
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 Computer Science and Engineering program objectives are: :

1. The graduates of the Program will have solid foundation in the principles and practices of computer science, including mathematics, science and basic engineering.
2. The graduates of the Program will have skills to function as members of multi-disciplinary teams and to communicate effectively using modern tools.
3. The graduates of the Program will be prepared for their careers in the software industry or pursue higher studies and continue to develop their professional knowledge.
4. The graduates of the program will 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

				Contact Hours			29
S. No.	Course Code	Course Category	Course Name	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)	3	0	0	3
5	23CS5205A 23CS5205B	OE-I	A. Web Programming (Other Dept.) B. Internet of Things (Other Dept.)	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	23CS5653	SEC	Full Stack Development -II	0	0	2	1
9	23CS5554	EPICS	Evaluation of Community Service Internship	0	0	0	2
8	23HS5155	HSS	Advanced Communication Skills Laboratory	0	0	2	1
11	23ES5156	ES	User Interface Design using Flutter / SWAYAM Plus - Android Application Development (with Flutter)	0	0	2	1
10	23TP5106	SS-3	Personality Development	0	0	2	1
13	23MC5107A	AC	Technincal Paper Writing & IPR	2	0	0	0
Total				17	0	12	23
Honors/ Minor Courses (Two Courses in each sem)				3	0	0	3

[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	A. Software Testing Methodologies B. Cyber Security C. DevOps D. Machine Learning	3	0	0	3
5	23CS6405	PE III	A. Software Project Management B. Mobile Adhoc Networks C. Natural Language Processing D. Distributed Operating System	3	0	0	3
6	23CS6206	OE II (NPTEL)	A. Foundations of R Software B. Social Networks C. Introduction to Industry 4.0 And Industrial Internet of Things D. Principles of Database Management Systems (Other Dept.)	0	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	23TP6107	SS - 4	Quantitative Aptitude	0	0	2	1
10	23MC6108A	AC	Humanities Elective	2	0	0	0
Total				17	0	8	22
Honors/ Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)				3	0	3	4.5

[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		MC	Human Resources and Project Management	2	0	0	2
3	23CS7403	PE IV	A. Software Architecture & Design Patterns B. Blockchain Technology C. Augmented Reality & Virtual Reality D. Foundations of Generative and Agentic AI E. 12 week MOOC Swayam/ NPTEL course recommended by the BoS	3	0	0	3
4	23CS7404	PE V	A. Agile methodologies B. Robotic Process Automation C. Computer Vision D. Cyber Physical Systems	3	0	0	3
5	23CS7205	OE III	A. Object Oriented Programming Through Java (Other Dept.) B. Data Science with Python (Other Dept.) C. AI Tools and Applications (Other Dept.)	3	0	0	3
6	23CS7206	OE IV	A. Programming in Modern C++ (NPTEL) B. Ethical Hacking (NPTEL) C. Privacy & Security in Social Media (NPTEL) D. Principles of Software Engineering (Other Dept.) E. Computer Networks (Other Dept.)	3	0	0	3
7		SEC	Prompt Engineering	0	1	2	2
8		AC	Constitution of India	2	0	0	-
9	23CS7551	PC-Lab	Deep Learning Lab	0	0	2	1
10	23CS7552	Internship	Evaluation of Industry Internship/Mini Project	0	0	4	2
Total				19	1	8	22
Industrial/ Research Internship Eight weeks (Mandatory) during summer vacation							
Honors/ Minor Courses (the hours distribution can be 4-0-0, 3-0-2 or 3-1-0 also)				3	0	0	3

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:

1. To obtain Minor Engineering, student needs to obtain 18 credits by successfully completing any of the following courses in the concern stream.
2. 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. Data Structures & Algorithms | 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: Web Programming/ Internet of Things

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

HUMANITIES ELECTIVE:

1. 23MC6108A1 FOREIGN LANGUAGES (GERMAN)
2. 23MC6108B BIOLOGY FOR ENGINEERS
3. 23MC6108C HUMAN RIGHTS AND LEGISLATIVE PROCEDURES
4. 23MC6108E INDIAN CONSTITUTION
5. 23MC6108G PSYCHOLOGY

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 I

23BS1101

LINEAR ALGEBRA & CALCULUS (COMMON TO ALL BRANCHES)

Course Category	Basic Science	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	10+2 level Mathematics	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Solve the system of homogeneous and non-homogeneous linear equations
2. Examine the nature of a quadratic form by transforming into a canonical form
3. Determine maxima and minima of multivariable functions
4. Evaluate areas and volumes using double, triple integrals

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			1											
2	3	2			1											
3	3	2			1											
4	3	2			1											

COURSE CONTENT

UNIT I-Matrices

Rank of a matrix by Echelon form, Normal form, Cauchy–Binet formulae (without proof), Inverse of Non- singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Jacobi and Gauss-Seidel Iteration Methods.

