William Stallings & Lawrie Brown (Latest Ed. 2024/2026)
2. Information Security: Principles and Practice by Mark Stamp (3rd Ed. 2021/2022)
3. Cryptography and Network Security: Principles and Practice by William Stallings (8th Ed. 2023)

Reference Books

1. The Cybersecurity Playbook by Allison Cerra
2. IT Auditing: Using Controls to Protect Information Assets by Chris Davis & Mike Schiller
3. Digital Forensics and Incident Response by Gerard Johansen (3rd Ed. 2023)
4. Cloud Security Fundamentals by Jason Edwards

List of Assignments

1. Analyze one famous cyberattack (e.g., SolarWinds) through the lens of the **CIA Triad**.
2. Write a Python script to compare **AES (Symmetric)** vs. **RSA (Asymmetric)** encryption speeds.
3. Create a **Role-Based Access Control (RBAC)** table for a hospital (Doctor, Nurse, Admin).
4. Use chmod and chown in Linux to implement **Discretionary Access Control (DAC)** on sensitive files.
5. Write a 1-page **Acceptable Use Policy (AUP)** for company laptops based on ISO 27001.
6. Use Windows **Event Viewer** to identify and document three failed login attempts.
7. Map a banking app using the **STRIDE** framework.
8. Set up **Snort** (Intrusion Detection System) to detect a simulated "Ping of Death" attack.
9. Use **Autopsy** or **FTK Imager** to recover a "deleted" file from a USB drive image.
10. Configure an **AWS/Azure IAM Role** using the "Principle of Least Privilege" (allow viewing, deny deleting).

List of Laboratory Exercises

1. Implementation of symmetric and asymmetric encryption algorithms
2. Configuration of access control lists (ACLs) for different security models.
3. Vulnerability Assessment: Perform a network vulnerability scan using industry-standard tools like Nessus or OpenVAS and generate a risk report.
4. Web & Email Security: Demonstrating and mitigating a SQL Injection or Cross-Site Scripting (XSS) attack on a test web application.
5. Intrusion Detection: Configuring and analyzing network traffic logs using an IDS tool like Snort to detect suspicious patterns.
6. Digital Forensics: Perform "Live Discovery" on a storage medium to recover deleted files and analyze metadata using tools like Autopsy or FTK Imager.
7. Cloud Security Configuration: Set up and audit a secure "S3 Bucket" or "Identity and Access Management (IAM)" policy on a cloud platform (AWS/Azure).

8. Business Continuity Planning (Case Study): Develop a Disaster Recovery and Business Continuity Plan for a simulated enterprise-level security breach.	
Project Based Learning 1. "Crypto-Vault" Messenger 2. Multi-Level File Manager 3. The "Compliance Audit" Simulation 4. Threat Modeling a FinTech App 5. The "Infection & Investigation" 6. Cloud-Native Secure Architecture	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PROGRAM ELECTIVE COURSE V: COMPUTATIONAL FINANCE & MODELING					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**2 Hrs./Week**	**University Examination:**	**60**		
Practical	**-**	**Internal Assessment:**	**40**	**Lecture**	**2**
		Term Work	**-**	**Practical**	**-**
		Oral	**-**		
		Total	**100**	**Total**	**2**

Course Objective:

1. To understand financial theories and quantitative models.
2. To apply computational techniques in financial problem solving.
3. To develop programming skills for financial data analysis.
4. To implement pricing, risk, and portfolio models using software tools.

Prerequisite:

1. Basic Calculus, Linear Algebra & Optimization techniques.
2. Probability & Statistics with Numerical methods.
3. Basic programming knowledge in Python/R/Matlab.
4. Basic knowledge of Finance.

Course Outcomes: On completion of the course, students will have the ability to:

1. Define key financial concepts.
2. Apply statistical tools to financial datasets.
3. Analyse pricing models critically.
4. Evaluate portfolio performance.
5. Assess suitability of computational methods.
6. Design computational financial models.

