
SCHEME OF INSTRUCTION AND SYLLABUS

B.Tech in Computer Science and Engineering

Regulation:VR23

w.e.f.2023-24



Department of Computer Science and Engineering

VELAGAPUDI RAMAKRISHNA SIDDHARTHA ENGINEERING COLLEGE

(An Autonomous, ISO 9001:2015 Certified Institution)

(Approved by AICTE, Accredited by NAAC with 'A+' Grade,
Affiliated to JNTUK, Kakinada)

(Sponsored by Siddhartha Academy of General & Technical Education)

Vijayawada, Andhra Pradesh - 520007, INDIA.

www.vrsiddhartha.ac.in



Institute Vision

To nurture excellence in various fields of engineering by imparting timeless core values to the learners and to mould the institution into a centre of academic excellence and advanced research.

Institute Mission

To impart high quality technical education in order to mould the learners into globally competitive technocrats who are professionally deft, intellectually adept and socially responsible. The institution strives to make the learners inculcate and imbibe pragmatic perception and proactive nature so as to enable them to acquire a vision for exploration and an insight for advanced enquiry.

Department Vision

The department vision is clearly defined and is in line with the college's vision. The vision of the department is "To evolve as a centre of academic excellence and advanced research in Computer Science and Engineering discipline."

Department Mission

This mission of the department is concise and supports the college's mission. The mission of the Computer Science and Engineering department is "To inculcate students with profound understanding of fundamentals related to discipline, attitudes, skills, and their application in solving real world problems, with an inclination towards societal issues and research."



Program Educational Objectives (Undergraduate)

We have program educational objectives for our Computer Science and Engineering program. Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

Our program educational objectives are:

The graduates of the program will

1. Have knowledge and analytical skills, including mathematics, science and basic engineering.
2. Have in-depth learning skills to function productively as leadership role or as supportive members in multidisciplinary teams with effective communication.
3. Have extensive knowledge in state-of the- art frameworks in Artificial Intelligence to design industry accepted AI solutions using modern tools for allied domains with realistic constraints or pursue higher studies and continue to develop their professional knowledge.
4. Practice the profession with ethics, integrity, leadership and social responsibility.



Program Outcomes

On successful completion of the B.Tech in CSE programme the student will be able to:

PO1 - *Engineering knowledge:* Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - *Problem analysis:* Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - *Design/development of solutions:* Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 - *Conduct investigations of complex problems:* Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 - *Modern tool usage:* Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 - *The engineer and society:* Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 - *Environment and sustainability:* Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 - *Ethics:* Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 - *Individual and team work:* Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 - *Communication:* Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 - *Project management and finance:* Demonstrate knowledge and understanding of the

engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 - Lifelong learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1: Develop software applications or solutions as per the needs of Industry and society.

PSO2: Adopt new and fast emerging technologies in computer science and engineering.

SCHEME OF INSTRUCTION

COURSE CATEGORY ABBREVIATIONS

1. Humanities and Sciences-HS
2. Basic Sciences-BS
3. Basic Sciences and Humanities-BSH
4. Engineering Science-ES
5. Program Core-PC
6. Soft Skills-SS
7. Skill Enhancement Course-SEC
8. Audit Course-AC
9. Mandatory Course-MC
10. Program Elective-PE
11. Open Elective-OE
12. Humanities and Social Sciences-HSS
13. Institutional Core-IC

**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME [VR23]**

Semester I

Contact Hours							27
S. No.	Course Code	Course Category	Course Name	L	T	P	C
1	23BS1101	BS	Linear Algebra & Calculus	3	0	0	3
2	23BS1102	BS	Engineering Physics	3	0	0	3
3	23ES1103A	ES	Basic Civil and Mechanical Engineering	3	0	0	3
4	23ES1104	ES	Introduction to Programming	3	0	0	3
5	23HS1105	HSS	Communicative English	2	0	0	2
6	23BS1151	BS	Engineering Physics Lab	0	0	2	1
7	23ES1152	ES	Computer Programming Lab	0	0	3	1.5
8	23HS1153	HSS	Communicative English Lab	0	0	2	1
9	23ES1154	ES	Engineering Workshop	0	0	3	1.5
10	23ES1155	ES	IT Workshop	0	0	2	1
11	23BS1156	BS	NSS/NCC/Community Service	0	0	1	0.5
12	23MC1106	MC	Induction Program				
Total				14	0	13	20.5

Semester II

Contact Hours							28
S. No.	Course Code	Course Category	Course Name	L	T	P	C
1	23BS2101	BS	Differential Equations Vector Calculus	3	0	0	3
2	23BS2102B	BS	Chemistry	3	0	0	3
3	23ES2103B	ES	Basic Electrical and Electronics Engineering	3	0	0	3
4	23PC2104A	PC	Data Structures	3	0	0	3
5	23ES2105	ES	Engineering Graphics	1	0	4	3
6	23BS2151B	BS	Chemistry Lab	0	0	2	1
7	23PC2152A	PC	Data Structures Lab	0	0	3	1.5
8	23ES2153	ES	Basic Electrical and Electronics Workshop	0	0	3	1.5
9	23BS2154B	BS	Health and wellness, Yoga and Sports	-	-	1	0.5
10	23MC2106	MC	Design Thinking	2	0	0	-
Total				15	0	13	19.5

Semester III

Contact Hours							24
S. No.	Course Code	Course Category	Course Name	L	T	P	C
1	23HS3101	HS	Engineering Economics & Management	2	0	0	2
2	23HS3102	BSH	Universal Human Values 2 -Understanding Harmony	2	1	0	3
3	23ES3103C	ES	Digital Logic & Computer Organisation	3	0	0	3
4	23CS3304	PC	Advanced Data Structures & Algorithms Analysis	3	0	0	3
5	23CS3305	PC	Object Oriented Programming Through Java	3	0	0	3
6	23TP3106	SS-1	Logic & Reasoning	0	0	2	1
7	23CS3651	SEC	Python Programming Lab	0	0	2	1
8	23CS3352	PC	Advanced Data Structures and Algorithms Lab	0	0	3	1.5
9	23CS3353	PC	Object Oriented Programming through Java Lab	0	0	3	1.5
Total				13	1	10	19

Semester IV

Contact Hours							30
S. No.	Course Code	Course Category	Course Name	L	T	P	C
1	23BS4101B	ES	Discrete Mathematics and Graph Theory	3	0	0	3
2	23BS4102B	BS	Probability & Statistics	3	0	0	3
3	23CS4303	PC	Operating Systems	3	0	0	3
4	23CS4304	PC	Database Management Systems	3	0	0	3
5	23CS4305	PC	Software Engineering	2	1	0	3
6	23TP4106	SS-2	English For Professionals	0	0	2	1
7	23MC4107	AC	Environmental Science	2	0	0	-
8	23CS4651	SEC	Full Stack Development-I	0	0	2	1
9	23ES4152	ES	Design Thinking & Innovation	1	0	2	2
10	23CS4353	PC	Operating Systems Lab	0	0	3	1.5
11	23CS4354	PC	Database Management Systems Lab	0	0	3	1.5
Total				17	1	12	22
Summer Internship 6 weeks (Mandatory) during summer vacation (EPICS)							
Honors/ Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)				4	0	0	4

[L - Lecture, T - Tutorial, P - Practical, C - Credits]

Semester V

S. No.	Course Code	Course Category	Course Name	Contact Hours			29
				L	T	P	C
1	23CS5301	PC	Data Warehousing and Data Mining	3	0	0	3
2	23CS5302	PC	Computer Networks	3	0	0	3
3	23CS5303	PC	Formal Languages and Automata Theory	3	0	0	3
4	23CS5404A 23CS5404B 23CS5404C 23CS5404D	PE I	A. Object Oriented Analysis and Design B. Artificial Intelligence C. Microprocessors & Micro controllers D. Internet of Things (IoT) E. 12 week MOOC Swayam/ NPTEL course recommended by the BoS	3	0	0	3
5	23CS5205A 23CS5205B	OE-I	A. Web Programming B. Internet of Things	3	0	0	3
6	23CS5351	PC Lab - 1	Data Mining Lab	0	0	2	1
7	23CS5352	PC Lab - 2	Computer Networks Lab	0	0	2	1
8	23HS5153	IC	Advanced Communication Skills Laboratory	0	0	2	1
9	23CS5651	SEC	Full Stack Development -II	0	0	2	1
10	23TP5106	SS-3	Personality Development	0	0	2	1
11		ES	User Interface Design using Flutter / SWAYAM Plus - Android Application Development (with Flutter)	0	0	2	1
12		Evaluation of Community Service Internship	EPICS	0	0	0	2
13			IPR	2	0	0	0
Total				17	0	12	23
Honors/ Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)				4	0	0	4

[L - Lecture, T - Tutorial, P - Practical, C - Credits]

NOTE: Open Elective-I is for the students of Non CSE/IT allied branches only.

Semester VI

Contact Hours							26
S. No	Course Code	Course Category	Course Name	L	T	P	C
1	23CS6301	PC	Compiler Design	3	0	0	3
2	23CS6302	PC	Cloud Computing	3	0	0	3
3	23CS6303	PC	Cryptography & Network Security	3	0	0	3
4	23CS6404	PE II	1. Software Testing Methodologies 2. Cyber Security 3. DevOps 4. Machine Learning 5. Any of the 12-Week SWAYAM / NPTEL Course suggested by the BoS	3	0	0	3
5	23CS6405	PE III	1. Software Project Management 2. Mobile Adhoc Networks 3. Natural Language Processing 4. Distributed Operating System 5. Any of the 12-Week SWAYAM /NPTEL Course suggested by the BoS	3	0	0	3
6	23CS6206	OE II	Principles of Database Management Systems	3	0	0	3
7	23CS6351	PC Lab-I	Cloud Computing Lab	0	0	3	1.5
8	23CS6352	PC Lab-II	Cryptography & Network Security Lab	0	0	3	1.5
9		SS - 4	Quantitative Aptitude	0	0	2	1
Total				18	0	8	22
Honors/ Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)				4	0	0	4

[L - Lecture, T - Tutorial, P - Practical, C - Credits]

Semester VII

Contact Hours							21
S. No.	Course Code	Course Category	Course Name	L	T	P	C
1	23CS7301	PC	Deep Learning	3	0	0	3
2	23CS7402	HSS	Human Resources & Project Management	2	0	0	2
3	23CS7403	PE IV	1. Software Architecture & Design Patterns 2. Blockchain Technology 3. Augmented Reality & Virtual Reality 4. Quantum Computing 5. 12 week MOOC Swayam/ NPTEL course recommended by the BoS	3	0	0	3
4	20CS7404	PE V	1. Agile methodologies 2. Generative AI 3. Computer Vision 4. Cyber Physical Systems 5. 12 week MOOC Swayam/ NPTEL course recommended by the BoS	3	0	0	3
5	20CS7205	OE III	Object Oriented Programming Through Java	3	0	0	3
6	20CS7206	OE IV	A. Principles of Software Engineering B. Computer Networks	3	0	0	3
7		SEC	Prompt Engineering/ SWAYAM Plus - Certificate program in Prompt Engineering and ChatGPT	0	1	2	2
8		AC	Constitution of India	2	0	0	-
9		Internship	Evaluation of Industry Internship/Mini Project	0	0	0	2
Industrial/ Research Internship six weeks (Mandatory) during summer vacation							
Honors/ Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)				0	0	0	4

L - Lecture, T - Tutorial, P - Practical, C - Credits

Note: Open Elective II and Open Elective IV are self-learning. Students may opt from any MOOCs platforms. They have to submit the certificate before the last instruction day of VII semester. Course selection for MOOCs is subject to approval by the Head of the Department.

Semester VIII

Contact Hours							24
S. No.	Course Code	Course Category	Course Name	L	T	P	C
1	23CS8551	**Internship & Project Work	Full semester Internship and Project Work	0	0	24	12
Total				0	0	24	12

[L - Lecture, T - Tutorial, P - Practical, C - Credits]

****** In Semester VIII, The student should undergo internship and simultaneously he/she should work on a project with well-defined objectives. At the end of the semester the student should submit an internship completion certificate and a project report.

****** If any of our associated company comes forward to offer an emerging course that will be offered as an industry offered course in V, VI or VII semesters under program elective with the approval of BoS. This is incorporated to enhance student skills and employability in cutting edge technologies.

Minor:

To obtain Minor Engineering, student needs to obtain 18 credits by successfully completing any of the following courses in the concern stream.

During Minor/Honors Course selection, there should not be any overlapping with Regular/Major/OPEN Electives

For Minor in CSE:

L-T-P-C

- | | |
|--|--------------------|
| 1. Advanced Data Structures & Algorithm Analysis | 3-0-3-4.5 (II-II) |
| 2. Principles of Operating Systems | 3-0-0-3 (III-I) |
| 3. Principles of Database Management Systems | 3-0-3-4.5 (III-II) |
| 4. Principles of Software Engineering | 3-0-0-3 (IV-I) |

Any of the following 12 Week 3 credit NPTEL MOOC Courses

5. Artificial Intelligence: Knowledge Representation and Reasoning
6. Computer Networks and Internet Protocol
7. Machine Learning and Deep Learning - Fundamentals and Applications
8. Fundamentals of Object Oriented Programming
9. Discrete Mathematics for CS
10. Software Engineering

Open Electives, offered to other department students:

Open Elective I: Principles of Operating Systems/ Computer Organization and Architecture

Open Elective II: Principles of Database Management Systems

Open Elective III: Object Oriented Programming Through Java

Open Elective IV: Principles of Software Engineering /Computer Networks

COURSES OFFERED FOR HONORS DEGREE IN CSE

Note: To obtain Honor's degree, student needs to obtain 18 credits by successfully completing any of the following courses in the concern stream. (without duplication)

Suggested MOOC Courses for HONORS in CSE

Student need to obtain 18 Credits by successfully completing the following

Mandatory Course(s):

1. Parallel Computer Architecture (MOOCS- SWAYAM / NPTEL 12W)
2. Quantum Algorithms and Cryptography (MOOCS- SWAYAM / NPTEL 12W)

Any of the following for remaining 12 Credits

3. Deep Learning for Computer Vision (MOOCS- SWAYAM / NPTEL 12W)
4. Applied Linear Algebra in AI & ML (MOOCS- SWAYAM / NPTEL 12W)
5. Applied Time-Series Analysis (MOOCS- SWAYAM / NPTEL 12W)
6. Machine Learning for Engineering and Science Applications (MOOCS- SWAYAM / NPTEL 12W)
7. Practical High-Performance Computing (MOOCS- SWAYAM / NPTEL 12W)
8. Deep Learning for Natural Language Processing (MOOCS- SWAYAM / NPTEL 12W)
9. Privacy and Security in Online Social Media (MOOCS- SWAYAM / NPTEL 12W)
10. Natural Language Processing (MOOCS- SWAYAM / NPTEL 12W)
11. Introduction to Large Language Models (LLMs) (MOOCS- SWAYAM / NPTEL 12W)
12. Responsible & Safe AI Systems (MOOCS- SWAYAM / NPTEL 12W)
13. Ethical Hacking (MOOCS- SWAYAM / NPTEL 12W)
14. Introduction To Industry 4.0 And Industrial Internet of Things (MOOCS- SWAYAM / NPTEL 12W)

Proposed Open Elective II and IV Courses:**Open Elective II**

S.No	Course Code	Course Name
1.	23CSxxxA/ 23AI&DSxxxxA/ 23AI&MLxxxxA	Foundations of R Software
2.	23CSxxxB/ 23AI&DSxxxxB/ 23AI&MLxxxxB	Social Networks
3.	23CSxxxC/ 23AI&DSxxxxC/ 23AI&MLxxxxC	Introduction to Industry 4.0 And Industrial Internet Of Things
4.	23CSxxxD/ 23AI&DSxxxxD/ 23AI&MLxxxxD	Any Other Course approved by BOS

Open Elective IV

S.No	Course Code	Course Name
1.	23CSxxxA/ 23AI&DSxxxxA/ 23AI&MLxxxxA	Programming in Modern C++
2.	23CSxxxB/ 23AI&DSxxxxB/ 23AI&MLxxxxB	Ethical Hacking
3.	23CSxxxC/ 23AI&DSxxxxC/ 23AI&MLxxxxC	Privacy and Security in Online Social Media
4.	23CSxxxD/ 23AI&DSxxxxD/ 23AI&MLxxxxD	Any Other Course approved by BOS

SEMESTER III

23HS3101

ENGINEERING ECONOMICS AND MANAGEMENT

Course Category	Humanities and Sciences	Credits	2
Course Type	Theory	L-T-P	2-0-0
Prerequisites	–	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the principles of management and various forms of organizations.
2. Understand the various aspects of business economics.
3. Perceive the knowledge on Human resources and Marketing functions.
4. Evaluate various alternatives economically and methods of calculating depreciation.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2											2		2	2	1.7.1, 1.2.2, 1.6.1 12.4.1, 12.6.1
2	2				3							2		2	2	1.7.1, 1.2.2, 1.6.1, 5.4.1, 5.5.2, 12.6.1
3	2											2		2	2	1.7.1, 1.2.2, 1.6.1 12.5.2
4	2				3							2		2	3	1.7.1, 1.2.2, 1.6.1, 5.4.1, 5.5.2, 12.6.2

COURSE CONTENT

UNIT I

Management: Introduction to Management, Functions of Management, Principles of Scientific Management, Modern Principles of Management.

Forms of Business Organization: Salient Features of Sole Proprietorship, Partnership, Joint Stock Company, Co-operative Society and Public Sector.