UNIT II-Eigenvalues, Eigenvectors and Orthogonal Transformation

Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), Finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic forms, Reduction of Quadratic form to Canonical forms by Orthogonal Transformation.

UNIT III-Differential Calculus

Mean Value Theorems: Rolle's theorem, Lagrange's mean value theorem with

their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof), Problems and applications on the above theorems.

Functions of Several Variables: Continuity and Differentiability, Partial derivatives, Total derivatives, Chain rule, Directional derivative, Taylor's and Maclaurin's series expansion of functions of two variables, Jacobians, Functional dependence, Maxima and Minima of functions of two variables, Method of Lagrange multipliers.

UNIT IV-Multiple Integrals (Multivariable Calculus)

Double integrals, Triple integrals, Change of order of integration, Change of variables to polar, cylindrical and spherical coordinates, Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

TEXT BOOKS

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition

REFERENCE BOOKS

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.
2. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition (9th reprint)
4. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition
5. Advanced Engineering Mathematics, Michael Greenberg, Pearson publishers, 9th Edition
6. Higher Engineering Mathematics, H. K. Das, Er. Rajnish Verma, S. Chand Publications, 2014, 3rd Edition (Reprint 2021)

E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. Prof. S. K. Gupta & Prof. Sanjeev Kumar, IIT Roorkee, Matrix Analysis with Applications [English], Available: https://onlinecourses.nptel.ac.in/noc19_ma28/preview
2. Prof. Jitendra Kumar, IIT Kharagpur, Engineering Mathematics – I [English], Available: https://onlinecourses.nptel.ac.in/noc20_ma37/preview
3. Prof. Jitendra Kumar & Prof. Somesh Kumar, IIT Kharagpur, Advanced Calculus For Engineers [English], Available: https://onlinecourses.nptel.ac.in/noc22_ma75/preview
4. Prof. Denis Auroux, Massachusetts Institute of Technology: MIT Open Courseware, Multivariable Calculus, Available: <https://ocw.mit.edu>.

23BS1102

ENGINEERING PHYSICS

(Common to all Programmes)

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

COURSE OBJECTIVES:

To bridge the gap between the Physics in school at 10+2 level and UG level engineering courses by identifying the importance of the modern optical devices such as Lasers and optical fibers, enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Elaborate different types of lasers, optical fibers and their applications
2. Familiarize with the basics of crystals and their structures
3. Summarize various types of polarization of dielectrics and classify the magnetic materials
4. Explain the basic concepts of Quantum Mechanics and types of semiconductors using Hall Effect.

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														
2	3	2														
3	3															
4	3															

COURSE CONTENT

UNIT I-Lasers and Fiber Optics

Lasers: Introduction, Characteristics of laser, Basic Principles of lasers (absorption, spontaneous emission and stimulated emission), Requirements of lasers (pumping, population inversion and cavity resonance), Einstein's coefficients, different types of lasers: solid-state lasers (Ruby), gas lasers, (He-Ne), Semiconductor laser, applications of lasers in science, engineering and medicine.

Fibre Optics: Introduction, Fundamentals of optic fibre, Propagation of light through optical fiber, Types of optical fibers, Numerical aperture, Fractional Refractive Index change, Fiber optics in communication and its advantages.

UNIT II-Crystallography and X-ray diffraction

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods.

UNIT III-Dielectric and Magnetic Materials

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius-Mossotti equation - Frequency dependence of polarization – complex dielectric constant (Qualitative) – dielectric loss (Qualitative).