Unit I	**04 Hours**

Foundations of Computational Finance: Introduction to Financial Systems & Markets, Time Value of Money, Interest Rates (Simple, Compound, Continuous), Financial Instruments: Bonds, Stocks, Derivatives, Financial Data Sources (Yahoo Finance, NSE/BSE), Introduction to Financial Modelling Concepts, Basics of Numerical Methods in Finance

Unit II	**04 Hours**

Probability, Statistics & Stochastic Processes in Finance: Probability Theory Refresher, Random Variables & Distributions (Normal, Lognormal), Expected Value & Variance, Covariance & Correlation, Brownian Motion & Wiener Process, Geometric Brownian Motion, Introduction to Monte Carlo Simulation

Unit III	**04 Hours**

Financial Derivatives & Pricing Models: Forwards & Futures, Options (Call & Put), Payoff Diagrams, Binomial Pricing Model, Black-Scholes Model, Greeks (Delta, Gamma, Vega, Theta, Rho), Volatility Modelling

Unit IV	**04 Hours**

Portfolio Theory & Risk Modelling: Risk & Return, Modern Portfolio Theory, Mean-Variance Optimization, Capital Asset Pricing Model (CAPM), Beta Estimation, Value at Risk (VaR), Conditional VaR CVaR), Risk Metrics & Performance Measures (Sharpe Ratio, Treynor Ratio)

Unit V	**04 Hours**

Computational Techniques & Financial Algorithms: Numerical Methods (Root Finding, Optimization), Finite Difference Methods, Monte Carlo Methods in Option Pricing, Optimization Algorithms in Finance, Machine Learning Applications in Finance, Time Series Analysis (AR, MA, ARIMA)

Unit VI	**04 Hours**

Advanced Topics & Applications: Algorithmic Trading Basics, High Frequency Trading Concepts, Credit Risk Modelling, Interest Rate Models (Vasicek, CIR), Financial Engineering Applications, Block chain & FinTech Overview, Case Studies in Computational Finance.

Textbooks	
1. Tools for Computational Finance: Rudiger U. Seydel	
2. Mathematics for Finance: An Introduction to Financial Engineering by **Marek Capiński and Tomasz Zastawniak.**	
Reference Books	
3. Computational Finance with R: Rituparna sen & Sourish Das	
4. Computation & Simulation for Finance: An Introduction with Python: Jessica James.	
5. Financial Engineering & Computation by Cambridge University Press.	
List of Assignments	
1. Financial Concepts & TVM: Explain types of financial markets and instruments, Compute: Present Value & Future Value, Continuous compounding, Compare simple vs compound interest. Case study: Bond pricing using discounting. 2. Financial Data Exploration: Collect 5 years of stock data (NSE/BSE/Yahoo Finance), Compute daily returns, Plot price vs return, Calculate mean, variance, volatility. 3. Regression & Correlation Analysis: Select two correlated stocks, Compute covariance & correlation, build linear regression model, Interpret beta and R^2. 4. Volatility Analysis: Calculate historical volatility, Compare implied vs historical volatility, Study volatility smile (if data available). 5. Portfolio Optimization: Select 4–5 stocks, construct efficient frontier, Identify minimum variance portfolio, Compute Sharpe Ratio. 6. Credit Risk Modelling: Build logistic regression model for credit default dataset, evaluate model using confusion matrix, Compare with decision tree or ML model. 7. Algorithmic Trading Strategy: Design rule-based trading strategy (e.g., Moving Average Crossover), Backtest on historical data, Compute performance metrics: CAGR, Maximum Drawdown, Sharpe Ratio.	
Project Based Learning	
1. Data Analysis & Modelling Projects (Intermediate Level). 2. Derivatives & Risk Engineering (Advanced). 3. Algorithmic & Quantitative Trading (High Level). 4. Integrated Capstone Projects. 5. Cryptocurrency Modelling & Risk Analysis. 6. Robo-Advisory System.	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PROGRAM ELECTIVE COURSE V: BEHAVIOURAL ECONOMICS					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**2 Hrs./Week**	**University Examination:**	**60**		
Practical	**-**	**Internal Assessment:**	**40**	**Lecture**	**2**
		Term Work	**-**	**Practical**	**-**
		Oral	**-**		
		Total	**100**	**Total**	**2**