UNIT II

Introduction to Economics: Introduction to Basic Economic Concepts, Utility Analysis: Marginal Utility and Total Utility, Law of Diminishing Marginal Utility, Law of Equi Marginal Utility.

Demand Analysis: Theory of Demand: Demand Function, Factors Influencing Demand, Demand Schedule and Demand Curve, Shift in Demand, Elasticity of Demand: Elastic and Inelastic Demand, Types of Elasticity.

Supply Analysis: Supply Schedule and Supply Curve, Factors Influencing Supply, Supply Function.

UNIT III

Human Resource Management: Meaning and difference between Personnel Management and Human Resource Management, Functions of Human Resource Management.

Marketing Management: Concept of Selling And Marketing – Differences, Functions of Marketing, Product Life Cycle, Concept of Advertising, Sales Promotion, Types of Distribution Channels, Marketing Research, Break-Even Analysis.

UNIT IV

Financial Management: Functions of Financial Management, Time value of money with cash flow diagrams, Concept of Simple and Compound Interest.

Economic Alternatives: Methods of Evaluating Alternatives under Present worth method, Future worth method, Annual Equivalent method - Problems. **Depreciation:** Causes of depreciation, Factors influencing depreciation, common methods of Depreciation: Straight Line Method, Declining Balance Method, Sum of Year's Digits Method –Problems.

TEXTBOOKS

1. M. Mahajan, Industrial Engineering and Production Management, Dhanpat Rai Publications, 2nd Edition, 2015.
2. Martand Telsang, Industrial & Business Management, S.Chand publications, 1st Edition, 2001.

REFERENCE BOOKS

1. R.Paneerselvam, Production and Operations Management, PHI, 3rd Edition, 2012.
2. Philip Kotler & Gary Armstrong, Principles of Marketing, Pearson Prentice Hall, New Delhi, 17th Edition, 2012.
3. IM Pandey, Financial Management, Vikas Publications 11th Edition, 2011.
4. B.B Mahapatro, Human Resource Management, New Age , 1st Edition, 2011.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Law of Supply, <https://www.toppr.com/guides/fundamentals-of-economics-and-management/supply/supply-function/>, Last Accessed On : 22/05/2024.
2. Personnel Management Vs. Human Resource Management, <https://keydifferences.com/\difference-between-personnel-management-and-human-resource-management.html>, Last Accessed On: 12/06/2024.
3. Product Life Stages Cycle, <http://productlifecyclestages.com/>, Last Accessed On: 10/04/2024.

23HS3102

UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

Course Category	Basic Sciences and Humanities	Credits	3
Course Type	Mandatory course (suggested by AICTE)	L-T-P	2-1-0
Prerequisites	Universal Human Values 1	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand and aware of themselves and their surroundings(family, society and nature).
2. Handle problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. Exhibit critical ability and become sensitive to their commitment towards their understanding of human values, human relationship and human society.
4. Apply what they have learnt to their own self in different day-to-day settings in real life.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1						1			2						2	6.1.1, 9.2.1, 9.2.2, 9.2.3
2			3												2	3.1.1, 3.2.3
3						2									2	6.2.1
4								3				2			3	8.1.1, 8.2.2 12.1.1, 12.2.2

COURSE CONTENT

UNIT I

Course introduction, need, basic guidelines, content and process for value education:

Part-1: Purpose and motivation for the course, recapitulation from UHV-I, Self-exploration: what is it?, its content and process, 'Natural acceptance' and experiential validation- as the process for self-exploration. Continuous Happiness and Prosperity

– A look at basic Human Aspirations.

Part-2: Right understanding, Relationship and Physical Facility – the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly – A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels. (Practice sessions are to be included to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking).

UNIT II *Understanding Harmony in the Human Being – Harmony in Myself:*

Part-1: Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’. Understanding the needs of Self (‘I’) and ‘Body’ – happiness and physical facility, Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer).

Part-2: Understanding the characteristics and activities of ‘I’ and harmony in ‘I’. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health. (Practice sessions are to be included to discuss the role others have played in making material goods available to me. Identifying from one’s own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs. dealing with disease).

UNIT III *Understanding Harmony in the Family and Society – Harmony in Human-Human Relationship:*

Part-1: Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.

Part-2: Understanding the harmony in the society (society being an extension of family); Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society–Undivided Society, Universal Order–from family to world family. (Practice sessions are to be included to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education, etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students’ lives).

UNIT IV *Understanding Harmony in Nature & Existence – Whole existence as Coexistence:*

Part-1: Understanding the harmony in the Nature, Inter-connectedness and mutual fulfillment among the four orders of Nature – recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

Part-2: Natural acceptance of human values, Definitiveness of ethical human conduct, Basis for humanistic education, humanistic constitution and humanistic universal order, Competence in professional ethics: a) ability to utilize the professional competence for augmenting universal human order, b) ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c) ability to identify and develop appropriate technologies and management patterns for above production systems, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) at the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) at the level of society: as mutually enriching institutions and organizations.

(Part-1: Practice sessions are to be included to discuss human being as cause of imbalance in nature (film “Home” can be used), pollution, depletion of resources and role of technology, etc.

Part-2: Practice exercises and case studies are to be taken up in practice (tutorial) sessions eg. to discuss the conduct as an engineer or scientist, etc.)

TEXTBOOKS

1. R. R. Gaur, R. Asthana and G. P. Bagaria, A Foundation Course in Human Values and Professional Ethics, Excel Books Private Limited, New Delhi, 2nd Revised Edition, 2019.
2. R. R. Gaur, R. Sangal and G. P. Bagaria, A Foundation Course in Human Values and Professional Ethics, Excel Books Private Limited, New Delhi, 1st Edition, 2010

REFERENCE BOOKS

1. Pandit Sunderlal, Prabhath Prakashan, Bharat Mein Angreji Raj, Delhi , 2018
2. J. C. Kumarappa, Sarva-Seva-Sangh Prakashan, Economy of Permanence, Varanasi, 2017.
3. Annie Leonard, The Story of Stuff: The impact of overconsumption on the planet, our communities, and our health and how we can make it better, Free Press, New York, 2010.
4. Romain Rolland, Advaita Ashrama, The Life of Vivekananda and the Universal gospel, India, 2010.
5. Mohandas Karamchand Gandhi, The story of my experiments with truth: Mahatma Gandhi Autobiography, B. N. Publishing, 2008.
6. Cecile Andrews, Slow is beautiful: New Visions of Community, New Society Pub-

- lishers, Canada, 2006.
7. A. N. Tripathi, Human Values, New Age International Publishers, New Delhi, 2004.
 8. Dharampal, Rediscovering India, Society for Integrated Development of Himilaya, 2003.
 9. Romain Rolland, Srishti Publishers & Distributors, Mahatma Gandhi: The Man who become one with the Universal Being, New Delhi, 2002.
 10. A. Nagaraj, JeevanVidya Prakashan, Amarkantak, JeevanVidya: EkParichaya, 1999.
 11. Maulana Abul Kalam Azad, Orient Blackswan, India Wins Freedom: The Complete Version, 1988.
 12. E. F. Schumacher, Small is beautiful: A study of economics as if people mattered, Vintage Books, London, 1993

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. A Foundation Course in Human Values and Professional Ethics, <https://dokumen.pub/a-foundation-course-in-human-values-and-professional-ethicsfirstnbsped-9788174467812.html>, Last Accessed On: 12/05/2024.
2. AICTE – SIP, https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLax6AhQ, Last Accessed On: 16/3/2024.
3. AICTE UHV Teaching Learning Material, <https://fdp-si.aicte-india.org/download.php#1>, Last Accessed On: 28/3/2024.

23ES3103C

DIGITAL LOGIC & COMPUTER ORGANISATION

Course Category	Engineering Science	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23ES2103B	Continuous Eval	30
	Basic Electrical and Electronics	Semester End Eval	70
	Engineering	Total Marks	100

COURSE OUTCOMES

1. Understand digital logic principles and basic structure of a computer.
2. Apply concepts of combinational and sequential logic to design digital circuits.
3. Apply algorithms to perform arithmetic operations on fixed point and floating point data.
4. Understand Processor, Memory and I/O organization of basic computer.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2													2	2	1.2.1, 1.7.1
2	1	2	2										1		3	1.7.1, 2.7.1, 2.7.2, 3.7.1, 3.8.1
3	1	2													3	1.6.1, 1.7.1, 2.7.1, 2.8.1
4	1	2												2	2	1.7.1, 2.7.1, 2.8.1

COURSE CONTENT

UNIT I

Data Representation: Binary Numbers, Fixed Point Representation, Floating Point Representation, Number base conversions, Octal and Hexadecimal Numbers, Complements, Signed binary numbers, Binary codes.

Digital Logic Circuits-I: Basic Logic Functions, Logic gates, universal logic gates, Minimization of Logic Expressions. K-Map Simplification, Combinational Circuits, Decoders, Multiplexers

UNIT II

Digital Logic Circuits-II: Sequential Circuits, Flip-Flops, Binary counters, Registers, Shift Registers, Ripple counters.

Basic Structure of Computers: Computer Types, Functional units, Basic operational concepts, Bus structures, Software, Performance, multiprocessors and multi computers, Computer Generations, VonNeumann Architecture.

UNIT III

Computer Arithmetic : Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed-operand Multiplication, Fast Multiplication, Integer Division, Floating-Point Numbers and Operations.

Processor Organization: Fundamental Concepts, Execution of a Complete Instruction, Multiple-Bus Organization, Hardwired Control and Multi programmed Control.

UNIT IV

The Memory Organization: Basic Concepts, Semiconductor RAM Memories, Read-Only Memories, Speed, Size and Cost, Cache Memories, Performance Considerations, Virtual Memories, Memory Management Requirements, Secondary Storage.

Input/Output Organization: Accessing I/O Devices, Interrupts, Processor Examples, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interface.

TEXTBOOKS

1. Morris Mano, Digital Logic and Computer Design, Pearson Education, 16th Impression, 2016.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, McGraw Hill, 5th Edition, 2014.
3. William Stallings, Computer Organization and Architecture, Pearson Education, 11th Edition, 2012.

REFERENCE BOOKS

1. M.Moris Mano, Computer Systems Architecture, Pearson Education, 3rd Edition, 2009.
2. Design, David A. Paterson, John L. Hennessy, Elsevier, Computer Organization and 2nd Edition, 2010.
3. Roth, Fundamentals of Logic Design, Thomson, 5th Edition, 2014.

E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. IIT Guwahati Prof. Jatindra Kumar Deka <https://nptel.ac.in/courses/106103068>, Computer Organization and Architecture, Last Accessed On: 31-05-2024.

23CS3304**ADVANCED DATA STRUCTURES & ALGORITHMS ANALYSIS**

Course Category	Program Core	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23PC2104A	Continuous Eval	30
	Data Structures	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the functions of different nonlinear data structures- binary trees, search trees.
2. Apply graph-based algorithms, design technique - divide and conquer, and greedy methods for solving complex problems.
3. Apply dynamic programming and backtracking design techniques to solve complex problems.
4. Apply the concepts of Branch and Bound techniques to solve complex problems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	1	2											1	1	2	1.2.1, 1.6.1, 1.7.1, 2.5.2
2	1	2	3										1	1	3	1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.4, 3.5.1
3	1	2	3										1	1	3	1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.7.1, 3.5.1
4	1	2	3										1	1	3	1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.4, 2.7.1, 3.5.1

COURSE CONTENT**UNIT I**

Introduction to Algorithm Analysis: Space and Time Complexity analysis, Asymptotic Notations.

AVL Trees Creation, Insertion, Deletion operations and Applications.

B-Trees Creation, Insertion, Deletion operations and Applications.

Heap Trees (Priority Queues) Min and Max Heaps, Operations and Applications.

UNIT II

Graphs: Terminology, Representations, Basic Search and Traversals, Connected Components and Biconnected Components, applications

Divide and Conquer: The General Method, Quick Sort, Merge Sort, Stassen's matrix multiplication, Convex Hull

Greedy Method: General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees, Single Source Shortest Paths.

UNIT III

Dynamic Programming: General Method, All pairs shortest paths, Single Source Shortest Paths– General Weights (Bellman Ford Algorithm), Optimal Binary Search Trees, 0/1 Knapsack, String Editing, Travelling Salesperson problem.

Backtracking: General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring, 0/1 Knapsack Problem.

UNIT IV

Branch and Bound:The General Method,0/1Knapsack Problem, Travelling Salesperson problem.

NP Hard and NP Complete Problems: Basic Concepts, Cook's theorem.

NP Hard Graph Problems:Clique Decision Problem (CDP), Chromatic Number Decision Problem (CNDP), Traveling Salesperson Decision Problem (TSP).

NP Hard Scheduling Problems:Scheduling Identical Processors, Job Shop Scheduling.

TEXTBOOKS

1. Reema Thareja, Data Structures using C, Oxford University Press, 2nd Edition, 2014. (Unit I)
2. Ellis Horowitz, Satraj Sahni and Rajasekharan, Fundamentals of Computer Algorithms, Galgotia Publications Pvt. Ltd, 2nd Edition, 2008. (Unit II, III, and IV).

REFERENCE BOOKS

1. Horowitz Sahni and Anderson-Freed, Fundamentals of Data Structures in C, Universities Press, 2nd Edition, 2008.
2. Richard F.Gilberg & B.A.Forouzan, Data Structures A Pseudo code Approach with C, Cengage Learning, 2nd Edition, 2007.
3. M.T.Goodrich and R.Tomassia, Algorithm Design: Foundations, Analysis and Internet examples, John Wiley and sons, 2nd Edition, 2006.
4. T.H.Cormen, C.E.Leiserson, R.L.Rivest and C.Stein, Introduction to Algorithms, Mit Press, 3rd Edition, 2009.
5. Allen Weiss, Data structures and Algorithm Analysis in C, Pearson Education, 2nd Edition, 2002.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Advanced Data Structures Course, <https://www.tutorialspoint.com/advanceddatastructures/index.asp>, Last Accessed On: 31/5/2024.
2. Computer Algorithms, <http://peterindia.net/Algorithms.html>, Last Accessed on: 24-06-2024.

23CS3305**OBJECT ORIENTED PROGRAMMING THROUGH JAVA**

Course Category	Program Core	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23ES1104	Continuous Eval	30
	Introduction to	Semester End Eval	70
	Programming	Total Marks	100

COURSE OUTCOMES

1. Understand the basic concepts of object oriented programming.
2. Interpret multiple inheritances through interfaces for a given application.
3. Apply exceptions, thread capabilities and handling files on a given application.
4. Illustrate the use of functional programming and Collections framework for a given application.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	3													2	1.7.1, 2.5.1, 2.5.2, 2.7.1
2	2	2	3										2	2	3	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.7.1, 3.5.1, 3.8.2
3	2	2	3										2	2	3	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 3.8.2
4	1	2	3	2	2								2	2	3	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 3.6.2, 3.8.2, 4.6.2, 5.4.2

COURSE CONTENT**UNIT I**

Introduction, The History and Evolution of Java: Java history and evolution, Java features, Java's Magic: Byte Code, How Java differs from C and C++.

An Overview of Java: Object Oriented Programming: Two paradigms, Principles of OOP, A First simple Program and Control statements. Data Types, Variables and Arrays: Java keywords, Primitive types, Integers, Floating-Point Types, Characters, Booleans, Variables, Operators, Type Conversion, Casting and Arrays.

Introducing Classes and Objects: Class fundamentals, declaring objects, assigning object reference variables, introducing methods, constructors, this keyword, Garbage collection, overloading methods, using objects as parameters, returning objects, static and final keywords, nested and inner classes.

UNIT II

String Handling: The String Constructors, String Buffer Class, String Tokenizer class.

Inheritance: Inheritance basics, using super, multilevel hierarchy, method overriding, dynamic method dispatch, using abstract classes, final with inheritance.

Packages & Interfaces: Defining a package, finding package and CLASSPATH. Access protection, importing packages, Defining an interface, implementing interfaces, nested interfaces, applying interfaces, variables in interfaces.

UNIT III

Exception handling: Exception handling fundamentals, exception types, uncaught exceptions, using try and catch, multiple catch clauses, throw, throws, finally, creating your own exception subclasses.

I/O streams: Byte Streams- Input Stream, Output Stream, File Input Stream, File Output Stream, Character Streams- Reader, Writer, File Reader, and File Writer.

Multithread Programming: The Java Thread Model, Creating a thread: Implementing Runnable, Extending Thread, creating multiple threads, Thread Priorities, Synchronization- Using Synchronized methods, The synchronized Statement.

UNIT IV

Pragmatic Functional Programming using Lambdas: Introduction to Functional programming, Functional Programming concepts and terminology, Functional Interfaces, Working with Lambda Expressions and Method References.

Collections Framework: Collections overview, Collection interfaces: Collection, List, and Set. Collection Classes: Array List, Linked List, Hash Set. Map Classes: Hash Map, Tree Map

The Stream API: Stream basics, Reduction operations, Using parallel streams, Mapping, Collecting, Iterators and Streams.

TEXTBOOKS

1. Herbert Schildt, Java The Complete Reference, Oracle Press, 11th Edition, 2019.

REFERENCE BOOKS

1. Herbert Schildt, Dale Skrien, Java Fundamentals: A Comprehension Introduction, McGraw-Hill Education India Pvt., Special Indian Edition, Ltd, 2017.
2. E Balaguruswamy, Programming with Java, Mc Graw Hill, 4th Edition, 2020.
3. Paul J. Dietel and Dr. Harvey M. Deitel, "Java How to Program", Deitel & Associates, 11th Edition, 2018.