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization- Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, Para and Ferro magnetic materials - Domain concept for Ferromagnetism Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

UNIT IV-Quantum Mechanics and Semiconductors

Quantum Mechanics: Dual nature of light, Matter waves, Properties and De-broglie's hypothesis, G.P.Thomson experiment, Heisenberg's Uncertainty Principle and its applications (Non existence of electron in nucleus) and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors- Fermi level-Extrinsic semiconductors-Fermi level - Drift and diffusion currents – Einstein's equation – Hall effect and its applications, Photodiode, Light Emitting Diode, Solar cell and its applications.

TEXT BOOKS

1. A Text book of Engineering Physics, M. N. Avadhanulu, P.G.Kshirsagar TVS Arun Murthy, S. Chand Publications, 11th Edition 2019.
2. Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press (2015)

REFERENCE BOOKS

1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021
2. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.

3. Engineering Physics - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press. 2010
4. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009)

E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. <https://www.loc.gov/rr/scitech/selected-internet/physics.html>

23ES1103A

BASICS OF CIVIL & MECHANICAL ENGINEERING

Course Category	Institutional Core	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	10+2	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Understand various Civil Engineering sub-divisions thereby appreciate their role in ensuring a better society and understand the basic building components along with attaining knowledge of Civil Engineering Materials and prefabricated technology
2. Know the basic concepts, uses and classification of surveying and realize the importance of Transportation in the nation's economy and the engineering measures related to Transportation and understand the importance of Water Storage and Conveyance Structures so that the social responsibilities of water conservation will be appreciated
3. Understand the scope of Mechanical Engineering in different sectors and industries and know about different manufacturing processes
4. Explain the basics of thermal engineering, Power plants , power transmission and robotics

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	3	2									
2	1				2	2	3									
3	2				1	2	3									
4	2				1	2	3									

COURSE CONTENT

UNIT I

Basics of Civil Engineering: Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental

Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel-Introduction to Prefabricated Construction Techniques.

UNIT II

Surveying and Transportation Engineering: Objectives of Surveying- Principles of Surveying-Classification based on function and instruments, Importance of Transportation in Nation's Economic Development- Basics components of Road-Classification of Highways.

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Simple introduction to Dams and Reservoirs.

UNIT III

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society- Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors. Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

Manufacturing Processes: Principles of Casting, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

UNIT IV

Thermal Engineering: IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Otto cycle, Diesel cycle, Components of Electric and Hybrid Vehicles., Refrigeration and air conditioning Working principle of Boilers: classification of Boilers Power plants – Working principle of Steam, Nuclear power plants. Mechanical Power Transmission - Belt and Gear Drives, Introduction to Robotics.

TEXT BOOKS

1. Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt. Ltd. Fourth Edition. (UNITS I & II)
2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers. 2022. First Edition (UNITS I & II)
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition (UNITS I & II)
4. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India) Pvt. Ltd. (UNITS III & IV)
5. A text book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications, (India) Pvt. Ltd. (UNITS III & IV)
6. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd. (UNITS III & IV)

REFERENCE BOOKS

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019.

- Fifth Edition. (UNITS I & II)
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016. (UNITS I & II)
 3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, Khanna Publishers, Delhi 2023. 38th Edition. (UNITS I & II)
 4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition. (UNITS I & II)
 5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012 (UNITS I & II)
 6. Advances in Civil Engineering (Volume - 5), S. Sathish, AkiNik Publications, 2021. (UNITS I & II)
 7. Advances in Civil Engineering (Volume - 5), S. Sathish, AkiNik Publications, 2021. (UNITS I & II)
 8. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, Tata McGraw Hill publications (India) Pvt. Ltd. (UNITS III & IV)
 9. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt. Ltd. (UNITS III & IV)
 10. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak M Pandey, Springer publications. (UNITS III & IV)
 11. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I. (UNITS III & IV)

E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. <http://nptel.iitm.ac.in/video.php?subjectId=10810607>
2. <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm>
3. <http://www.mike-willis.com/Tutorial/PF2.htm>
4. <https://www.scribd.com/document/680441639/Basic-Civil-and-Mechanical-Engineering>
5. <https://www.imeche.org/careers-education/careers-information/what-is-mechanical-engineering/where-do-mechanical-engineers-work>

23ES1104

Introduction To Programming (Common to All Branches)

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

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. To introduce students to the fundamentals of computer programming
2. To provide hands-on experience with coding and debugging on control structures and arrays
3. To foster logical thinking and problem-solving skills on strings and pointers
4. To familiarize students with programming concepts such as functions, structures and files

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														
2		2	3													
3		2	3													
4		2	3													

COURSE CONTENT

UNIT I- Introduction to Programming and Problem Solving

History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program- Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting.