Course Objective:

1. To understand behavioural economics concepts and how psychological factors influence economic decision-making beyond traditional theory
2. **To analyze and apply** behavioral insights related to biases, risk, uncertainty, and intertemporal choices in real-world economic and market contexts.
3. **To evaluate and design** behavioral interventions and policy applications using empirical evidence and case-based learning

Prerequisite: Basic knowledge of Mathematics and Microeconomics

Course Outcomes: On completion of the course, students will have the ability to:

1. Explain the foundations of behavioural economics and distinguish it from traditional microeconomic theory
2. Analyse consumer decision-making using concepts of bounded rationality, heuristics, and cognitive biases.
3. Apply behavioral models to choices under risk, uncertainty, and intertemporal decision-making.
4. Evaluate behavioural factors influencing financial behaviour, market outcomes, and strategic interactions.
5. Assess the role of social preferences, norms, and behavioural game theory in economic behaviour and policy design.
6. Design behavioural interventions (nudges) and conduct case-based analysis for real-world economic and policy problems.

Unit I - Foundations of Behavioural Economics	**04 Hours**
Evolution from neoclassical to behavioural economics, Bounded rationality and decision anomalies, Behavioural economics & interdisciplinary links (psychology, neuroscience), Money illusion, framing, loss perception, **Indian context:** charitable giving, digital payments behaviour	
Unit II - Behavioral Choice Theory & Consumer Behavior	**04 Hours**
Utility in economics vs psychology, Models of rationality and bounded rationality, Addiction, retail therapy, and environmental choices, Pricing psychology, valuation biases, public goods behaviour, **Digital marketplace behaviour**	
Unit III - Beliefs, Heuristics & Cognitive Biases	**04 Hours**
Types of heuristics (availability, representativeness, anchoring), Overconfidence, confirmation bias, projection bias, Probability misjudgement and belief updating, Applications: counterfeit markets, financial trading, cryptocurrency behaviour	
Unit IV - Decision Making under Risk & Uncertainty	**04 Hours**
Expected utility theory vs Prospect theory, Loss aversion and reference dependence, Mental accounting and probability weighting, Applications: insurance, sports decision-making, portfolio choice	
Unit V - Intertemporal Choice & Behavioural Finance	**04 Hours**
Time preference and discounting (geometric vs hyperbolic),Self-control problems and commitment devices, Credit card behaviour, BNPL, savings patterns, Behavioural consumption planning and future projection	
Unit VI - Strategic Behavior, Nudges & Public Policy	**04 Hours**

Behavioural game theory and Nash equilibrium, social preferences: fairness, trust, reciprocity, Nudging and behavioural public policy, Behavioural labour markets and compensation design,Compliance, social norms, and punishment, Behavioural interventions in Indian policy (UPI, Swachh Bharat, tax compliance)	
Textbooks	
1. Wilkinson & Klaes — Introduction to Behavioural Economics	
Reference Books	
1. Camerer, Loewenstein & Rabin — Advances in Behavioral Economics	
2. Thaler & Sunstein — Nudge	
Project Based Learning(PBL)	
1. Impact of digital payments on consumer behaviour in India 2. Gig economy and behavioural labour supply 3. Social media influence on spending patterns 4. Behavioural analysis of sustainability choices 5. Behavioural biases in stock market investing 6. Hyperbolic discounting in student spending habits 7. Behavioural nudges in government policy (UPI adoption, tax compliance) 8. Gender differences in labour force participation decisions 9. Behavioural analysis of BNPL and credit usage 10. Consumption behaviour post-COVID	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