4. Timothy Budd, Understanding Object Oriented Programming with Java, Pearson Education, Updated edition, 2013.
5. Kathy Sierra & Bert Bates, Head First Java, Oreilly, 2nd Edition, 2023.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Debasis Samanta, Department of Computer Science & Engineering, I.I.T, Kharagpur, Swayam, NPTEL, https://onlinecourses.nptel.ac.in/noc21_cs03/preview, Last Accessed On: 14/04/ 2024.
2. Evan Jones, Adam Marcus, Eugene Wu Introduction to Programming in Java, MIT OpenCourseWare, Massachusetts Institute of Technology, <https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/>, Last Accessed On: 28/05/2024.
3. Prof. Owen Astrachan, Object Oriented Programming in Java, Duke University, <https://www.coursera.org/specializations/object-oriented-programming>, Last Accessed On: 21/05/2024.
4. Dheeru Mundluru, Java In-Depth: Become a Complete Java Engineer, Udemy, <https://www.udemy.com/course/java-in-depth-become-a-complete-java-engineer/>, Last Accessed On: 14/05/2024.
5. Prof. Olufisayo Omojokun, Introduction to OOPS with Java I: Foundations and Syntax Basics, Georgia Institute of Technology, edX, <https://www.edx.org/certificates/professional-certificate/gtx-introduction-to-object-oriented-programming-with-java>, Last Accessed On: 04/05/2024.

23TP3106

LOGIC & REASONING

Course Category	Soft Skill-1	Credits	1
Course Type	Theory	L-T-P	0-0-2
Prerequisites	–	Continuous Eval	100
		Semester End Eval	0
		Total Marks	100

COURSE OUTCOMES

1. Think reason logically in any critical situation.
2. Analyze given information to find correct solution.
3. To reduce the mistakes in day to day activities in practical life.
4. Develop time management skills by approaching different shortcut methods.
5. Use mathematical based reasoning to make decisions.
6. Apply logical thinking to solve problems and puzzles in qualifying exams for companies and in other competitive exams.

COURSE CONTENT

UNIT I

1. Series Completion
2. Coding-Decoding
3. Blood Relation
4. Puzzles test

UNIT II

1. Direction sense test
2. Logical Venn diagrams
3. Number test, ranking test
4. Mathematical operations

UNIT III

1. Arithmetical Reasoning
2. Inserting missing character
3. Syllogism
4. Binary logic
5. Data sufficiency

UNIT IV

1. Water images
2. Mirror images
3. Paper folding
4. Paper cutting
5. Embedded Figures
6. Dot situation

7. Cubes & Dice

TEXTBOOKS

1. R. S. Aggarwal, Verbal and non-verbal reasoning, S Chand publication, Revised Edition, 2017, ISBN:81-219-0551-6,
2. Vikramjeeth, Reasoning Guru Verbal & Non-Verbal Reasoning, Multilingual Edition, 2023, ISBN :978-9358706000.

23CS3651

PYTHON PROGRAMMING LAB

Course Category	Skill Enhancement Course	Credits	1
Course Type	Laboratory	L-T-P	0-0-2
Prerequisites	23ES1152 Computer Programming Lab	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Introduce core programming concepts of Python programming language.
2. Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
3. Implement Functions, Modules and Regular Expressions in Python Programming and to create practical and contemporary applications using these.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	2	1											1	1	1.6.1, 1.7.1, 2.5.2, 3.6.1, 3.7.2
2	2	2		2										1	1	1.7.1, 1.5.1, 2.5.1, 2.6.2, 4.4.2, 4.5.1
3	3		2		2									1	1	1.6.1, 1.7.1, 3.6.1, 3.6.3, 3.8.3, 5.4.2

UNIT-I:

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupiter Notebook.

Parts of Python Programming Language: Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: if statement, if-else statement, if...elif...else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a Program to display all prime numbers within an interval
3. Write a program to swap two numbers without using a temporary variable.
4. Demonstrate the following Operators in Python with suitable examples. i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators
5. Write a program to add and multiply complex numbers
6. Write a program to print multiplication table of a given number.

UNIT-II:

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments. Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings. Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

Sample Experiments:

1. Write a program to define a function with multiple return values.
2. Write a program to define a function using default arguments.
3. Write a program to find the length of the string without using any library functions.
4. Write a program to check if the substring is present in a given string or not.
5. Write a program to perform the given operations on a list: i. Addition ii. Insertion iii. Slicing 6. Write a program to perform any 5 built-in functions by taking any list.

UNIT-III:

Dictionaries: Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement. Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Using zip() Function, Sets, Set Methods, Frozenset.

Sample Experiments:

1. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
2. Write a program to count the number of vowels in a string (No control flow allowed).
3. Write a program to check if a given key exists in a dictionary or not.
4. Write a program to add a new key-value pair to an existing dictionary.
5. Write a program to sum all the items in a given dictionary.

UNIT-IV:

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules. Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes Vs Data Attributes, Encapsulation, Inheritance, Polymorphism.

Sample Experiments:

1. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
2. Python program to print each line of a file in reverse order.
3. Python program to compute the number of characters, words and lines in a file.
4. Write a program to create, display, append, insert and reverse the order of the items in the array.
5. Write a program to add, transpose and multiply two matrices.
6. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter.
7. Implement subclasses for different shapes like circle, triangle, and square.

UNIT-V:

Introduction to Data Science: Functional Programming, JSON and XML in Python, NumPy with Python, Pandas.

Sample Experiments:

1. Python program to check whether a JSON string contains complex object or not.
2. Python Program to demonstrate NumPy arrays creation using array () function.
3. Python program to demonstrate use of ndim, shape, size, dtype.
4. Python program to demonstrate basic slicing, integer and Boolean indexing.
5. Python program to find min, max, sum, cumulative sum of array
6. Create a dictionary with at least five keys and each key represent value as a list where this list contains at least ten values and convert this dictionary as a pandas data frame and explore the data through the data frame as follows: a) Apply head () function to the pandas data frame b) Perform various data selection operations on Data Frame
7. Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in matplotlib

TEXT BOOKS

1. Anuradha A. Puntambekar, Programming and Problem Solving using Python (Fundamentals and Applications), Technical Publication, 1st Edition, 2020.

REFERENCE BOOKS

1. Gowri shankar S, Veena A, Introduction to Python Programming, CRC Press, Special Indian Edition, 2019.
2. S Sridhar, J Indumathi, V M Hariharan, Python Programming, Pearson Education, 2nd Edition, 2024
3. Daniel Liang, Introduction, to Programming Using Python, Y, Pearson Education, 1st Edition, 2023.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Python for Data Science, AI & Development, <https://www.coursera.org/learn/python-for-applied-data-science-ai>, Last Accessed On: 19/03/2024.
2. Programming for Everybody (Getting Started with Python), <https://www.coursera.org/learn/python?specialization=python#syllabus>, Last Accessed On: 05/04/2024.

23CS3352**ADVANCED DATA STRUCTURES & ALGORITHMS LAB**

Course Category	Program Core	Credits	1.5
Course Type	Laboratory	L-T-P	0-0-3
Prerequisites	23PC2152A	Continuous Eval	30
	Data Structures Lab	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Implement AVL trees, B-Trees, and Heap Trees, efficient binary trees, M-way search trees, graph traversal and shortest path algorithms.
2. Implement graph-based algorithms, design technique - divide and conquer, and greedy methods for solving complex problems.
3. Implement solutions for problems using dynamic programming and backtracking.
4. Apply Branch and Bound techniques to write programs for different problems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	2											3		3	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.3
2	2	3	3										3		3	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1
3	2	3	3										3		3	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1
4	2	3	3										3		3	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1

Experiments covering the Topics:

1. Operations on AVL trees, B-Trees, Heap Trees
2. Graph Traversals
3. Sorting techniques
4. Minimum cost spanning trees
5. Shortest path algorithms
6. 0/1 Knapsack Problem
7. Travelling Salesperson problem
8. Optimal Binary Search Trees

9. N-Queens Problem
10. Job Sequencing

Sample Programs:

1. Construct an AVL tree for a given set of elements which are stored in a file. And implement insert and delete operation on the constructed tree. Write contents of tree into a new file using in-order.
2. Construct B-Tree an order of 5 with a set of 100 random elements stored in array. Implement searching, insertion and deletion operations.
3. Construct Min and Max Heap using arrays, delete any element and display the content of the Heap.
4. Implement BFT and DFT for given graph, when graph is represented by a) Adjacency Matrix b) Adjacency Lists
5. Write a program for finding the biconnected components in a given graph.
6. Implement Quick sort and Merge sort and observe the execution time for various input sizes (Average, Worst and Best cases).
7. Compare the performance of Single Source Shortest Paths using Greedy method when the graph is represented by adjacency matrix and adjacency lists.
8. Implement Job Sequencing with deadlines using Greedy strategy.
9. Write a program to solve 0/1 Knapsack problem Using Dynamic Programming.
10. Implement N-Queens Problem Using Backtracking.
11. Use Backtracking strategy to solve 0/1 Knapsack problem.
12. Implement Travelling Sales Person problem using Branch and Bound approach.

TEXTBOOKS

1. Reema Thareja, Data Structures using C, Oxford University Press, 2nd Edition, 2014.
2. Ellis Horowitz, Satraj Sahni and Rajasekharan, Fundamentals of Computer Algorithms, Galgotia Publications Pvt. Ltd, 2nd Edition, 2008.

REFERENCE BOOKS

1. Horowitz Sahni and Anderson-Freed, Fundamentals of Data Structures in C, Universities Press, 2nd Edition, 2008.
2. Richard F.Gilberg & B.A.Forouzan, Data Structures A Pseudo code Approach with C, Cengage Learning, 2nd Edition, 2007.
3. M.T.Goodrich and R.Tomassia, Algorithm Design: Foundations, Analysis and Internet examples, John Wiley and sons, 2nd Edition, 2006.
4. T.H.Cormen, C.E.Leiserson, R.L.Rivest and C.Stein, Introduction to Algorithms, Mit Press, 3rd Edition, 2009.
5. Allen Weiss, Data structures and Algorithm Analysis in C, Pearson Education, 2nd Edition, 2002.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Advanced Data Structures Course, <https://www.tutorialspoint.com/advanceddatastructures/index.asp>, Last Accessed On: 31/5/2024.
2. Computer Algorithms, <http://peterindia.net/Algorithms.html>, Last Accessed on: 24-06-2024.

23CS3353**OBJECT ORIENTED PROGRAMMING THROUGH JAVA LAB**

Course Category	Program Core	Credits	1.5
Course Type	Laboratory	L-T-P	0-0-3
Prerequisites	23ES1152	Continuous Eval	30
	Computer –	Semester End Eval	70
	Programming Lab	Total Marks	100

COURSE OUTCOMES

1. Apply the basic concepts of object oriented programming.
2. Apply multiple inheritance through interfaces for a given application.
3. Apply exceptions, thread capabilities and handling files on a given application.
4. Apply functional programming and Collections framework for a given application.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	3													3	1.7.1, 2.5.1, 2.5.2, 2.7.1
2	2	2	3										2	2	3	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.7.1, 3.5.1, 3.8.2
3	2	2	3										2	2	3	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4 3.5.1, 3.8.2
4	1	2	3										2	2	3	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 3.6.2, 3.8.2

COURSE CONTENT

Task 1: Apply fundamentals of Java Data types, Variables, Operators, and Control Statements to a given application.

Task 2: Apply the concepts of Classes and Objects to a given application.

Task 3: Apply the concepts of Arrays to a given application.

Task 4: Apply Inheritance and types of Inheritance of a given application.

Task 5: Use concepts of String and String Tokenizer classes and develop a java application.

Task 6: Use Interfaces and develop a java application.

Task 7: Create a package and access members of a package.

Task 8: Apply the concepts of Method Overloading and Method Overriding.

Task 9: Apply the concepts of Exception Handling.

Task 10: Develop a Java application to copy content from one file to another file using I/O Streams.

Task 11: Apply the concepts of Threads and Multithreading on a given application.

Task 12: Apply the concepts of Lambda Expressions, Collections Framework and Stream API.

Lab Projects:

1. Design and develop an automated ballot vote system.
2. Design and develop a banking application.

TEXTBOOKS

1. Herbert Schildt, Java The Complete Reference, Oracle Press, 11th Edition, 2019.

REFERENCE BOOKS

1. Herbert Schildt, Dale Skrien, Java Fundamentals: A Comprehension Introduction, McGraw-Hill Education India Pvt., Special Indian Edition, Ltd, 2017.
2. E Balaguruswamy, Programming with Java, Mc Graw Hill, 4th Edition, 2020.
3. Paul J. Dietel and Dr. Harvey M. Deitel, “Java How to Program”, Deitel & Associates Inc., 11th Edition, 2018.
4. Timothy Budd, Understanding Object Oriented Programming with Java, Pearson Education, Updated edition, 2013.
5. Kathy Sierra & Bert Bates, Head First Java, Oreilly, 2nd Edition, 2023.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Debasis Samanta, Department of Computer Science & Engineering, I.I.T, Kharagpur, Swayam, NPTEL, <https://onlinecourses.nptel.ac.in/>, Last Accessed On: 14/04/ 2024.
2. Evan Jones, Adam Marcus, Eugene Wu, Introduction to Programming in Java, MIT OpenCourseWare, Massachusetts Institute of Technology, https://ocw.mit.edu/search/?s=department_course_numbers.sort_coursenum, Last Accessed On: 28/05/2024.
3. Prof. Owen Astrachan, Object Oriented Programming in Java, Duke University, <https://www.coursera.org/specializations/object-oriented-programming>, Last Accessed On: 21/05/2024.
4. Dheeru Mundluru, Java In-Depth: Become a Complete Java Engineer, Udemy, <https://www.udemy.com/course/java-in-depth-become-a-complete-java-engineer/>, Last Accessed On: 14/05/2024.
5. Prof. Olufisayo Omojokun, Introduction to OOPS with Java I: Foundations and Syntax Basics, Georgia Institute of Technology, edX, <https://www.edx.org/certificates/professional-certificate/gtx-introduction-to-object-oriented-programming-with-java>, Last Accessed On: 04/05/2024.

SEMESTER IV

23BS4101B

DISCRETE MATHEMATICS & GRAPH THEORY

Course Category	Engineering Science	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites		Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Analyze of propositional calculus and first order logic.
2. Apply the basic and advanced counting techniques.
3. Analyze of relations and digraphs and their applications.
4. Analyze of graphs and their applications.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	3	3		1								1			4	1.2.1, 1.7.1, 2.5.1, 4.6.3, 12.4.2
2	3	3		1								1			3	1.2.1, 2.5.1, 2.5.3, 4.6.3, 12.4.2
3	3	3		1								1			4	1.2.1, 2.8.1, 4.4.1, 12.4.2
4	3	3		1								1			4	1.2.1, 1.7.1, 2.5.1, 4.6.3, 12.4.2

COURSE CONTENT

UNIT I

Propositional Calculus:

Fundamentals of Logic: Propositions, Connectives, Propositional functions, Truth tables, Tautology, Contradiction, Logical equivalences, Normal forms, Logical inferences, Methods of proof of an implication.

First Order Predicate Logic: Predicate, Quantifiers, Rules of inference for Quantified propositions.

UNIT II

Counting Techniques:

Basics of Counting: Sum and product rules, Indirect counting, One to one correspondence, Combinations and permutations, Enumerating combinations and permutations with and without repetitions.

Advanced Counting Techniques: Generating function of sequences, Recurrence relations, Solving recurrence relations – substitution- Generating functions-The method of characteristic roots, Solution of inhomogeneous recurrences relations.

UNIT III

Relations and Digraphs: Relations and basic graphs, Special properties of binary relations, Equivalence relation, Partially ordered sets, Hasse diagrams, Lattices, Operations on relations, Paths and closures, Directed graphs and Adjacency matrices, Transitive closure, Warshall's algorithm.

UNIT IV

Graph Theory: Introduction(graphs, sub graphs, circuits, trees) Sum of degrees theorem, Isomorphism and sub graphs, planar graphs, Euler's formula, Multi graphs and Euler's circuits, Hamiltonian graphs, Grin-berg's theorem, Graph coloring, Chromatic numbers.

TEXTBOOKS

1. Joe L. Mott, Abraham Kandel, and Theodore P. Baker: Discrete Mathematics for Computer Scientists & Mathematicians, PHI, 2nd Edition.

REFERENCE BOOKS

1. J. P. Tremblay and R.Manohar: Discrete Mathematical structures with applications to computer science, MGHE.
2. K. H. Rosen: Discrete Mathematics and its Applications, Mc Graw Hill Companies, 7th Edition.
3. D. S. Malik and M. K. Sen: Discrete Mathematical Structures: Theory and applications

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Arindama Singh Department of Maths IIT Madras, <https://nptel.ac.in/courses/111/106/111106052/>, Last accessed on: 15/11/2024.
2. Prof Soumen Maity, Department of Maths, IISER Pune, <https://nptel.ac.in/courses/111/106/111106102/>, Last accessed on: 15/11/2024.
3. Dr.L.Sunil Chandran, Department of Computer Science and Automation, IISC Bangalore, <https://nptel.ac.in/courses/106/108/106108051/>, Last accessed on: 15/11/2024.