Problem solving techniques: Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

UNIT II-Control Structures and Arrays

Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for,

while, do- while) Break and Continue, Arrays indexing, memory model, programs with array of integers, two dimensional arrays.

UNIT III-Strings and pointers

Introduction to Strings. Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers.

UNIT IV-Functions, User Defined Data types and File Handling

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scope and Lifetime of Variables, User-defined data types-Structures and Unions, Basics of File Handling

TEXT BOOKS

1. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice- Hall, 1988
2. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education, 1996.

REFERENCE BOOKS

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.W. H. Hayt and J. A. Buck, "Engineering Electromagnetics", 7th edition, Tata McGraw Hill, New Delhi, 2006.
2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition.
3. C Programming,A Problem Solving Approach,Forouzan,Gilberg,Prasad, CEN-GAGE, 3rd edition.

E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. <http://nptel.iitm.ac.in/video.php?subjectId=10810607>
2. <http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-%20Guwahati/em/index.htm>
3. <http://www.mike-willis.com/Tutorial/PF2.htm>

23HS1105

COMMUNICATIVE ENGLISH

Course Category	Institutional Core/ Humanities and Social Science	Credits	2
Theory	Theory	L-T-P	2-0-0
Prerequisites	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction abilities	Continuous Eval Semester End Eval Total Marks	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Understand the context, topic, and pieces of specific information from social or Transactional dialogues
2. Apply grammatical structures to formulate sentences and correct word forms
3. Analyze discourse markers to speak clearly on a specific topic in informal discussions
4. Evaluate reading texts / listening to write summaries based on global comprehension and create a coherent paragraph, essay and résumé

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				
2	2	2								3		2				
3	2									3		2				
4	2	2								3		2				

COURSE CONTENT UNIT I

Lesson: HUMAN VALUES: Gift of Magi (Short Story)

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.

Grammar: Parts of Speech, Basic Sentence Structures-forming questions.

Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNIT II

Lesson: NATURE: The Brook by Alfred Tennyson (Poem)

Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts.

Speaking: Discussion in pairs/small groups on specific topics followed by short structure talks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Writing: Structure of a paragraph - Paragraph writing (specific topics).

Grammar: Cohesive devices - linkers, use of articles and zero article; prepositions.

Vocabulary: Homonyms, Homophones, Homographs.

UNIT III

Lesson: BIOGRAPHY: Elon Musk

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed.

Reading: Reading a text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

Writing: Summarizing, Note-making, paraphrasing, Essay Writing, (The Power of Intrapersonal Communication).

Grammar: Verbs - tenses; subject-verb agreement; Compound words, Collocations.

Vocabulary: Compound words, Collocations.

UNIT IV

Lesson: INSPIRATION: The Toys of Peace by Saki

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.

Writing: Letter Writing: Official Letters, Resumes & Report Writing.

Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice.

Vocabulary: Words often confused, Jargons & Technical Jargons.

TEXT BOOKS

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023 (Units 1,2 & 3)
2. Empowering with Language by Cengage Publications, 2023 (Units 4 & 5).
3. English: Language, Context and Culture, 1st Edition, Orient Black Swan, 2023 (Units5)

REFERENCE BOOKS

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020.
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

E-RESOURCES AND OTHER DIGITAL MATERIALS:**GRAMMAR**

1. www.bbc.co.uk/learningenglish
2. <https://dictionary.cambridge.org/grammar/british-grammar/>
3. www.eslpod.com/index.html
4. <https://www.learngrammar.net/>
5. <https://english4today.com/english-grammar-online-with-quizzes/>
6. <https://www.talkenglish.com/grammar/grammar.aspx>

VOCABULARY

1. <https://www.youtube.com/c/DailyVideoVocabulary/videos>
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

23BS1151

ENGINEERING PHYSICS LAB

(Common to All Branches)

Course Category	Institutional Core/ Basic Sciences	Credits	1
Theory	Lab	L-T-P	0-0-2
Prerequisites	–	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Test optical components using principles of interference and diffraction of light
2. Use spectrometer, travelling microscope and function generator in various experiments
3. Determine the V-I characteristics of photo cells and appreciate the accuracy in measurements

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				3												
3	2			3												

COURSE CONTENT

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings.
2. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
3. Determination of wavelength of Laser light using diffraction grating
4. Estimation of stopping potential and work function of a photo material using photoelectric effect. 4. Estimation of stopping potential and work function of a photo material using photoelectric effect.
5. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
6. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect.