PROGRAM ELECTIVE COURSE V: INDUSTRIAL AND ORGANIZATIONAL PSYCHOLOGY					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**2 Hrs./Week**	**University Examination:**	**60**		
Practical	**-**	**Internal Assessment:**	**40**	**Lecture**	**2**
		Term Work	**-**	**Practical**	**-**
		Oral	**-**		
		Total	**100**	**Total**	**2**

Course Objective:

1. Introduces psychological principles applied to workplace behaviour and organizational effectiveness.
2. Explores individual factors such as personality, motivation, attitudes, and job satisfaction
3. Examines leadership, communication, teamwork, and organizational culture.
4. Covers HR functions including recruitment, training, and performance management.
5. Addresses workplace issues like stress, conflict, and employee well-being.

Prerequisite:

Students should understand human behaviour and organizational functioning is helpful, though no prior knowledge of psychology is required.

Course Outcomes: On completion of the course, students will have the ability to:

1. Explain the major content areas of Industrial Psychology, including job analysis, recruitment, selection, employment law, training, performance management, and workplace health and well-being.
2. Apply statistical concepts to support evidence-based personnel decisions in organizational contexts.
3. Demonstrate **p**ractical skills by conducting hands-on projects related to job analysis, selection, training design, and employee well-being initiatives
4. Analyse and interpret psychological tests and measurement data to make accurate, data-driven organizational decisions
5. Integrate foundational knowledge of Industrial/Organizational Psychology to prepare for advanced studies or specialized courses in HRM and I/O Psychology.
6. Analyse and interpret individual differences in behavior using established theories of personality.

Unit I: Foundations of I/O Psychology & Job Analysis	**04 Hours**

Introduction to Industrial and Organizational Psychology, its scope, research methods, and legal context. Covers job analysis, competency modeling, job evaluation, compensation systems, job design, employee well-being, and recruitment processes.

Unit II: Employee Selection & Assessment Methods	**04 Hours**

Identifying performance criteria and validating tests used in personnel selection. Screening techniques: resumes and tests, interviews, assessment centers, and background checks.

Unit III: Performance Management Systems	**04 Hours**

Performance goal setting, feedback mechanisms, and coaching techniques. Performance appraisal methods and the use of evaluation results for employee development and organizational effectiveness.

Unit IV: Employee Attitudes, Motivation & Diversity	**04 Hours**

Theories of motivation, job satisfaction, and organizational commitment. Fairness, organizational justice, diversity, and inclusion in managing a productive workforce.

Unit V: Leadership & Organizational Processes	**04 Hours**

Leadership theories, organizational climate and culture, and organizational development. Teamwork, group dynamics, and the structure of work behavior in organizations.

Unit VI: Stress Management & Work–Life Balance	**04 Hours**

Sources and effects of stress related to work and life demands. Coping strategies, stress management

techniques, and organizational initiatives to promote employee well-being and work–life balance.

Textbooks

1. Landy, F. J. and Conte, J. M. (2013). Work in the 21st Century (4th Edition). Oxford: Blackwell Publishing
2. Introduction to Psychology, University of Minnesota Libraries Publishing, ISBN 13: 9781946135131
3. Introduction to Psychology, Manoj Kr Singh, Anmol Publications Pvt. Ltd.
4. Introduction to Industrial/Organizational Psychology — Ronald E. Riggio & Stefanie K. Johnson
5. Industrial/Organizational Psychology: Understanding the Workplace — Paul E. Levy
6. Psychology and Work: An Introduction to Industrial and Organizational Psychology — Donald M. Truxillo et al.