23BS4102B

PROBABILITY AND STATISTICS

Course Category	Basic Science	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23BS1101 Linear Algebra	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Examine probability distributions with random variables.
2. Apply random phenomena of sample to test the Hypothesis concerning means.
3. Analyze the Hypothesis concerning variance and proportions.
4. Estimate Correlation and Regression coefficients.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	3	3		2											3	1.2.1, 1.2.2, 2.6.3, 4.6.1
2	3	3		2											3	1.2.2, 2.6.3, 4.6.1, 4.6.3
3	3	3		2											4	1.2.2, 2.6.3, 4.6.1, 4.6.3
4	3	3		2											3	1.2.1, 2.6.3, 4.6.1, 4.6.3

COURSE CONTENT

UNIT I

Probability Distributions: Random Variables (discrete and continuous) , Expectation, Variance and Standard deviation of discrete random variable, Binomial distribution, Poisson distribution. Expectations, Variance and standard deviation of continuous random variables, Normal distribution, Normal approximation to the Binomial distribution.

Joint distribution: Joint distributions-Discrete and Continuous.

UNIT II

Sampling Distributions: Introduction, Populations and Samples.

Inferences Concerning Mean: Point Estimation- Interval Estimation. Test of

Hypothesis – Null Hypothesis and Tests of Hypothesis – Hypothesis concerning one mean – Relation between tests and Confidence intervals –Operating characteristic curves - Inferences concerning two means.

UNIT III

Inferences Concerning Variances: Estimation of variances- Hypothesis concerning one variance- Hypothesis concerning two variances.

Inference Concerning Proportions: Estimation of Proportions- Hypothesis concerning one Proportion- Hypothesis concerning several Proportions – The Analysis of r x c Tables- Goodness of fit.

UNIT IV

Correlation: Types of Correlation, Scatter diagram, Karl Pearson's coefficient of correlation, Rank Correlation.

Regression Analysis: The method of least squares, Multiple Regression.

TEXTBOOKS

1. Johnson, R. A. (2011). Probability and statistics for engineers (8th ed.). Prentice Hall India Learning Private Limited.

REFERENCE BOOKS

1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (1993). Probability and statistics for engineers and scientists (Vol. 5). New York: Macmillan.
2. Biswal, P. C.(2007). Probability and statistics. Prentice Hall India Learning Private Limited.
3. Iyengar, T. K. V., Gandhi, B. K., Ranganadham, S., & Prasad, M. V. S. S. N, (2008). Probability and statistics. S. Chand Publishing.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Somesh Kumar, Department of Maths, IIT Kharagpur, <https://nptel.ac.in/courses/111105090>, Last Accessed on: 10/11/2024.
2. Prof. Niladri Chatterjee, Department of Maths, IIT Delhi, <https://nptel.ac.in/courses/111102112>, Last Accessed on: 10/11/2024.
3. Prof. Soumen Maity, Department of Maths, IISER Pune, <https://nptel.ac.in/courses/111105042>, Last Accessed on: 10/11/2024.

23CS4303

OPERATING SYSTEMS

Course Category	Program Core	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23ES1104	Continuous Eval	30
	Introduction to	Semester End Eval	70
	Programming	Total Marks	100

COURSE OUTCOMES

1. Understand the basic components of an Operating System.
2. Apply CPU Scheduling techniques and mechanisms used for process synchronization.
3. Analyse Memory management techniques and methods for handling deadlocks.
4. Analyse File system Implementation techniques and protection mechanisms.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	3												1	1	2	1.7.1
2	2	2	3										1	1	3	1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4, 3.7.1
3	2	2	3										1	2	4	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1
4	2	2	3										1	2	4	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1

COURSE CONTENT

UNIT I

System Structures: Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, operating system Design and Implementation, operating system structure, Building and Booting an Operating System, Operating system debugging.

Processes: Process Concept, Process scheduling, Operations on processes, Inter-process communication.

Threads and Concurrency: Multithreading models, Thread libraries, threading issues.

UNIT II

CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, multiple processor scheduling.

Synchronization Tools: The Critical Section Problem, Peterson's Solution, Mutex Locks, Semaphores, Monitors, Classic problems of Synchronization.

UNIT III

Deadlocks: system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.

Memory-Management Strategies: Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping.

Virtual Memory Management: Introduction, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing.

Storage Management: Overview of Mass Storage Structure, HDD Scheduling.

UNIT IV

File System: File System Interface: File concept, Access methods, Directory Structure; File system Implementation: File-system structure, File-system Operations, Directory implementation, Allocation method.

Free space management: File-System Internals: File-System Mounting, Partitions and Mounting, File Sharing.

Protection: Goals of protection, Principles of protection, Protection Rings, Domain of protection, Access matrix.

TEXTBOOKS

1. Silberschatz A, Galvin P B, Gagne G, Operating System Concepts, Wiley, 10th Edition, 2018.
2. Tanenbaum A S, Modern Operating Systems, Galgotia Publications Pvt. Ltd, 4th Edition, 2016.

REFERENCE BOOKS

1. Stallings W, Operating Systems -Internals and Design Principles, Pearson, 9th Edition, 2018.
2. D.M Dhamdhere, Operating Systems: A Concept Based Approach, McGraw- Hill, 3rd Edition, 2013.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof Santanu Chattopadhyay - NPTEL Course on Operating Sytems, <https://nptel.ac.in/courses/106/105/106105214/>, Last Accessed On: 28/10/2024.
2. Stanford University - Lecture Notes on Operating Systems, <https://www.scs.stanford.edu/21wi-cs140/notes>, Last Accessed on: 28/10/2024.
3. IIT Bombay – Lecture Notes on Operating Systems , <https://www.cse.iitb.a>

c.in/~mythili/os/, Last Accessed on: 28/10/2024.

23CS4304

DATABASE MANAGEMENT SYSTEMS

Course Category	Program Core	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23PC2104A:	Continuous Eval	30
	Data Structures	Semester End Eval	70
	23CS3304: Advanced Data Structures & Algorithms Analysis	Total Marks	100

COURSE OUTCOMES

1. Apply database management techniques using relational SQL database to real world applications.
2. Analyse the Entity-Relationship models, in turn develop the Relational models that leads to database design.
3. Apply various normalization techniques to relational models in order to improve database design quality.
4. Understand database transactions processing, protocols for Concurrency control and Recovery techniques in database.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	1	2	3										2	2	3	1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.6.4, 2.8.4, 3.5.6.
2	1	2	3										1	1	4	1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.7.2, 3.5.6, 3.6.2
3	1	2	3										1	1	3	1.7.1, 2.5.2, 2.5.3, 2.6.3, 2.7.2, 3.5.6, 3.6.2
4	1	2											1	1	2	1.7.1, 2.5.2, 2.6.3, 2.7.2

COURSE CONTENT

UNIT I

Introduction: Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of

different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

SQL: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update). Basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions (Date and Time, Numeric, String conversion). Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view (updatable and non updatable), relational set operations.

UNIT II

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra, Relational Database Design using ER-to-Relational Mapping.

UNIT III

Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition, (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form (BCNF), MVD, Fourth normal form (4NF), Fifth Normal Form (5NF).

UNIT IV

Transaction Processing, Concurrency Control, and Recovery: Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability, Two-Phase Locking Techniques for Concurrency Control, Recovery Concepts, NO-UNDO/REDO Recovery Techniques based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging, The ARIES Recovery Algorithm.

TEXTBOOKS

1. Raghurama Krishnan, Johannes Gehrke, TMH, Database Management Systems, 3rd Edition. (For Chapters 2, 3, 4)
2. Silberschatz, Korth, Sudarsan, TMH, Database System Concepts, 5th Edition, (For Chapter 1 and Chapter 5)

REFERENCE BOOKS

1. C J Date, Introduction to Database Systems, Pearson, 8th Edition, Ltd,.
2. Ramez Elmasri, Shamkant ,B. Navathe, Database Management System, Mc Graw Hill, Pearson, 6th Edition.
3. Corlos Coronel, Steven Morris, Peter Robb, Database Principles Fundamentals of Design Implementation and Management, Cengage Learning.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Dr S.Srinath IIT-Madras “Conceptual design process “ <https://nptel.ac.in/courses/106/106/106106093/>, Last accessed on: 12/11/2024.
2. Prof P.Srinivasa Kumar IIT-Madras “ Normalization process” <https://nptel.ac.in/courses/106/106/106106095/> Lecture 7, Last accessed on 12/11/2024.
3. Prof D.Janakiram IIT-Madras Concurrency Control techniques, <https://nptel.ac.in/courses/106/106/106106093/> Lecture 20,21,22,23, Last accessed on: 12/11/2024.
4. Andy Pavlo, Carnegie Mellon University, Relational model concepts, <https://15445.courses.cs.cmu.edu/fall2017/slides/01-introduction.pdf> Last accessed on: 12/11/2024.

23CS4305

SOFTWARE ENGINEERING

Course Category	Program Core	Credits	3
Course Type	Theory	L-T-P	2-1-0
Prerequisites	–	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the basic concepts of software engineering process models.
2. Apply the concepts of Estimation and Requirements for any given application.
3. Apply Design and Testing techniques for any given application.
4. Apply Software Development Life Cycle process using Case Tools.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	2											2	2	2	1.6.1, 1.7.1, 2.5.1, 2.5.2, 2.6.5, 2.7.1.
2	2	2	3										1	2	3	1.6.1, 1.7.1, 2.6.2, 2.7.1, 3.5.1, 3.5.2, 3.5.3, 3.5.6.
3	2	2	3										1	2	3	1.6.1, 1.7.1, 2.5.1, 2.7.1, 3.5.1, 3.6.1, 3.6.3, 3.8.1, 3.8.2.
4	2	2	3										1	2	3	1.6.1, 1.7.1, 2.5.2, 2.6.2, 2.7.1, 3.5.4, 3.6.1, 3.6.2.

COURSE CONTENT

UNIT I

Introduction: Evolution, Software development projects, Exploratory style of software developments, Emergence of software engineering, Notable changes in software development practices, Computer system engineering.

Software Life Cycle Models: Basic concepts, Waterfall model and its extensions, Rapid application development, Agile development model, Spiral model.

Agility: Agility and the Cost of Change, Agile Process, Extreme Programming (XP), Other Agile Process Models, Tool Set for the Agile Process (Text Book 2).

UNIT II

Software Project Management: Software project management complexities, Responsibilities of a software project manager, Metrics for project size estimation, Project estimation techniques, Empirical Estimation techniques, COCOMO, Halstead's software science, risk management.

Requirements Analysis And Specification: Requirements gathering and analysis, Software Requirements Specification (SRS), Formal system specification, Axiomatic specification, Algebraic specification, Executable specification and 4GL.

UNIT III

Software Design: Overview of the design process, how to characterize a good software design? Layered arrangement of modules, Cohesion and Coupling. approaches to software design.

Function-Oriented Software Design: Overview of SA/SD methodology, Structured analysis, Developing the DFD model of a system, Structured design, Detailed design, and Design Review.

User Interface Design: Characteristics of a good user interface, Basic concepts, Types of user interfaces, Fundamentals of component-based GUI development, and user interface design methodology.

Coding and Testing: Coding, Code review, Software documentation, Testing, Black-box testing, White-Box testing, Debugging, Program analysis tools, Integration testing, testing object-oriented programs, Smoke testing, and Some general issues associated with testing.

UNIT IV

Software Reliability and Quality Management: : Software reliability. Statistical testing, Software quality, Software quality management system, ISO 9000. SEI Capability maturity model. Few other important quality standards, and Six Sigma.

Computer-Aided Software Engineering (Case): CASE and its scope, CASE environment, CASE support in the software life cycle, other characteristics of CASE tools, Towards second generation CASE Tool, and Architecture of a CASE Environment.

Software Maintenance: Characteristics of software maintenance, Software reverse engineering, Software maintenance process models and Estimation of maintenance cost.

Software Reuse: reuse- definition, introduction, reason behind no reuse so far, Basic issues in any reuse program, A reuse approach, and Reuse at organization level.

TEXTBOOKS

1. Rajib Mall, Fundamentals of Software Engineering, -PHI Publication, 5th Edition.
2. Roger S. Pressman, Software Engineering A Practitioner's Approach, Mc-Graw Hill International Edition, 9th Edition.

REFERENCE BOOKS

1. Ian Sommerville, Software Engineering, Pearson, 10th Edition, Ltd,.
2. Deepak Jain, Software Engineering, Principles and Practices, Oxford University Press.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Rajib Mall, IIT Kharagpur, Software Engineering, <https://nptel.ac.in/courses/106/105/106105182/>, Last accessed on: 22/10/2024.
2. Roger S Pressman, The future of Software Engineering, <https://www.youtube.com/watch?v=vbPo0yNOLQo> Lecture 7, Last accessed on: 22/11/2024.

20TP4106

ENGLISH FOR PROFESSIONALS

Course Category	Soft Skill-2	Credits	1
Course Type	Theory	L-T-P	0-0-2
Prerequisites	–	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. How conversations are made
2. The usage of grammar
3. Apply speaking skills through activities
4. Apply Etiquettes and manners

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	2											2	2	2	1.6.1, 1.7.1, 2.5.1, 2.5.2, 2.6.5, 2.7.1.
2	2	2	3										1	2	3	1.6.1, 1.7.1, 2.6.2, 2.7.1, 3.5.1, 3.5.2, 3.5.3, 3.5.6.
3	2	2	3										1	2	3	1.6.1, 1.7.1, 2.5.1, 2.7.1, 3.5.1, 3.6.1, 3.6.3, 3.8.1, 3.8.2.
4	2	2	3										1	2	3	1.6.1, 1.7.1, 2.5.2, 2.6.2, 2.7.1, 3.5.4, 3.6.1, 3.6.2.

COURSE CONTENT

UNIT I

Introduction: Beginners, Functional, Situational Conversations Introduction -Importance of spoken English in the placements and Group Discussion Beginners Conversation -Self Introduction-Introducing Self -Introducing each other in a team (Pair Activity) Functional Conversation -Seeking Permission from Seniors Teachers and other superiors (Team Activity) -Asking Direction-Direction from stranger or from Helpline -Making Requests-Requests for borrowing books, applications, or any other help from office staff in college or outside. Just a minute: -Give a topic and ask the student to

talk impromptu. -To present the topic in a structured manner.

UNIT II

Structuring and forming sentences -Structure of mother tongue and pit falls in translation to English. -Formation of sentences in English Errors in Usage -Difficulty in right usage of words. -Difficulty in Pronunciation-Phonetic differences in mother tongue and English –areas to improve. -Idioms and Phrase –Frequently used Idiom and Phrases which help to enhance the quality of presentation and make the presentation meaningful. -Meaning of frequently used Idioms and Phrases.

UNIT III

Introduction to different ways of speaking. -Elocution, Debate and Extempore - Principles of Elocution and its challenges practice in session. -Principles of Debates and its challenges –practice session. -Principles of Extempore - its pitfalls- practice sessions.

UNIT IV

Etiquette -Need of Etiquette in Social arena -Dining Etiquette -Social Etiquette in conversation -formal and informal gathering. -Book a table etc. Versant Test -Mode of versant Test, -Aim of the test and various methods it follows -Practice session.

REFERENCE BOOKS

1. Kamalesh Sadanand, “A Spoken English”, VOL 1&2; Orient BlackSwan, Second Edition,2014.
2. “Communicative English”; Pearson; 2010

23MC4107

ENVIRONMENTAL SCIENCE

Course Category	Audit Course	Credits	-
Course Type	Theory	L-T-P	2-0-0
Prerequisites	–	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Identify various factors causing degradation of natural resource.
2. Identify various ecosystem and need for biodiversity.
3. Realize and explore the problems related to environmental pollution and its management.
4. Apply the information and technology to analyze social issues, use acts associated with environment.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	2													2	1.6.1, 1.7.1, 2.5.1
2	2	2													2	1.6.1, 1.7.1, 2.5.1
3	2	2													2	1.6.1, 1.7.1, 2.5.1
4	2	2													3	1.6.1, 1.7.1, 2.5.1

COURSE CONTENT

UNIT I

Multidisciplinary Nature Of Environmental Studies: – Definition, Scope and Importance – Need for Public Awareness. Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

UNIT II

Ecosystems: Ecosystems: Concept to an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem. b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity And Its Conservation: Introduction Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT III

Environmental Pollution: Definition, Cause, effects and control measures of: a. Air Pollution. b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies.

Disaster management: floods, earthquake, cyclone and landslides.

UNIT IV

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies.

Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Waste and reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wild life Protection Act – Forest Conservation Act – Issues involved in enforcement of environment legislation

Public awareness: Human Population And The Environment, Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health, Case studies.

Field Work: Visit to a local area to document environmental assets River/ forest grassland/ hill/ mountain – Visit to a local polluted site – Urban/Rural/Industrial, Agricultural Study of common plants, insects, and birds – river, hills, lakes, etc.

Self Study:

Water resources, soil resources, mineral resource: radioactive elements, Threats to biodiversity, Solid waste management, Role of Information Technology in environment and human health.

TEXTBOOKS

1. Erach Bharucha. 2004, Environmental Studies for undergraduate courses, University Grants Commission, New Delhi, Bharati Vidyapeeth Institute of Environment Education and Research.
2. Palaniswamy, Environmental Studies, Pearson education.
3. S.AzeemUnnisa, "Environmental Studies" Academic Publishing Company.
4. K.RaghavanNambiar, "Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus", Scitech Publications (India), Pvt.Ltd.

REFERENCE BOOKS

1. AnjaneyuluY. Introduction to Environmental sciences, B S Publications PVT Ltd, Hyderabad
2. Anjireddy.M Environmental science & Technology, BS Publications PVT Ltd, Hyderabad.
3. Benny Joseph, 2005, Environmental Studies, The Tata McGraw- Hill publishing company limited, New Delhi.
4. Principles of Environmental Science. &Engg. P.Venu Gopala Rao, 2006, Prentice-Hall of India Pvt. Ltd., New Delhi.
5. Ecological and Environmental Studies – Santosh Kumar Garg, Rajeswari Garg (or) Rajani Garg, 2006, Khanna Publishers, New Delhi. Essentials of Environmental Studies, Kurian Joseph & R Nagendran, Pearson Education publishers, 2005.
6. A.K Dee – Environmental Chemistry, New Age India Publications.
7. BharuchaErach- Biodiversity of India, Mapin Publishing Pvt.Ltd..

REFERENCE BOOKS

1. Erach Bharucha. 2004, Environmental Studies for undergraduate courses, University Grants Commission, New Delhi, Bharati Vidyapeeth Institute of Environment Education and Research.<https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf>
2. NPTEL Courses - Environmental Studies by Dr. Tushar Banerjee, Devi Ahilya Viswavidyalaya, Indore.

23CS4651

FULL STACK DEVELOPMENT-I

Course Category	Skill Enhancement Course	Credits	1
Course Type	Laboratory	L-T-P	0-0-2
Prerequisites	–	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the fundamentals of HTML elements, CSS Styles.
2. Apply HTML elements and their attributes for designing static web pages.
3. Create a web page by applying appropriate CSS styles and HTML elements.
4. Create dynamic web application and validate forms using JavaScript.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	2													2	1.7.1, 2.5.1, 2.5.2
2	2	2	3		2								2	2	3	1.7.1, 2.5.1, 2.5.2, 2.6.3, 3.5.1, 5.5.2
3	2	2	3		2								2	2	6	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 5.5.2
4	2	2	3		2								2	2	6	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 5.5.2

1. Lists, Links and Images

- Write a HTML program, to explain the working of lists Note: It should have an ordered list, unordered list, nested lists and ordered list in an unordered list and definition lists.
- Write a HTML program, to explain the working of hyperlinks using <a>tag and href, target Attributes
- Create a HTML document that has your image and your friend's image with a specific height and width. Also when clicked on the images it should navigate to their respective profiles

- Write a HTML program, in such a way that, rather than placing large images on a page, the preferred technique is to use thumbnails by setting the height and width parameters to something like to 100*100 pixels. Each thumbnail image is also a link to a full sized version of the image. Create an image gallery using this technique

2. HTML Tables, Forms and Frames

- Write a HTML program, to explain the working of tables. (use tags: `<table>`, `<tr>`, `<th>`, `<td>` and attributes: border, rowspan, colspan)
- Write a HTML program, to explain the working of tables by preparing a timetable (Note: Use `<caption>` tag to set the caption to the table& also use cell spacing, cell padding, border, rowspan, colspan etc.)
- Write a HTML program, to explain the working of forms by designing Registration form (Note: Include text field, password field, number field, date of birth field, checkboxes, radio buttons, list boxes using `<select>` & `<option>` tags, `<text area>` and two buttons ie: submit and reset. Use tables to provide a better view)
- Write a HTML program, to explain the working of frames, such that page is to be divided into 3 parts on either direction. (Note: first frame image, second frame paragraph, third frame hyperlink. And also make sure of using “no frame” attribute such that frames to be fixed)

3. HTML 5 and Cascading Style Sheets, Types of CSS

- Write a HTML program, that makes use of `<article>`, `<aside>`, `<figure>`, `<figcaption>`, `<footer>`, `<header>`, `<main>`, `<nav>`, `<section>`, `<div>`, `` tags
- Write a HTML program, to embed audio and video into HTML web page
- Write a program to apply different types (or levels of styles or style specification formats) - inline, internal, external styles to HTML elements. (identify selector, property and value)

4. Selector forms

- Write a program to apply different types of selector forms
 - (i) Simple selector (element, id, class, group, universal)
 - (ii) Combinator selector (descendant, child, adjacent sibling, general sibling)
 - (iii) Pseudo-class selector
 - (iv) Pseudo-element selector
 - (v) Attribute selector

5. CSS with Color, Background, Font, Text and CSS Box Model

- Write a program to demonstrate the various ways you can reference a color in CSS.
- Write a CSS rule that places a background image halfway down the page, tilting it horizontally. The image should remain in place when the user scrolls up or down.
- Write a program using the following terms related to CSS font and text:
 - (i) font-size
 - (ii) font-weight
 - (iii) font-style
 - (iv) text-decoration
 - (v) text-transformation
 - (vi) text-alignment
- Write a program, to explain the importance of CSS Box model using
 - (i) Content
 - (ii) Border
 - (iii) Margin
 - (iv) Padding

6. Applying JavaScript - internal and external, I/O, Type Conversion

- Write a program to embed internal and external JavaScript in a web page
- Write a program to explain the different ways for displaying output
- Write a program to explain the different ways for taking input
- Create a webpage which uses prompt dialogue box to ask a voter for his name and age. Display the information in table format along with either the voter can vote or not

7. JavaScript Pre-defined and User-defined Objects

- Write a program using document object properties and methods
- Write a program using window object properties and methods
- Write a program using array object properties and methods
- Write a program using math object properties and methods
- Write a program using string object properties and methods
- Write a program using regex object properties and methods
- Write a program using date object properties and methods
- Write a program to explain user-defined object by using properties, methods, accessors, constructors and display.

8. JavaScript Conditional Statements and Loops

- Write a program which asks the user to enter three integers, obtains the numbers from the user and outputs HTML text that displays the larger number followed by the words “LARGER NUMBER” in an information message dialog. If the numbers are equal, output HTML text as “EQUAL NUMBERS”.
- Write a program to display week days using switch case.
- Write a program to print 1 to 10 numbers using for, while and do-while loops.
- Develop a program to determine whether a given number is an ‘ARM-STRONG NUMBER’ or not. [Eg: 153 is an Armstrong number, since sum of the cube of the digits is equal to the number i.e., $1^3 + 5^3 + 3^3 = 153$]
- Write a program to display the denomination of the amount deposited in the bank in terms of 100’s, 50’s, 20’s, 10’s, 5’s, 2’s & 1’s. (Eg: If deposited amount is Rs.163, the output should be 1-100’s, 1-50’s, 1- 10’s, 1-2’s & 1-1’s)

9. Javascript Functions and Events

- Design a appropriate function should be called to display
 - (i) Factorial of that number
 - (ii) Fibonacci series up to that number
 - (iii) Prime numbers up to that number
 - (iv) Is it palindrome or not
- Design a HTML having a text box and four buttons named Factorial, Fibonacci, Prime, and Palindrome. When a button is pressed an appropriate function should be called to display
 - (i) Factorial of that number
 - (ii) Fibonacci series up to that number
 - (iii) Prime numbers up to that number
 - (iv) Is it palindrome or not
- Write a program to validate the following fields in a registration page
 - (i) Name (start with alphabet and followed by alphanumeric and the length should not be less than 6 characters)
 - (ii) Mobile (only numbers and length 10 digits)
 - (iii) E-mail (should contain format like xxxxxxxx@xxxxxx.xxx)

TEXTBOOKS

1. Programming the World Wide Web, 7th Edition, Robert W Sebesta, Pearson, 2013.
2. Web Programming with HTML5, CSS and JavaScript, John Dean, Jones & Bartlett Learning, 2019 (Chapters 1-11).

3. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasani Subramanian, 7th, APress, O'Reilly.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. <https://www.w3schools.com/html>, Last Accessed on: 10/10/2024.
2. <https://www.w3schools.com/css>, Last Accessed on: 10/10/2024.
3. <https://www.w3schools.com/js/>, Last Accessed on: 10/10/2024.
4. <https://www.w3schools.com/nodejs>, Last Accessed on: 10/10/2024.
5. <https://www.w3schools.com/typescript>, Last Accessed on: 10/10/2024.

23ES4152

DESIGN THINKING AND INNOVATION

Course Category	Engineering Science	Credits	2
Course Type	Theory	L-T-P	1-0-2
Prerequisites	–	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the fundamentals of Design Thinking and innovation.
2. Apply the design thinking techniques for solving problems in various sectors.
3. Analyse to work in a multidisciplinary environment.
4. Analyse the value of creativity.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	2											2	2	2	1.7.1, 2.6.2, 2.7.1
2	2	2											1	2	3	1.6.1, 1.7.1, 2.6.2, 2.7.1
3	2	2											1	2	4	1.6.1, 1.7.1, 2.5.1, 2.7.1
4	2	2											1	2	4	1.6.1, 1.7.1, 2.6.2, 2.7.1

COURSE CONTENT

UNIT I

Introduction to Design Thinking: Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

Design Thinking Process: Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development.

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT II

Innovation: Art of innovation, Difference between innovation and creativity, role

of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT III

Product Design: : Software reliability. Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

Activity: Importance of modeling, how to set specifications, Explaining their own product design.

UNIT IV

Design Thinking in Business Processes: : Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes..

Activity: How to market our own product, about maintenance, Reliability and plan for startup.

TEXTBOOKS

1. Tim Brown, Change by design, 1/e, Harper Bollins, 2009.
2. Idris Mootee, Design Thinking for Strategic Innovation, 1/e, Adams Media, 2014.

REFERENCE BOOKS

1. David Lee, Design Thinking in the Classroom, Ulysses press, 2018.
2. Shrrutin N Shetty, Design the Future, 1/e, Norton Press, 2018.
3. William lidwell, Kritinaholden, &Jill butter, Universal principles of design, 2/e, Rockport Publishers, 2010.
4. Chesbrough.H, The era of open innovation, 2003.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. IDEO U - Design Thinking Online Courses, Created by IDEO, pioneers in design thinking, "Foundations in Design Thinking" and "Advanced Design Thinking Methods", https://www.ideo.com/products/design-thinking-certificate?_pos=8&_sid=0c2902189&_ss=r, Last Accessed On: 12/12/2024.
2. Interaction Design Foundation (IxDF) Design Thinking Guide Rich articles and in-depth tutorials with an engineering focus, <https://www.youtube.com/watch?v=ldYzbVONDp8>, Last Accessed On: 12/12/2024.
3. AI x Design Thinking Workshop Series, https://www.ideo.com/products/aiworkshop?_pos=1&_sid=0c2902189&_ss=r

23CS4353

OPERATING SYSTEMS LAB

Course Category	Program Core	Credits	1.5
Course Type	Laboratory	L-T-P	0-0-3
Prerequisites	23ES1104	Continuous Eval	30
	Introduction to Programming	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Implement UNIX concepts for creation of Shell Scripts
2. Apply CPU Scheduling algorithms, page replacement algorithms, thread implementation
3. Analyze Bankers Algorithm for Dead Lock avoidance and process Synchronization
4. Analyze the memory management techniques

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	1	2											1	1	3	1.7.1, 2.6.4
2	1	3	3	2									1	1	3	1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4, 3.7.1, 4.6.1
3	1	3	3	2									1	1	4	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1, 4.6.1
4	1	3	3	2									1	1	4	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1, 4.6.1

COURSE CONTENT

Task 1: Practicing of Basic UNIX Commands.

Task 2: Write programs using the following UNIX operating system calls fork, exec, getpid, exit, wait, close, stat, opendir and readdir

Task 3: Simulate UNIX commands like cp, ls, grep, etc.,

Task 4: Simulate the following CPU scheduling algorithms a) FCFS b) SJF c) Priority d) Round Robin

Task 5: Control the number of ports opened by the operating system with a) Semaphore b) Monitors.

Task 6: Write a program to illustrate concurrent execution of threads using pthreads library.

Task 7: Write a program to solve producer-consumer problem using Semaphores.

Task 8: Implement the following memory allocation methods for fixed partition a) First fit b) Worst fit c) Best fit

Task 9: Simulate the following page replacement algorithms a) FIFO b) LRU c) LFU

Task 10: Simulate Paging Technique of memory management.

Task 11: Implement Bankers Algorithm for Dead Lock avoidance and prevention

Task 12: Simulate the following file allocation strategies a) Sequential b) Indexed c) Linked

Task 13: Download and install nachos operating system and experiment with it

REFERENCE BOOKS

1. Silberschatz A, Galvin P B, Gagne G, Operating System Concepts, Wiley, 10th Edition, 2018.
2. Tanenbaum A S, Modern Operating Systems, Galgotia Publications Pvt. Ltd, 4th Edition, 2016.
3. Stallings W, Operating Systems -Internals and Design Principles, Pearson, 9th Edition, 2018.
4. D.M Dhamdhere, Operating Systems: A Concept Based Approach, McGraw- Hill, 3rd Edition, 2013.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof Santanu Chattopadhyay - NPTEL Course on Operating Sytems, <https://nptel.ac.in/courses/106/105/106105214/>, Last Accessed On: 28/10/2024.
2. Stanford University - Lecture Notes on Operating Systems, <https://www.scs.stanford.edu/21wi-cs140/notes>, Last Accessed on: 28/10/2024.
3. IIT Bombay – Lecture Notes on Operating Systems , <https://www.cse.iitb.ac.in/~mythili/os/>, Last Accessed on: 28/10/2024.

23CS4354**DATABASE MANAGEMENT SYSTEMS LAB**

Course Category	Program Core	Credits	1.5
Course Type	Laboratory	L-T-P	0-0-3
Prerequisites	23PC2104A Data Structures	Continuous Eval	30
	23CS3304	Semester End Eval	70
	Advanced Data Structure & algorithms Analysis	Total Marks	100

COURSE OUTCOMES

1. Apply DDL, DML and DCL statements with integrity constraints
2. Design relational database and manipulate the same using simple and complex queries in SQL.
3. Develop Entity Relationship and the corresponding Relational models for the given real-world application.
4. Analyze database objects like Procedure, Functions, Triggers and Package using PL/SQL

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	1	2	2		2								1	1	3	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2
2	1	3	3		3								1	1	6	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2, 5.5.2
3	1	3	3		3								1	1	6	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2, 5.5.2
4	1	2	2		2								1	1	4	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2

COURSE CONTENT

Task 1: Creation, altering and dropping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command.

Task 2: Queries using Conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length,

substr and instr), date functions (Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date)

Task 3: Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSET, Constraints. Example: Select the roll number and name of the student who secured fourth rank in the class.

Task 4: Implementation of basic building blocks of Queries(Joins,Aggregate Functions,Set Operations,Cartesian Product,GROUP BY, HAVING clause),Creation and dropping of Views.

Task 5: Draw ER diagram for an application with at least 3 entities and establish relationships between them using a tool. Perform ER to Relational mapping to derive Relational database.

Task 6: Implementation of first, second, third, BCNF, fourth Normal forms and conversions.

Task 7: (I) Create a simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found)
(II) Insert data into student table and use COMMIT, ROLLBACK and SAVE-POINT in PL/SQL block.

Task 8: Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.

Task 9: Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISE- APPLICATION ERROR.

Task 10: Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.

Task 11: Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions.

Task 12: Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.

Task 13: Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers.

Task 14: Real Time Database Application for uploads(File,Image,Video).

TEXT BOOKS

1. Oracle: The Complete Reference by Oracle Press
2. Nilesh Shah, Database Systems Using Oracle, PHI, 2007
3. Rick F Vander Lans, Introduction to SQL, Pearson, 4th Edition, 2007.

REFERENCE BOOKS

1. Gordon S Linoff, Data Analysis Using SQL and Excel, Wiley, 2nd Edition, 2016.
2. Joan Casteel, Oracle 12c:SQL, Cengage Learning, 2017

3. J D Ullman, —Principles of database systems, Computer Science Press, 2001.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof Arnab Bhattacharya, IIT Kanpur, SQL Introduction, <https://nptel.ac.in/courses/106104135/10>, Last accessed on: 12/11/2024
2. Prof Arnab Bhattacharya, IIT Kanpur, SQL: Updates, Joins, Views and Triggers <https://nptel.ac.in/courses/106104135/11>, Last accessed on: 12/11/2024
3. Geoff Allix and Graeme Malcolm: Microsoft , Querying with Transact-SQL (edX), <https://www.mooc-list.com/course/querying-transact-sql-edx> Last accessed on: 12/11/2024.

SEMESTER V

23CS5301

DATA WAREHOUSING AND DATA MINING

Course Category	PC	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS3304	Continuous Eval	30
	Advanced Data Structures &	Semester End Eval	70
	Algorithms Analysis	Total Marks	100

COURSE OUTCOMES

1. Understand fundamental concepts of and techniques of data warehousing and data mining.
2. Apply various pre-processing techniques in Data mining.
3. Analyze classification and apriori algorithms to solve real life problems.
4. Analyze different types of clustering algorithms to solve real life problems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	3												3	2	2	1.2.1, 1.7.1
2	1	3											1	1	3	1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1
3	1	3											1	1	4	1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1
4	1	2											2	2	4	1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1

COURSE CONTENT

UNIT I

Introduction to Data Warehousing: Data Warehousing and Online Analytical Processing: Basic concepts, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Cloud Data Warehouse, Data Mining and Pattern Mining, Technologies, Applications Major Issues in Data Mining.

Getting to Know your data: Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity.

UNIT II

Data Preprocessing: An Overview; Data Cleaning- Missing Values, Noisy data. Data Integration: Entity Identification problem, Redundancy and Correlation Analysis.

Data Reduction: Overview of Data Reduction Strategies, Wavelet Transformation, Principal Components Analysis; Attribute Subset selection.

Data Transformation and Data Discretization: Data Transformation Strategies Overview, Data Transformation by Normalization, Discretization by Binning.

UNIT III

Association Analysis: Problem Definition, Frequent Itemset Generation, Rule Generation: Confident Based Pruning, Rule Generation in Apriori Algorithm, Compact Representation of frequent item sets, FP-Growth Algorithm.

Classification: Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Attribute Selection Measures, Tree Pruning, Scalability and Decision Tree Induction, Visual Mining for Decision Tree Induction.