Reference Books

1. Encyclopedia of Psychology (English, Hardcover, unknown), Oxford University Press Inc ISBN: 9781557981875, 979781557981875, Edition2000
2. Industrial and Organizational Psychology — P. K. Ghosh & M. B. Ghorpade
3. Industrial/Organizational Psychology: An Applied Approach — Michael G. Aamodt

Project Based Learning:

1. Job Analysis Study of a Technical Role
2. Employee Motivation Assessment in a Workplace
3. Workplace Stress and Well-Being Survey
4. Leadership Style Evaluation in Organizations
5. Recruitment and Selection Process Analysis
6. Organizational Culture Assessment of a Company/Institution
7. Team Dynamics and Group Behaviour Stud
8. Training Needs Analysis and Program Design
9. Employee Job Satisfaction and Engagement Study
10. Work-Life Balance and Productivity Analysis

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit – III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

PROGRAM ELECTIVE COURSE V: SERVICES SCIENCE & SERVICE OPERATIONAL MANAGEMENT					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**2 Hrs./Week**	**University Examination:**	**60**		
Practical	**-**	**Internal Assessment:**	**40**	**Lecture**	**2**
		Term Work	**-**	**Practical**	**-**
		Oral	**-**		
		Total	**100**	**Total**	**2**

Course Objective:

1. To transition from a goods-centric mindset to Service-Dominant (S-D) Logic and value co-creation.
2. To apply mathematical models for Facility Location, Vehicle Routing, and Inventory Management.
3. To foster a mindset of continuous improvement and **Open Service Innovation** for business growth.

Prerequisite:

Students should understand Fundamentals of Management, Operations Research

Course Outcomes: On completion of the course, students will have the ability to:

1. Understand concepts about Services and distinguish it from Goods.
2. Able to identify characteristics and nature of Services.
3. Comprehend ways to design Services and evaluate those using Service qualities.
4. Understand how various methods can be used to operate and manage Service businesses.
5. Understand how innovation can be approached from Services point of view.
6. Understand the need of Services Innovation.

Unit I: Introduction & Nature of Services and Service Encounters	**04 Hours**

Introduction to the course, Introduction to service operations, Role of service in economy and society, Introduction to Indian service sector. Differences between services and operations, Service package, characteristics, various frameworks to design service operation system, Kind of service encounter, importance of encounters.

Unit II: Service-Dominant Logic & New Service Development	**04 Hours**

Service-Dominant Logic: From Goods-Dominant logic to Service-Dominant logic, Value Co-creation. Service Strategy and Competitiveness: Development of Strategic Service Vision (SSV), Data Envelopment Analysis.New Service Development: NSD cycle, Service Blueprinting, Elements of service delivery system.Service Design: Customer Journey and Service Design, Design Thinking methods to aid Service Design.

Unit III: Locating facilities and designing their layout	**04 Hours**

Models of facility locations (Huff's retail model), Role of service-scape in layout design.
Service Quality: SERVQUAL, Walk through Audit, Dimensions of Service quality & other quality tools.
Service Guarantee & Service Recovery: How to provide Service guarantee? How to recover from Service failure?

Unit IV: Forecasting Demand for Services	**04 Hours**

Forecasting Demand for Services: A review of different types of forecasting methods for demand forecasting. Managing Capacity and Demand: Strategies for matching capacity and demand, Psychology of waiting, Application of various tools used in managing waiting line in services. Managing Facilitating Goods: Review of inventory models, Role of inventoryin services.