UNIT IV

Cluster Analysis: Overview, Basics and Importance of Cluster Analysis, Clustering techniques, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Bi-secting K Means, Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses. (Text Book- 2).

TEXTBOOKS

1. Jiawei Han, Michel Kamber, Data Mining concepts and Techniques, 3rd edition, Elsevier, 2011.
2. Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Introduction to Data Mining, 2nd Edition, Pearson, 2012.

REFERENCE BOOKS

1. VikramPudi and P. Radha Krishna, Data Mining: 1st Edition, Oxford Publisher, 2009.
2. Arun K Pujari, Data Mining Techniques, 3rd edition, Universities Press, 2013.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. PabitraMitra, Data Mining, https://onlinecourses.nptel.ac.in/noc22_cs11/preview, Last accessed on: 25/04/2025.
2. Dr. Saed Sayad, An Introduction to Data Science, http://www.saedsayad.com/data_mining_map.html, Last accessed on: 25/04/2025.

23CS5302

COMPUTER NETWORKS

Course Category	PC	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS4303	Continuous Eval	30
	Operating Systems	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the concepts related to network categories, topologies, and reference models.
2. Analyze error and flow control mechanisms in data link layer
3. Analyse subnetting and various routing protocols of network layer
4. Analyze transport layer and application layer protocols for specific applications.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	3											1	3	2	1.2.1, 1.6.1, 1.7.1, 2.5.2
2	2	3											1	3	4	1.6.1, 1.7.1, 2.5.2, 2.6.4
3	2	3											1	3	4	1.7.1, 2.5.2, 2.6.4
4	2	3											1	3	4	1.6.1, 1.7.1, 2.5.2, 2.6.4

COURSE CONTENT

UNIT I

Introduction: Network Types, LAN, MAN, WAN, Network Topologies Reference models- The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models, OSI Vs TCP/IP.

Physical Layer: Introduction to Guided Media- Twisted-pair cable, Coaxial cable and Fiber optic cable and introduction about unguided media.

UNIT II

Data link layer: Design issues, Framing: fixed size framing, variable size framing, flow control, error control, error detection and correction codes, CRC, Checksum: idea, one's complement internet checksum, services provided to Network Layer.

Elementary Data Link Layer protocols. Sliding window protocol: One bit, Go back N, Selective repeat-Stop and wait protocol, Data link layer in HDLC, Point to point protocol (PPP).

Media Access Control: Random Access: ALOHA, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance, Controlled Access: Reservation, Polling, Token Passing, Channelization: frequency division multiple Access (FDMA), time division multiple access (TDMA), code division multiple access (CDMA).

Wired LANs: Ethernet, Ethernet Protocol, Standard Ethernet, Fast Ethernet (100 Mbps), Gigabit Ethernet, 10 Gigabit Ethernet.

UNIT III

The Network Layer Design Issues: Store and Forward Packet Switching-Services Provided to the Transport layer, Implementation of Connectionless Service, Implementation of Connection Oriented Service, Comparison of Virtual Circuit and Datagram Networks.

Routing Algorithms: The Optimality principle-Shortest path, Flooding, Distance vector, Link state, Hierarchical, Congestion Control algorithms-General principles of congestion control, Congestion prevention policies, Approaches to Congestion Control-Traffic Aware Routing- Admission Control-Traffic Throttling-Load Shedding. Traffic Control Algorithm-Leaky bucket & Token bucket.

Internet Working: How networks differ- How networks can be connected- Tunneling, internetwork routing-, Fragmentation, network layer in the internet – IP protocols-IP Version 4 protocol-IPV4 Header Format, IP addresses, Class full Addressing, CIDR, Subnets-IP Version 6-The main IPV6 header, Transition from IPV4 to IPV6, Comparison of IPV4 & IPV6.

UNIT IV

The Transport Layer: Transport layer protocols: Introduction-services- port number-User data gram protocol-User datagram-UDP services-UDP applications-Transmission control protocol: TCP services- TCP features- Segment- A TCP connection-windows in TCP- flow control-Error control, Congestion control in TCP.

Application Layer: World Wide Web: HTTP, Electronic mail-Architecture- web based mail- email security- TELENET-local versus remote Logging-Domain Name System.

TEXTBOOKS

1. Andrew S Tanenbaum, David J Wetherall, Computer Networks, 5th Edition, Pearson Education, 2011.
2. Behrouz A.Fourozan, Data Communications and Networking. 4th Edition, TATA McGraw Hill, 2007.

REFERENCE BOOKS

1. J.F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 6th Edition, Pearson Education, 2012.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof Sowmya Kanti Ghosh, Computer Networks and Internet Protocol, IIT Kharagpur, NPTEL Lectures, Video Lectures, Available: <https://nptel.ac.in/courses/106105183>, Last Accessed on: 18/4/2025.
2. Prof. Hari Balakrishnan, MIT Open Courseware, Computer Networks, MIT, Video Lectures, Available: <https://ocw.mit.edu/courses/6-829-computer-networks-fall-2002/>, Last Accessed on: 18/4/2025.
3. Dheeraj, Computer Networks, IIT Kharagpur, Lecture Notes, Available: <http://www.cse.iitk.ac.in/users/dheeraj/cs425>, Last Accessed on: 18/4/2025.

23CS5303

FORMAL LANGUAGES AND AUTOMATA THEORY

Course Category	PC	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23BS4101B	Continuous Eval	30
	Discrete Mathematics	Semester End Eval	70
	and Graph Theory	Total Marks	100

COURSE OUTCOMES

1. Understand the basic concepts of formal languages of finite automata techniques.
2. Apply regular expressions to various problems and minimize the finite automata.
3. Apply various languages to construct context free grammar, normal forms, PDA.
4. Analyze a Turing machine and Post's Correspondence problems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	3			2								1		2	1.1.1, 1.3.1, 2.1.1, 2.1.3, 2.2.4, 5.4.1, 5.4.2
2	2	3			2								1		3	1.1.1, 1.3.1, 2.1.1, 2.1.3, 2.2.4, 5.4.1, 5.4.2
3		3	3		2								1		3	2.2.3, 2.2.4, 3.1.1, 3.3.1, 5.4.1, 5.4.2
4		3	3		2								1		4	2.2.3, 2.2.4, 3.1.1, 3.3.1, 5.4.1, 5.4.2

COURSE CONTENT

UNIT I

Finite Automata: Need of Automata theory, Central Concepts of Automata Theory, Automation, Finite Automata, Transition Systems, Acceptance of a String, DFA, Design of DFAs, NFA, Design of NFA, Equivalence of DFA and NFA, Conversion of NFA into DFA, Finite Automata with E-Transitions, Minimization of Finite Automata, Finite Automata with output-Mealy and Moore Machines, Applications and Limitation of Finite Automata.

UNIT II

Regular Expressions, Regular Sets, Identity Rules, Equivalence of two RE, Manipulations of REs, Finite Automata and Regular Expressions, Inter Conversion, Equivalence between FA and RE, Pumping Lemma of Regular Sets, Closure Properties of Regular Sets, Grammars, Classification of Grammars, Chomsky Hierarchy Theorem, Right and Left Linear Regular Grammars, Equivalence between RG and FA, Inter Conversion.

UNIT III

Formal Languages, Context Free Grammar, Leftmost and Rightmost Derivations, Parse Trees, Ambiguous Grammars, Simplification of Context Free Grammars Elimination of Useless Symbols, -Productions and Unit Productions, Normal Forms-Chomsky Normal Form and Greibach Normal Form, Pumping Lemma, Closure Properties, Applications of Context Free Grammars. Pushdown Automata, Definition, Model, Graphical Notation, Instantaneous Description, Language Acceptance of Pushdown Automata, Design of Pushdown Automata.

UNIT IV

Deterministic and Non – Deterministic Pushdown Automata, Equivalence of Pushdown Automata and Context Free Grammars, Conversion, Two Stack Pushdown Automata, Application of Pushdown Automata. Turning Machine: Definition, Model, Representation of TMs-Instantaneous Descriptions, Transition Tables and Transition Diagrams, Language of a TM, Design of TMs, Types of TMs, Church's Thesis, Universal and Restricted TM, Decidable and Un-decidable Problems, Halting Problem of TMs, Post's Correspondence Problem, Modified PCP.

TEXTBOOKS

1. J. E. Hopcroft, R. Motwani and J. D. Ullman, Introduction to Automata Theory, Languages and Computation, 3rd Edition, Pearson, 2008.
2. K. L. P. Mishra and N. Chandrasekharan, Theory of Computer Science-Automata, Languages and Computation, 3rd Edition, PHI, 2007.

REFERENCE BOOKS

1. Lewis H.P., Papadimitiou C.H., Elements of Theory of Computation, Pearson, PHI, 2015.
2. V. Kulkarni, Theory of Computation, Oxford University Press, 2013.
3. Rajendrakumar, Theory of Automata, Languages and Computation, McGraw Hill, 2014.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Sourav Mukhopadhyay , Introduction to Automata, Languages and Computation, https://onlinecourses.nptel.ac.in/noc21_cs19/preview, Last Accessed on: 29/4/2025.

2. Prof. Scott Aaronson, Automata, Computability, and Complexity, <https://ocw.mit.edu/courses/6-045j-automata-computability-and-complexity-spring-2011/>, Last Accessed on: 29/4/2025.

23C5404A

OBJECT ORIENTED ANALYSIS AND DESIGN

Course Category	PE -I	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS3305 Object Oriented Programming Language	Continuous Eval	30
	23CS4305 Software Engineering	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the basic concepts of object oriented analysis and design.
2. Apply object oriented methodologies for a given application.
3. Apply object oriented analysis process for any given application.
4. Illustrate the use of object oriented design process for a given application.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	3													2	1.7.1, 2.5.1, 2.5.2
2	2	2	3										2		3	1.7.1, 2.5.1, 3.5.2, 3.5.6
3	2	2	3										2		3	1.7.1, 2.5.1, 3.5.2, 3.5.6
4		2	3										2		3	2.5.1, 3.5.2, 3.5.6

COURSE CONTENT

UNIT I

Introduction: The Structure of Complex systems, The Inherent Complexity of Software, Attributes of Complex System, Designing Complex Systems.

Introduction to UML: Importance of modeling, principles of modeling, object-oriented modeling, conceptual model of the UML, Architecture.

UNIT II

Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams. Case Study: Control System: Traffic Management.

Class Diagrams: Terms, concepts, modeling techniques for Class Diagrams.

Advanced Structural Modeling: Advanced classes, advanced relationships, Interfaces, Types and Roles. Case Study: Passport Automation System

UNIT III

Basic Behavioral Modeling-I: Interactions, Interaction diagrams Use cases, Use case Diagrams, Activity Diagrams. Case Study: Web Application: Vacation Tracking System.

UNIT IV

Advanced Behavioral Modeling: Events and signals, state machines, processes and Threads, time and space, state chart diagrams.

Architectural Modeling: Component, Deployment, Component diagrams and Deployment diagrams. Case Study: Weather Forecasting.

TEXTBOOKS

1. Grady BOOCH, Robert A. Maksimchuk, Michael W. ENGLE, Bobbi J. Young, Jim Conallen, Kellia Houston , Object- Oriented Analysis and Design with Applications, 3rd edition, Pearson, 2013.
2. Grady Booch, James Rumbaugh, Ivar Jacobson: The Unified Modeling Language User Guide, 2nd Edition, Pearson Education, 2005.

REFERENCE BOOKS

1. Meilir Page-Jones: Fundamentals of Object Oriented Design in UML, 1st Edition, Pearson Education, 2002.
2. Pascal Roques: Modeling Software Systems Using UML2, 1st Edition, WILEY-Dreamtech India Pvt. Ltd., 2004.
3. Atul Kahate: Object Oriented Analysis & Design, The McGraw-Hill Companies, 1st Edition, 2004.
4. Applying UML and Patterns: An introduction to Object – Oriented Analysis and Design and Unified Process, Craig Larman, Pearson Education, 3rd Edition, 2004.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Partha Pratim Das, Object Oriented Analysis and Design, <https://archive.nptel.ac.in/courses/106/105/106105153/>, Last accessed on: 12/04/2025.

23CS5404B ARTIFICIAL INTELLIGENCE

Course Category	PE-1	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23BS4102B Probability and Statistics	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the AI agents for problem solving.
2. Understand AI solutions using Heuristic and Pruning approaches.
3. Apply various knowledge representation techniques.
4. Apply the logic concepts and learnings to Expert Systems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	2											1	1	2	1.2.1, 1.6.1, 1.7.1, 2.5.2, 2.6.2
2	1	2	2										1	1	2	1.6.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1, 3.5.1
3	1	2	2										1	1	3	1.6.1, 1.7.1, 2.5.2, 2.6.4, 3.5.1
4	2	2	2										1	1	3	1.6.1, 1.7.1, 2.5.2, 2.6.4, 2.7.1, 3.5.1

COURSE CONTENT

UNIT I

Introduction: AI problems, foundation of AI and history of AI.

Intelligent Agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents.

Problem solving agents: Well defined problems and Solutions, problem formulation, Example problems- 8-puzzle problem, Water jug problem.

UNIT II

Searching: Searching for solutions, uniformed search strategies – Breadth first search, depth first Search.

Heuristic Search: Search with partial information, Informed search strategies, Hill climbing, Best First search, A* Algorithm, Problem Reduction -AO* Algorithms..

Adversarial Search: Games, mini-max algorithm, Problem in Game playing, Alpha-Beta pruning, Evaluation functions.

UNIT III

Representation of Knowledge: Weak Slot and filler structures, Semantic nets-frames and frame systems.

Representing knowledge using rules: Procedural versus declarative knowledge, Logic programming, Forward vs Backward reasoning.

Knowledge Representation Issues: Representation and mapping, Approaches in knowledge representation, Issues in knowledge representation.

UNIT IV

Logic concepts: Predicate Logic, Propositional vs. Predicate Logic, unification & lifts forward chaining, Backward chaining, Resolution.

Learning: Learning from observation, Explanation based learning, Statistical Learning methods, Reinforcement Learning.

Agentic AI Systems: Agentic Framework, Key features of Agentic Framework, Importance, 7 Agentic Frameworks, AI builders vs Agentic Frameworks.

TEXTBOOKS

1. S. Russel and P. Norvig, Artificial Intelligence – A Modern Approach, Pearson Education, 2nd Edition, 2007.
2. Kevin Night and Elaine Rich, Nair B, Artificial Intelligence (SIE), Mc Graw Hill, 3rd Edition, 2010.

REFERENCE BOOKS

1. David Poole, Alan Mackworth, Randy Goebel, Computational Intelligence: a Logical approach, Oxford University Press, 1st Edition, 2004.
2. G. Luger, Artificial Intelligence: Structures and Strategies for complex problem-solving, Pearson Education, 4th Edition, 2001.
3. J. Nilsson, Artificial Intelligence: A new Synthesis, Elsevier Publishers, 1st Edition, 2003.
4. Saroj Kaushik, Artificial Intelligence, Cengage Learning, 1st Edition, 2011.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Shyamanta M. Hazarika, Fundamentals of Artificial Intelligence, https://onlinecourses.nptel.ac.in/noc21_ge20/preview, Last Accessed On: 31/04/2025.
2. Agentic Frameworks: The Complete Guide to the Systems Used in Building Autonomous Agents, <https://www.moveworks.com/us/en/resources/blog/what-is-agentic-framework>, Last Accessed on: 05/05/2025.

23CS5404C

MICROPROCESSOR AND MICROCONTROLLERS

Course Category	PE -I	Credits	3
Course Type	Theory	L-T-P	3 -0-0
Prerequisites	23ES3103C	Continuous Eval	30
	Digital Logic	Semester End Eval	70
	& Computer Organisation	Total Marks	100

COURSE OUTCOMES

1. Understand the internal Architecture and programming of 8086 Microprocessor.
2. Apply interfacing concepts to various peripherals with the 8086 Microprocessor.
3. Understand the internal Architecture and programming of 8051 Microcontroller.
4. Apply interfacing concepts to various peripherals with the 8051 Microcontroller.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	1	2													2	1.7.1, 2.7.1
2	2	2	3										2		3	1.7.1, 2.7.1, 3.8.3
3	1	2											2		2	1.7.1, 2.7.1
4	2	2	3												3	1.7.1, 2.7.1, 3.8.3

COURSE CONTENT

UNIT I

8086 Architecture: Main features, pin diagram/description, 8086 microprocessor family, internal architecture, bus interfacing unit, execution unit, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode.

8086 Programming: Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

UNIT II

8086 Interfacing: Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDs, Interfacing seven segment displays, software and hardware interrupt applications, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

UNIT III

8051 Architecture & Programming: Microcontroller, Architecture of 8051, Special Function Registers (SFRs), I/O Pins Ports and Circuits, Instruction set, Addressing modes, Assembly language programming.

UNIT IV

8051 Interfacing: Interfacing Microcontroller, Programming 8051 Timers, Serial Port Programming, Interrupts Programming, LCD & Keyboard Interfacing, ADC, DAC & Sensor Interfacing, External Memory Interface, Stepper Motor and Waveform generation, Comparison of Microprocessor, Microcontroller, PIC and ARM processors

TEXT BOOKS

1. Douglas V Hall, SSSP Rao, Microprocessors and Interfacing – Programming and Hardware, Tata McGraw Hill Education Private Limited, 3rd Edition, 2012.
2. K M Bhurchandi, A K Ray, Advanced Microprocessors and Peripherals, 3rd edition, McGraw Hill Education, 2017.
3. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, 2nd edition, Pearson, 2012.

REFERENCE BOOKS

1. Ramesh S Gaonkar, Microprocessor Architecture Programming and Applications with the 8085, 6th edition, Penram International Publishing, 2013.
2. Kenneth J. Ayala, The 8051 Microcontroller, 3rd edition, Cengage Learning, 2004.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Santanu Chattopadhyay, IIT Kharagpur, Microprocessors and Microcontrollers <https://archive.nptel.ac.in/courses/108/105/108105102/>, Last accessed on 25/04/2025.

23CS5404D

INTERNET OF THINGS (IoT)

Course Category	PE -I	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23ES3103C Digital Logic& Computer Organization	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand how the Internet and Internet of Things (IoT) function at a conceptual level.
2. Analyze the constraints and opportunities of wireless and mobile networks used in IoT applications.
3. Apply basic sensing and measurement techniques to evaluate real-time network performance of connected devices.
4. Design prototype models for practical applications using IoT technologies.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2												1	2	2	1.6.1, 1.7.1
2	2												1	2	4	1.6.1, 1.7.1
3		2	2										2		3	2.7.1, 2.7.2, 3.6.2
4	1				2										3	1.6.7, 1.7.1, 5.4.1

COURSE CONTENT

UNIT I

The Internet of Things: An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, M2M Communication, Examples of IoTs, Design Principles For Connected Devices Internet Connectivity Principles, Internet connectivity, Application Layer Protocols: HTTP, HTTPS, FTP, Telnet.

UNIT II

Business Models for Business Processes in the Internet of Things, IoT/M2M systems LAYERS AND designs standardizations, Modified OSI Stack for the IoT/M2M Systems, ETSI M2M domains and High- level capabilities ,Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability.

UNIT III

Design Principles for the Web Connectivity for Connected: Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for Connected-Devices. Data Acquiring, Organizing and Analytics in IoT/M2M, Applications /Services /Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet Of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

UNIT IV

Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology, Sensing the World.

TEXT BOOKS

1. Rajkamal, Internet of Things: Architecture, Design Principles And Applications, McGraw Hill Higher Education, 2nd Edition, 2022.
2. A. Bahgya and V.Madisetti, Internet of Things, Univesity Press, 1ast Edition, 2015.

REFERENCE BOOKS

1. A. McEwen and H. Cassimally, Designing the Internet of Things, 1st edition, Wiley, 2013.
2. C. Pfister, Getting Started with the Internet of Things, 1st edition, O'Reilly Media, 2011.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Sudip Misra, IIT Kharagpur Introduction to Internet of things, Available: <https://nptel.ac.in/courses/106/105/106105166/>, Last accessed on 25/04/2025.
2. Prof. T V Prabhakar, IISc Bangalore, Design for Internet of things, Available: <https://nptel.ac.in/courses/108/108/108108098/>, Last accessed on 25/04/2025.

23CS5205A

WEB PROGRAMMING

Course Category	OE- I	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	–	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the concepts of Web designing.
2. Apply the concepts of HTML5 and CSS to design static web pages.
3. Apply client side technologies to design interactive Web interfaces
4. Apply interactive server side scripting for a web application.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	3	2													2	1.3.1, 2.1.1
2		2	3										2		3	2.2.3, 3.2.1, 3.2.2
3		2	3										3		3	2.2.3, 2.2.4, 3.3.1, 3.2.1, 3.2.2
4		2	3										3		3	2.2.3, 3.2.1, 3.2.2

COURSE CONTENT

UNIT I

Introduction: Concept of WWW, Internet and WWW, HTTP Protocol : Request and Response, Web browser and Web servers, Features of Web 2.0.

Web Design: Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation.

UNIT II

HTML: Basics of HTML, formatting and fonts, commenting code, color, hyperlink, lists, tables, images, forms, XHTML, Meta tags, Character entities, frames and frame sets, Browser architecture and Web site structure. Overview and features of HTML5.

Style sheets: Need for CSS, introduction to CSS, basic syntax and structure, using

CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2, Overview and features of CSS3

UNIT III

JavaScript: Client side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript: Javascript and objects, JavaScript own objects, the DOM and web browser environments, Manipulation using DOM, forms and validations, DHTML : Combining HTML, CSS and Javascript, Events and buttons.

XML: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Using XML with application. Transforming XML using XSL and XSLT.

UNIT IV

PHP: Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions, Object Oriented Programming with PHP.

PHP and MySQL: Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs.

TEXT BOOKS

1. R. Moseley and M. T. Savaliya, Developing Web Applications, 2nd ed. New Delhi, India: Wiley India Pvt. Ltd., 2011.

REFERENCE BOOKS

1. J. Sklar, Web Design Principles, 5th edition, Boston, MA: Course Technology Cengage Learning, 2012.
2. H. M. Deitel, P. J. Deitel, and T. R. Nieto, Internet & World Wide Web: How to Program, 3rd edition, Upper Saddle River, NJ: Pearson/Prentice Hall, 2004.
3. B. M. Harwani, Developing Web Applications in PHP and AJAX. New Delhi, India: Tata McGraw-Hill Education, 2010.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Sengupta, Internet Technology, NPTEL, Jun. 28, 2014. <https://nptel.ac.in/courses/106105084>, Last Accessed: 05-05-2025.
2. PHP Group, PHP: MySQL - Manual, PHP: Hypertext Preprocessor, <https://www.php.net/manual/en/book.mysql.php>, Last Accessed: 05-05-2025.

23CS5205B

INTERNET OF THINGS

Course Category	OE- I	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites		Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the design concepts and applications of Internet of Things
2. Understand Standards and Key Technologies in IoT.
3. Apply the steps of the design methodology in developing IoT applications using Raspberry Pi
4. Understand the Privacy, security and Vulnerabilities of internet of Things

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2												1	2	2	1.6.1,1.7.1
2	2												1	2	2	1.6.1, 1.7.1
3		2	2										2		3	2.7.1, 2.7.2, 3.6.2
4	1				2										2	1.6.1, 1.7.1, 5.4.1

COURSE CONTENT

UNIT I

Introduction to Internet of things: Introduction, Physical design of IoT, Logical Design of IoT, IoT Enabling technologies, IoT levels & Deployment templates.

Domain Specific IoTs – Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle

UNIT II

IoT and M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT, Software Defined Networking, Network Function Virtualization.

IoT Platforms Design Methodology: Introduction, IoT Design Methodology, Case Study on IoT System for Home Automation , IoT system for Weather Monitoring.

UNIT III

IoT Physical Devices and Endpoints: Basic building blocks of an IoT Device, Introduction to Raspberry Pi Board, Linux on Raspberry Pi, Raspberry Pi Interfaces (serial, SPI, I2C)

Programming Raspberry PI with Python – Controlling LED with Raspberry Pi, Interfacing an LED and Switch with Raspberry Pi, Interfacing a Light sensor (LDR) with Raspberry Pi.

UNIT IV

IoT Privacy, Security and Vulnerabilities Solutions: Introduction, Vulnerabilities, Security Requirements and Threat Analysis – Privacy, Vulnerabilities of IoT, Security Requirements, Threat Analysis, Use Cases and Misuse Cases, IoT Security Tomography and Layered Attacker model. Security models, profiles and protocols for IoT.

TEXTBOOKS

1. Arshdeep Bahga , Vijay Madisetti, Internet of Things (A Hands-on Approach), 1st Edition, Universities Press Private Limited, 2014.
2. Raj Kamal, Internet of Things, Architecture and Design Principles, 1st Edition, McGraw Hill Education Private Limited, 2017.

REFERENCE BOOKS

1. Matt Richardson & Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly (SPD), 2014.
2. David Hanes, IOT Fundamentals, 1st Edition, CISCO Press, 2018.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Sudip Misra, IIT Kharagpur, Introduction to Internet of things, Available: <https://nptel.ac.in/courses/106/105/106105166/>, Last Accessed on: 24/04/2025.
2. Prof. T V Prabhakar, IISc Bangalore, Design for Internet of things, Available: <https://nptel.ac.in/courses/108/108/108108098/>, Last Accessed on: 24/04/2025.

23CS5351 DATA MINING LAB

Course Category	PC	Credits	1
Course Type	Laboratory	L-T-P	0-0-2
Prerequisites	23CS4304 Data Base Management Systems	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Design techniques of data warehousing and data mining.
2. Apply various pre-processing techniques on datasets using Data mining techniques.
3. Analyze classification and apriori algorithms to solve real life problems.
4. Analyze different types of clustering algorithms to solve real life problems.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	3												3	2	2	1.2.1, 1.7.1
2	1	3											1	1	3	1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1
3	1	3											1	1	4	1.2.1, 1.7.1, 2.5.2,
4	1	2											2	2	4	1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1

Software Requirements: WEKA Tool/Python/R-Tool/Rapid Tool/Oracle Data mining

COURSE CONTENT

Task 1: Creation of a Data Warehouse.

- Build Data Warehouse/Data Mart (using open source tools like Pentaho Data Integration Tool, Pentaho Business Analytics; or other data warehouse tools like Microsoft-SSIS, Informatica, Business Objects, etc.,)
- Design multi-dimensional data models namely Star, Snowflake and Fact Constellation schemas for any one enterprise (ex. Banking, Insurance, Finance, Healthcare, manufacturing, Automobiles, sales etc).
- Write ETL scripts and implement using data warehouse tools.
- Perform Various OLAP operations such slice, dice, roll up, drill up and pivot

Task 2: Explore machine learning tool “WEKA”

- Explore WEKA Data Mining/Machine Learning Toolkit.
- Downloading and/or installation of WEKA data mining toolkit.
- Understand the features of WEKA toolkit such as Explorer, Knowledge Flow interface, Experimenter, command-line interface.
- Navigate the options available in the WEKA (ex. Select attributes panel, Preprocess panel, Classify panel, Cluster panel, Associate panel and Visualize panel)
- Study the arff file format Explore the available data sets in WEKA. Load a data set (ex. Weather dataset, Iris dataset, etc.)
- Load each dataset and observe the following: 1. List the attribute names and they types 2. Number of records in each dataset 3. Identify the class attribute (if any) 4. Plot Histogram 5. Determine the number of records for each class. 6. Visualize the data in various dimensions

Task 3: Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets

- Explore various options available in Weka for preprocessing data and apply Unsupervised filters like Discretization, Resample filter, etc. on each dataset
- Load weather nominal, Iris, Glass datasets into Weka and run Apriori Algorithm with different support and confidence values.
- Study the rules generated. Apply different discretization filters on numerical attributes and run the Apriori association rule algorithm. Study the rules generated.
- Derive interesting insights and observe the effect of discretization in the rule generation process.

Task 4: Demonstrate performing classification on data sets Weka/R

- Load each dataset and run 1d3, J48 classification algorithm. Study the classifier output. Compute entropy values, Kappa statistic.
- Extract if-then rules from the decision tree generated by the classifier, Observe the confusion matrix.
- Load each dataset into Weka/R and perform Naïve-bayes classification and k-Nearest Neighbour classification. Interpret the results obtained.
- Plot RoC Curves
- Compare classification results of ID3, J48, Naïve-Bayes and k-NN classifiers for each dataset, and deduce which classifier is performing best and poor for each dataset and justify.

Task 5: Demonstrate performing clustering of data sets

- Load each dataset into Weka/R and run simple k-means clustering algorithm with different values of k (number of desired clusters).
- Study the clusters formed. Observe the sum of squared errors and centroids, and derive insights.
- Explore other clustering techniques available in Weka/R.
- Explore visualization features of Weka/R to visualize the clusters. Derive interesting insights and explain.

Task 6: Demonstrate knowledge flow application on data sets into Weka/R

- Develop a knowledge flow layout for finding strong association rules by using Apriori, FP Growth algorithms
- Set up the knowledge flow to load an ARFF (batch mode) and perform a cross validation using J48 algorithm
- Demonstrate plotting multiple ROC curves in the same plot window by using j48 and Random forest tree

Task 7: Demonstrate ZeroR technique on Iris dataset (by using necessary preprocessing technique(s)) and share your observations

Task 8: Write a java program to prepare a simulated data set with unique instances.

Task 9: Write a Python program to generate frequent item sets / association rules using Apriori algorithm

Task 10: Write a program to calculate chi-square value using Python/R. Report your observation.

Task 11: Write a program of Naive Bayesian classification using Python/R programming language

Task 12: Implement a Java/R program to perform Apriori algorithm

Task 13: Write a R program to cluster your choice of data using simple k-means algorithm using JDK

Task 14: Write a program of cluster analysis using simple k-means algorithm Python/R programming language.

Task 15: Write a program to compute/display dissimilarity matrix (for your own dataset containing at least four instances with two attributes) using Python

Task 16: Visualize the datasets using matplotlib in python/R.(Histogram, Box plot, Bar chart, Pie chart etc.,)

TEXTBOOKS

1. Jiawei Han, Michel Kamber, Data Mining concepts and Techniques, 3rd edition, Elsevier, 2011.
2. Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Introduction to Data Mining, 2nd Edition, Pearson, 2012.

REFERENCE BOOKS

1. VikramPudi and P. Radha Krishna, Data Mining, 1st Edition, Oxford Publisher.

2. Arun K Pujari, Data Mining Techniques, 3rd edition, Universities Press, 2013.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. PabitraMitra, Data Mining Techniques, https://onlinecourses.nptel.ac.in/noc22_cs11/preview, Last accessed on: 25/04/2025.
2. Dr. Saed Sayad, An Introduction to Data Science, http://www.saedsayad.com/data_mining_map.html, Last accessed on: 25/04/2025.

23CS5352

COMPUTER NETWORKS LAB

Course Category	PC	Credits	1
Course Type	Laboratory	L-T-P	0-0-2
Prerequisites	23CS4303 Operating Systems	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Analyze working of Reference models in action.
2. Analyse protocols at Data Link Layer.
3. Apply IPv4 and IPv6 addressing schemes for the given network and troubleshoot issues.
4. Analyse the security measures implemented in networks.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	1	2	2		2								1	1	4	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2
2	1	3	3		3								1	1	4	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2, 5.5.2
3	1	3	3		3								1	1	3	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2, 5.5.2
4	1	2	2		2								1	1	4	1.2.1, 1.7.1, 2.5.2, 2.5.3, 2.6.3, 3.5.1, 3.6.2, 5.4.2

COURSE CONTENT

Task 1: CCNA-1: Investigate OSI and TCP reference models in action. i) Examine HTTP Web Traffic ii) Display Elements of the TCP/IP Protocol Suite

Task 2: Write a Program to implement the data link layer framing methods such as i) Character stuffing ii) bit stuffing.

Task 3: Write a Program to implement data link layer error control methods - checksum, the three CRC polynomials – CRC 12, CRC 16 and CRC CCIP.

Task 4: Write a program for Hamming Code generation for error detection and correction.

Task 5: CCNA-1- Basic Switch and End Device Configuration Configure Initial Switch Settings (PT 2.5.5) & Basic Switch and End Device Configuration (PT 2.9.1); Configure Initial Router Settings (PT 10.1.4), Connect a Router to a LAN (PT 10.3.4) & Troubleshoot Default Gateway Issues (10.3.5)

Task 6: Write a Program to implement Sliding window protocol for Goback N and for Selective repeat.

Task 7: CCNA-1: IPv4 Addressing - Subnet an IPv4 Network (PT 11.5.5), Subnetting Scenario (PT 11.7.5), VLSM Design and Implementation Practice (PT 11.9.3), Design and Implement a VLSM Addressing Scheme (PT 11.10.1), Configure IPv6 Addressing (PT 12.6.6), Implement a Subnetted IPv6 Addressing Scheme (PT 12.9.1)

Task 8: Write a Program to implement Stop and Wait Protocol.

Task 9: Write a program for congestion control using leaky bucket algorithm

Task 10: Implement Dijkstra's algorithm to compute the Shortest path through a graph.

Task 11: Write a Program to implement Distance vector routing algorithm by obtaining routing table at each node (Take an example subnet graph with weights indicating delay between nodes).

Task 12: Write a Program to implement Broadcast tree by taking subnet of hosts.

Task 13: Wireshark

i) Packet Capture Using Wire shark ii) Starting Wire shark iii) Viewing Captured Traffic iv) Analysis and Statistics & Filters.

Task 14: CCNA-1: Verify IPv4 and IPv6 Addressing (PT 13.2.6), Use Ping and Traceroute to Test Network Connectivity (PT 13.2.7), Use ICMP to Test and Correct Network Connectivity (PT 13.3.1)

Task 15: How to run Nmap scan and Operating System Detection

Task 16: CCNA-1: Device Security - Configure Secure Passwords and SSH (PT 16.4.6), Secure Network Devices (PT 16.5.1)

TEXTBOOKS

1. Andrew S Tanenbaum, David J Wetherall, Computer Networks, 5th Edition, Pearson Education, 2011.
2. Behrouz A.Fourozan, Data Communications and Networking. 4th Edition, TATA McGraw Hill, 2007.

REFERENCE BOOKS

1. J.F. Kurose and K. W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 6th Edition, Pearson Education, 2012.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof Sowmya Kanti Ghosh, Computer Networks and Internet Protocol, IIT Kharag-

- pur, NPTEL Lectures, Video Lectures, Available: <https://nptel.ac.in/course/s/106105183>, Last Accessed on: 18/4/2025.
2. Prof. Hari Balakrishnan, MIT Open Courseware, Computer Networks, MIT, Video Lectures, Available: <https://ocw.mit.edu/courses/6-829-computer-networks-fall-2002/>, Last Accessed on: 18/4/2025.
 3. Dheeraj, Computer Networks, IIT Kharagpur, Lecture Notes, Available: <http://www.cse.iitk.ac.in/users/dheeraj/cs425>, Last Accessed on: 18/4/2025.