Unit V: Managing service supply relationship	**04 Hours**
Managing service supply relationship: Understanding the supply chain/hub of service, Strategies for managing suppliers of service.	
Unit VI: Vehicle Routing Problem	**04 Hours**
Vehicle Routing Problem: Managing after sales service, understanding services that involve transportation of people and vehicle, Techniques for optimizing vehicle routes. Service Innovation: Services Productivity, Need for Services Innovation.	
Textbooks	
1. Fitzsimmons & Fitzsimmons, Service Management: Operations, Strategy, Information Technology, McGraw Hill publications (7th edition).	
Reference Books	
1. Wilson, A., Zeithaml, V. A., Bitner, M. J., & Gremler, D. D. (2012). Servicesmarketing: Integrating customer focus across the firm. McGraw Hill.	
2. Lovelock, C. (2011). Services Marketing, 7/e. Pearson Education India	
3. Reason, Ben, and Lovlie, Lavrans, (2016) Service Design for Business: A PracticalGuide to Optimizing the Customer Experience, Pan Macmillan India.	
4. Chesbrough, H. (2010). Open services innovation: Rethinking your business to growand compete in a new era. John Wiley & Sons.	
Topics for Project Based Learning: 1. Choose any service organization around and present it from the perspective of nature of service, classification of service, blueprint or service design analysis, service quality, and any additional perspective you would like to add. 2. Choose the latest research paper in services and explain your understanding and feedback on the same. 3. Case study of Huff's Retail model with reference to the service organization for locating different facilities. 4. Do a case study and prepare strategies for matching capacity and demand 5. Analyze the Psychology of waiting with reference to the service organization 6. Do a review of different types of forecasting methods for demand forecasting 7. Case study of inventory models, Role of inventoryin services. 8. Do a case study of supply chain/hub of service and prepare strategies for managing suppliers of service. 9. Prepare a case study Vehicle Routing Problem 10. Service industry requires continuous innovation. Do case study of its requirement	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

SEMINAR					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**- Hrs/Week**	**University Examination:**	**--**		
Practical:	**- 04 Hrs./Week**	**Internal Assessment:**	**--**	**Lecture**	**-**
		Term Work	**50**	**Practical**	**02**
		Oral	**50**		
		Total	**100**	**Total**	**02**

Course Objective:

The Seminar aims to:

1) Develop self-learning ability and research orientation

2) Enhance technical understanding of emerging technologies

3) Improve presentation and communication skills

4) Encourage analytical and critical thinking

5) Prepare students for industry discussions, higher studies, and interviews

Course Outcomes: On completion of the course, students will have the ability to:

1. Demonstrate an understanding of the organizational structure, workflow, and professional ethics of the host company.
2. Apply engineering principles and analytical skills to execute tasks or projects assigned by the industry mentor.
3. Utilize industry-standard software tools, IDEs, and version control systems (e.g., Git, Jira, Docker) to complete deliverables.
4. Prepare professional technical reports and deliver presentations documenting the work performed and challenges solved.
5. Function effectively as an individual or a member of a diverse team to meet project deadlines and objectives.
6. Identify and bridge skill gaps by learning new technologies or methodologies independently during the internship period.

GUIDELINES:

Scope of Topics

Students must select a topic from recent, relevant, and advanced areas such as:

i) Emerging/Recent Technologies

ii) Case Studies such as

Real-world system implementations (e.g., Smart Cities, Aadhaar, UPI)
Failure analysis of major IT systems
Security breaches (e.g., ransomware attacks)
Tech product architecture (e.g., Netflix, Google, Amazon systems)

iii) Research-Oriented Topics

Survey papers from IEEE, Springer, ACM
Comparative analysis of algorithms/technologies
Recent innovations (last 3–5 years)

iv) Interdisciplinary Topics such as

AI in Healthcare
IT in Agriculture
Smart Education Systems
Sustainable Technologies

What Students Are Expected to Do

Step 1: Topic Selection Choose a unique topic (no duplication in the batch) and get approval from seminar guide/faculty
Step 2: Literature Survey Refer minimum 5–8 quality sources like Research papers (IEEE, Springer, etc.), Technical blogs (credible sources), White papers / Industry reports Focus on recent developments (last 5 years)
Step 3: Content Preparation
Step 4: Report Writing Students must submit a Seminar Report (Approx. 20–25 pages) containing: • Abstract (1 page) • Introduction • Detailed explanation • Diagrams / charts • Case study (if applicable) • Conclusion • References (IEEE format)
Step 5: Presentation Prepare PPT (10–15 slides) Duration: 15–20 minutes presentation + 5–10 minutes Q&A Use diagrams, flowcharts, visuals
Step 6: Demonstration (Optional but Highly Encouraged) • Simulation / small prototype / video demo • Tools: Python, MATLAB, IoT kits, etc.

INTERNSHIP					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**-Hrs/Week**	**University Examination:**	**--**		
Practical:	**- Hrs./Week**	**Internal Assessment:**	**--**	**Lecture**	**-**
		Term Work	**150**	**Practical**	**14**
		Oral	**100**		
		Total	**250**	**Total**	**14**

Course Objective:

To provide exposure to the industrial environment and professional culture of the IT/Business sectors.

To apply theoretical knowledge gained in previous semesters to solve real-world technical or business problems.

To develop practical skills in modern tools, platforms, and emerging technologies currently used in the industry.

Prerequisite: Students should have

Proficiency in at least one programming language (Python, Java, or C++) and web/mobile development frameworks. Domain Knowledge: Foundational understanding of Database Management (SQL/NoSQL), Software Engineering principles, and Data Structures. Professional Readiness: Basics of workplace ethics, corporate communication, and time management.

Course Outcomes: On completion of the course, students will have the ability to:

1. Demonstrate an understanding of the organizational structure, workflow, and professional ethics of the host company.
2. Apply engineering principles and analytical skills to execute tasks or projects assigned by the industry mentor.
3. Utilize industry-standard software tools, IDEs, and version control systems (e.g., Git, Jira, Docker) to complete deliverables.
4. Prepare professional technical reports and deliver presentations documenting the work performed and challenges solved.
5. Function effectively as an individual or a member of a diverse team to meet project deadlines and objectives.
6. Identify and bridge skill gaps by learning new technologies or methodologies independently during the internship period.

GUIDELINES:

Internship Structure

Component	**Industry Internship**	**In-House Internship**
Duration	One full semester (16–20 weeks)	One full semester (16–20 weeks)
Mode	At Industry/Organization	Within Institute
Credits	14	14
Mentorship	Industry + Faculty Mentor	Faculty + Industry Expert
Evaluation	Continuous + Final	Continuous + Final

Industry Internship

Allocation

• Students may obtain internships through:
Institute
Off-campus applications
Faculty/Alumni references

Approval

• Internship must be approved by:

Department Internship Coordinator

Concerned Faculty Mentor

Requirements

• Minimum 16 weeks duration

• Work must be relevant to: XXVI o IT / Computer Science / Emerging Technologies

Students must submit:

Offer Letter

Joining Report

Weekly Logbook

Monitoring

• Weekly progress submission (online/offline)

• Minimum 2 reviews by faculty mentor

• Feedback from industry supervisor

Deliverables

• Internship Report (standard format)

• Work Diary / Logbook

• Project/Task Completion Proof

• Presentation & Viva

In-House Internship

Structure

• Designed by department in emerging domains, such as:

o Artificial Intelligence / Machine Learning

o Data Science

o Cybersecurity

o IoT / Embedded Systems

o Cloud Computing / DevOps

o Web/App Development

Execution Model

• Combination of:

o Structured Modules (30–40%)

o Hands-on Project Work (60–70%)

Mentorship

• Internal Faculty Mentor

• External Industry Expert (minimum 20–30% involvement)

Weekly Schedule

• Technical sessions (lectures/workshops)

• Lab/practical implementation

• Project development

• Weekly review meetings

Deliverables

• Module Assignments

• Mini Projects (phase-wise)

• Final Capstone Project

• Documentation + Presentation

Common Guidelines (Applicable to Both)

Attendance

• Minimum 80% attendance mandatory
• Industry: certified by company
• In-house: monitored by department

Logbook

• Weekly record of:
o Tasks performed
o Skills learned
o Challenges faced