23HS5153

ADVANCED COMMUNICATION SKILLS LAB

Course Category	Institutional Core	Credits	1
Course Type	Laboratory	L-T-P	0-0-2
Prerequisites	20TP4106 English for Professionals	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Execute rational pronunciation of speech sounds including accentuation.
2. Apply elements of listening comprehension in professional environments.
3. Develop the abilities of rational argumentation and skills of public speaking.
4. Demonstrate proficiency in the elements of professional communication including the competitive examination.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1										3					3	5.5.1, 10.4.1, 10.4.2, 10.5.2
2					2					3					4	5.5.2, 10.4.1, 10.4.2, 10.5.1
3					2					3					4	5.5.2, 10.4.1, 10.4.2, 10.5.2
4					1					3					4	5.5.1, 5.5.2, 10.4.1, 10.4.2

COURSE CONTENT/TASK

UNIT:I Elements of Spoken Expression and processes of Listening Comprehension:

- Speech Mechanism
- Articulation of vowels and consonants
- Patterns of Accentuation
- Types and processes of Listening comprehension

UNIT II: Patterns of Substantiation and Refutation in Public Speaking:

- Group Discussion(Open and Monitored)
- Pyramid Discussion
- PNI
- Seminar Talk and Power Point Presentation

UNIT III: Professional Communication:

- Self Affirmation Advanced Composition including
- Memo and e-mail
- Résumé Preparation
- Corporate ethic of Non-Verbal Communication

UNIT IV: Life Skills and Vocabulary for Competitive Examinations:

- Select Life Skills(50)
- Select Logies, Isms, Phobias and Manias (25 each)
- Sentence Completion and Double Unit Verbal Analogies (50 items)
- Fundamentals of Syllogisms(Descriptive and Pictorial)

TEXTBOOKS TEXTBOOKS

1. M. Cutts, Oxford Guide to Plain English, 7th impression, Oxford, UK: Oxford University Press, 2011.
2. Department of Phonetics and Spoken English, Exercises in Spoken English, 21st impression, Hyderabad, India: Central Institute of English and Foreign Languages (CIEFL), published by Oxford University Press, 2003.

REFERENCE BOOKS

1. S. R. Covey, The 7 Habits of Highly Effective People, 2nd edition, London, UK: Simon & Schuster UK Ltd (Pocket Books), 2004.
2. J. S. Brubacher, Eclectic Philosophy of Education: A Book of Readings, Englewood Cliffs, NJ, USA: Prentice-Hall, 1951.

23CS5651

FULL STACK DEVELOPMENT-II

Course Category	SEC	Credits	1
Course Type	Laboratory	L-T-P	0-0-2
Prerequisites	23CS3305	Continuous Eval	30
	Object Oriented Programming	Semester End Eval	70
	Through Java	Total Marks	100

COURSE OUTCOMES

1. Implement router, template engine and authentication using sessions to develop application in ExpressJS.
2. Build a single page application using RESTful APIs in ExpressJS
3. Apply router and hooks in designing ReactJS application
4. Implement MongoDB queries to perform CRUD operations on document database

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	2													3	1.7.1, 2.5.1, 2.5.2
2	2	2	3										2	2	3	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.7.1, 3.5.1
3	2	2	3										2	2	3	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4 3.5.1
4		2	3	2									2	2	3	2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 4.6.2

Experiments covering the Topics:

- ExpressJS – Routing, HTTP Methods, Middleware, Templating, Form Data
- ExpressJS – Cookies, Sessions, Authentication, Database, RESTful APIs
- ReactJS – Render HTML, JSX, Components – function & Class, Props and States, Styles, Respond to Events
- ReactJS – Conditional Rendering, Rendering Lists, React Forms, React Router, Updating the Screen
- ReactJS – Hooks, Sharing data between Components, Applications – To-do list and Quiz

- MongoDB – Installation, Configuration, CRUD operations, Databases, Collections and Records

Sample Experiments:**1. ExpressJS – Routing, HTTP Methods, Middleware**

- Write a program to define a route, Handling Routes, Route Parameters, Query Parameters and URL building.
- Write a program to accept data, retrieve data and delete a specified resource using http methods.
- Write a program to show the working of middleware.

2. ExpressJS – Templating, Form Data

- Write a program using templating engine.
- Write a program to work with form data.

3. ExpressJS – Cookies, Sessions, Authentication

- Write a program for session management using cookies and sessions.
- Write a program for user authentication

4. ExpressJS – Database, RESTful APIs

- Write a program to connect MongoDB database using Mongoose and perform CRUD operations.
- Write a program to develop a single page application using RESTful APIs.

5. ReactJS – Render HTML, JSX, Components – function & Class

- Write a program to render HTML to a web page.
- Write a program for writing markup with JSX.
- Write a program for creating and nesting components (function and class).

6. ReactJS – Props and States, Styles, Respond to Events

- Write a program to work with props and states.
- Write a program to add styles (CSS & Sass Styling) and display data.
- Write a program for responding to events.

7. ReactJS – Conditional Rendering, Rendering Lists, React Forms

- Write a program for conditional rendering.
- Write a program for rendering lists.

- Write a program for working with different form fields using react forms.
8. **ReactJS – React Router, Updating the Screen**
- Write a program for routing to different pages using react router.
 - Write a program for updating the screen.
9. **ReactJS – Hooks, Sharing data between Components**
- Write a program to understand the importance of using hooks.
 - Write a program for sharing data between components.
10. **MongoDB – Installation, Configuration, CRUD operations**
- Install MongoDB and configure ATLAS
 - Write MongoDB queries to perform CRUD operations on document using insert(), find(), update(), remove()
11. **MongoDB – Databases, Collections and Records**
- Write MongoDB queries to Create and drop databases and collections.
 - Write MongoDB queries to work with records using find(), limit(), sort(), createIndex(), aggregate().
12. **Augmented Programs: (Any 2 must be completed)**
- Design a to-do list application using NodeJS and ExpressJS.
 - Design a Quiz app using ReactJS.
 - Complete the MongoDB certification from MongoDB University website.

TEXTBOOKS

1. Vasan Subramanian, Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, 2nd edition, APress, O'Reilly.
2. Mike Cantelon, Mark Harter, T.J. Holowaychuk, Nathan Rajlich, Node.js in Action, Manning Publications. (Chapters 1-11)
3. AzatMardan, React Quickly, Manning Publications, 2nd Edition, 2017.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. ExpressJS - <https://www.tutorialspoint.com/expressjs>, Last Accessed on: 25/03/2025.
2. ReactJS - <https://www.w3schools.com/REACT/DEFAULT.ASP>, Last Accessed on: 25/03/2025.
3. MongoDB - <https://learn.mongodb.com/learning-paths/introduction-to-mongodb> , Last Accessed on: 25/03/2025.

23TP5106

PERSONALITY DEVELOPMENT

Course Category	SS-3	Credits	1
Course Type	Learning by Doing	L-T-P	0-0-2
Prerequisites	20TP4106 English for Professionals	Continuous Eval	100
		Semester End Eval	0
		Total Marks	100

COURSE OUTCOMES

1. Understand the corporate etiquette.
2. Make presentations effectively with appropriate body language.
3. Be composed with positive attitude.
4. Understand the core competencies to succeed in professional and personal life.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1									2	3					2	9.5.2, 10.5.1, 10.4.2
2									2	3					3	9.5.1, 10.4.1, 10.4.2
3									3	3					3	9.4.1, 10.5.1, 10.4.2
4									2	3					2	9.5.2, 10.4.1, 10.4.2

COURSE CONTENT

UNIT I

Analytical Thinking and Communication Skills: Self-Introduction, Shaping Young Minds - A Talk by Azim Premji (Listening Activity), Self-Analysis, Developing Positive Attitude, Perception; Verbal Communication, Non Verbal Communication (Body Language)

UNIT II

Self-Management Skills and Etiquette: Anger Management, Stress Management, Time Management, Six Thinking Hats, Team Building, Leadership Qualities; Social Etiquette, Business Etiquette, Telephone Etiquette, Dining Etiquette

UNIT III

Standard Operation Methods and Verbal Ability: Note Making, Note Taking, Minutes Preparation, Email Letter Writing; Synonyms, Antonyms, One Word Substitutes-Correction of Sentences-Analogies, Spotting Errors, Sentence Completion, Course of

Action -Sentences Assumptions, Sentence Arguments, Reading Comprehension, Practice work.

UNIT IV

Career-Oriented Skills: Group Discussion, Mock Group Discussions, Resume Preparation, Interview Skills, Mock Interviews

METHODOLOGY Audio—Visuals / Hand Outs (Compiled/Created by Training Division, T&P Cell, VR Siddhartha Engineering College), Board & Chalk and Interactive Sessions.

REFERENCE BOOKS

1. Mitra, B. K., Personality development and soft skills (Vol. 156). Oxford University Press, 2011.
2. Dhanavel, S. P, English and Soft Skills. Orient Blackswan Pvt Limited, 2011.
3. Aggarwal, R. S., A Modern Approach to Verbal & Non Verbal Reasoning. S. Chand, 2018.
4. Meenakshi, R. & Sharma, S, Technical Communication Principles and Practice, Oxford University Press, 2011.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Aptitude Questions and Answers, IndiaBIX. <https://www.indiabix.com>, Last accessed on 02/05/25.
2. Placement Papers of all IT Companies, Freshersworld, <https://placement.freshersworld.com/placement-papers>, Last accessed on 02/05/25.

USER INTERFACE DESIGN USING FLUTTER

Course Category	ES	Credits	1
Course Type	Laboratory	L-T-P	0-0-2
Prerequisites	–	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Learns to Implement Flutter Widgets and Layouts
2. Understand Responsive UI Design and with Navigation in Flutter
3. Knowledge on Widges and customize widgets for specific UI elements, Themes
4. Understand to include animation apart from fetching data

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 - Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1	2	2													2	1.7.1, 2.5.1, 2.5.2
2	2	2	3										2	2	2	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.7.1, 3.5.1
3	2	2	3										2	2	2	1.7.1, 2.5.1, 2.5.2, 2.6.3, 2.6.4 3.5.1
4		2	3	2									2	2	2	2.5.1, 2.5.2, 2.6.3, 2.6.4, 3.5.1, 4.6.2

List of Experiments: Students need to implement the following experiments:

1. (a) Install Flutter and Dart SDK
(b) Write a program to accept data, retrieve data and delete a specified resource using http methods.
2. (a) Explore various Flutter widgets (Text, Image, Container, etc.).
(b) Implement different layout structures using Row, Column, and Stack widgets
3. (a) Design a responsive UI that adapts to different screen sizes.
(b) Implement media queries and breakpoints for responsiveness.
4. (a) Set up navigation between different screens using Navigator.

- (b) Implement navigation with named routes.
- 5. (a) Learn about stateful and stateless widgets.
(b) Implement state management using set State and Provider.
- 6. (a) Create custom widgets for specific UI elements.
(b) Apply styling using themes and custom styles.
- 7. (a) Design a form with various input fields.
(b) Implement form validation and error handling.
- 8. (a) Add animations to UI elements using Flutter's animation framework.
(b) Experiment with different types of animations (fade, slide, etc.).
- 9. (a) Fetch data from a REST API.
(b) Display the fetched data in a meaningful way in the UI.
- 10. (a) Write unit tests for UI components.
(b) Use Flutter's debugging tools to identify and fix issues.

TEXTBOOKS

- 1. M. L. Napoli, Beginning Flutter: A Hands-on Guide to App Development, Hoboken, NJ, USA: John Wiley & Sons, 2020.
- 2. R. Payne, Beginning App Development with Flutter: Create Cross-Platform Mobile Apps, 1st edition, New York, NY, USA: Apress, 2021.
- 3. R. Rose, Flutter & Dart Cookbook: Developing Full-Stack Applications for the Cloud, Sebastopol, CA, USA: O'Reilly Media, 2022.

23CS5354**ENGINEERING PROJECT FOR COMMUNITY SERVICES**

Course Category	Project Work/Internship	Credits	2
Course Type	Laboratory	L-T-P	0-0-0
Prerequisites	–	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Identify the Societal problems.
2. Solve the problems.
3. Design of the problem/work plan.
4. Design of the prototype/model.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1						2	3						2	2
CO2						3	1			2			2	2
CO3						3			2				2	2
CO4									1	3			2	2

EPICS: Engineering Project for community services will be carried out during summer vacation for a period of six weeks after IV Semester and the report shall be submitted in V Semester. Students will go to the society (Villages/ Hospitals/Towns, etc..) to identify the problem and survey the literature for a feasible solution. The student(s) is encouraged to solve real life problems leading to innovative model building.. This can be done in a group of students or as an individual.

20MC5107

INTELLECTUAL PROPERTY RIGHTS (IPR)

Course Category	MC	Credits	–
Course Type	Theory	L-T-P	2-0-0
Prerequisites	–	Continuous Eval	100
		Semester End Eval	0
		Total Marks	100

COURSE OUTCOMES

1. Learn the innovation concepts related to business organizations.
2. Understand the importance of innovation in new start-ups.
3. Know fundamental aspects of Intellectual property Rights.
4. Learn the basic concepts of entrepreneurship and its benefits.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1		1						2	2		2		1		2	2.5.1, 2.5.1, 2.6.2, 2.6.3, 2.6.4, 8.3.1, 8.4.2, 9.4.2, 9.5.1, 11.6.1, 11.6.2
2		2						1	2		2		1		2	2.5.1, 2.5.1, 2.6.2, 2.6.3, 2.6.4, 8.3.1, 8.4.2, 9.4.2, 9.5.1, 11.6.1, 11.6.2
3		2						2	3		3		1		2	2.5.1, 2.5.1, 2.6.2, 2.6.3, 2.6.4, 8.3.1, 8.4.2, 9.4.2, 9.5.1, 11.6.1, 11.6.2
4		1						3	2		2		1		2	2.5.1, 2.5.1, 2.6.2, 2.6.3, 2.6.4, 8.3.1, 8.4.2, 9.4.2, 9.5.1, 11.6.1, 11.6.2

COURSE CONTENT

UNIT I

Innovation Management: Introduction Innovation: Definition, Importance –

The need to view innovation in an organizational context – Different types of innovation - Innovation and Invention – Popular views of innovation – Innovation as a management process.

UNIT II

Innovation: New Product Development (NPD): Innovation Management and New Product Development – Considerations when developing as NPD strategy - NPD as a strategy for growth – What is new product? – Classification of new products – NPD as an industry innovation cycle.

UNIT III

Intellectual Property Rights (IPR): Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development.

UNIT IV

Entrepreneurship Concept and need of entrepreneurship: Characteristics and Types of Entrepreneurship - Entrepreneurship as a career - Entrepreneurship as a style of Management - The changing role of the entrepreneur - Entrepreneurial traits, factors affecting entrepreneurs.

TEXT BOOKS

1. P. Trott, Innovation Management and New Product Development, 6th edition, Harlow, UK: Pearson Education Limited, 2017.
2. K. V. Nithyananda, Intellectual Property Rights: Protection and Management, 1st edition, New Delhi, India: Cengage Learning India Pvt. Ltd., 2019.
3. S. S. Khanka, Entrepreneurial Development, Revised edition, New Delhi, India: S. Chand Publishing, 2020.

REFERENCE BOOKS

1. J. Tidd and J. R. Bessant, Managing Innovation: Integrating Technological, Market and Organizational Change, 6th edition, Hoboken, NJ, USA: Wiley, 2018.
2. N. Pandey and K. Dharni, Intellectual Property Rights, 1st edition, New Delhi, India: PHI Learning Pvt. Ltd., 2014.
3. V. Desai, The Dynamics of Entrepreneurial Development and Management, 6th edition, Mumbai, India: Himalaya Publishing House, 2022.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof . K. D. Raju, Prof. Niharika Sahoo Bhattacharya, Intellectual Property Rights and Competition Law, NPTEL, IIT Kharagpur, <https://archive.nptel.ac.in/courses/110/105/110105139/#>, Last Accessed on: 02/05/2025.

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INTELLECTUAL PROPERTY RIGHTS (IPR)

Course Category	MC	Credits	–
Course Type	Theory	L-T-P	2-0-0
Prerequisites	–	Continuous Eval	100
		Semester End Eval	0
		Total Marks	100

COURSE OUTCOMES

1. Learn the innovation concepts related to business organizations.
2. Understand the importance of innovation in new start-ups.
3. Know fundamental aspects of Intellectual property Rights.
4. Learn the basic concepts of entrepreneurship and its benefits.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 – Medium, 3 – High)

CO	PO												PSO		BTL	POI
	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
1		1						2	2		2		1		2	2.5.1, 2.5.1, 2.6.2, 2.6.3, 2.6.4, 8.3.1, 8.4.2, 9.4.2, 9.5.1, 11.6.1, 11.6.2
2		2						1	2		2		1		2	2.5.1, 2.5.1, 2.6.2, 2.6.3, 2.6.4, 8.3.1, 8.4.2, 9.4.2, 9.5.1, 11.6.1, 11.6.2
3		2						2	3		3		1		2	2.5.1, 2.5.1, 2.6.2, 2.6.3, 2.6.4, 8.3.1, 8.4.2, 9.4.2, 9.5.1, 11.6.1, 11.6.2
4		1						3	2		2		1		2	2.5.1, 2.5.1, 2.6.2, 2.6.3, 2.6.4, 8.3.1, 8.4.2, 9.4.2, 9.5.1, 11.6.1, 11.6.2

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