7. Determination of Acceleration due to Gravity and radius of Gyration by using a compound pendulum.
8. Sonometer: Verification of laws of stretched string.
9. Determination of Dielectric constant of different solid materials.
10. Determination of Numerical Aperture of a given optical fiber.
11. Determination of Frequency of electrically maintained tuning fork by Melde's experiment.
12. Determination of Rigidity Modulus of the material of the given wire using Torsional pendulum.
13. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
14. Determination of Energy Gap of a semiconductor using p-n junction diode.
15. Determination of thickness of a thin foil by Wedge Method.
16. Estimation of Fill Factor of a given Solar Cell.
17. Study the frequency response and determination of resonating frequency of LCR Circuit.
18. Determination of Figure of merit of a Galvanometer.

- **Note:** Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.

TEXT BOOKS

1. Madhusudhan Rao, "Engineering Physics Lab Manual", Ist ed., Scitech Publications, 2015.
2. Ramarao Sri, Choudary Nityanand and Prasad Daruka, "Lab Manual of Engineering Physics"., Vth ed., Excell Books, 2010.

E-RESOURCES

1. <http://plato.stanford.edu/entries/physics-experiment>
2. <http://www.physicsclassroom.com/The-Laboratory>
3. <http://facstaff.cbu.edu/~jvarrian/physlabs.html>.

VIRTUAL LAB REFERENCES

1. <http://vlab.amrita.edu/?sub=1&brch=201&sim=366&cnt=1>
2. <http://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1>
3. <http://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1>

23ES1152

COMPUTER PROGRAMMING LAB

(Common to All Branches)

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

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Read, understand, and trace the execution of programs written in C language
2. Select the right control structure for solving the problem
3. Develop C programs which utilize memory efficiently using programming constructs like pointers
4. Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C

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														
2		2	3													
3	2	2	3													
4		2	3													

COURSE CONTENT

UNIT I

Week 1

Objective: Getting familiar with the programming environment on the computer and writing the first program.

Suggested Experiments/Activities:

Tutorial 1: Problem-solving using Computers.

Lab1: Familiarization with programming environment.

- i. Basic Linux environment and its editors like Vi, Vim & Emacs etc.
- ii. Exposure to Turbo C, gcc
- iii. Writing simple programs using printf(), scanf()

Week 2

Objective: Getting familiar with how to formally describe a solution to a problem in a series of finite steps both using textual notation and graphic notation.

Suggested Experiments/Activities:

Tutorial 2: Problem-solving using Algorithms and Flow charts.

Lab2: Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs

- i. Sum and average of 3 numbers.
- ii. Conversion of Fahrenheit to Celsius and vice versa
- iii. Simple interest calculation

Week 3

Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

Suggested Experiments/Activities:

Tutorial 3: Variable types and type conversions.

Lab3: Simple computational problems using arithmetic expressions.

- i. Finding the square root of a given number
- ii. Finding compound interest
- iii. Area of a triangle using heron's formulae
- iv. Distance travelled by an object

Unit II**Week 4**

Objective: Explore the full scope of expressions, type-compatibility of variables & constants and operators used in the expression and how operator precedence works.

Suggested Experiments/Activities:

Tutorial 4: Operators and the precedence and as associativity.

Lab4: Simple computational problems using the operator' precedence and associativity.

- i. Evaluate the following expressions
 - (a) $A+B*C+(D*E) + F*G$
 - (b) $A/B*C-B+A*D/3$
 - (c) $A++++B-A$
 - (d) $J= (i++) + (++i)$
- ii. Find the maximum of three numbers using conditional operator
- iii. Take marks of 5 subjects in integers, and find the total, average in float

Week 5

Objective: Explore the full scope of different variants of “if construct” namely if-else, null- else, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for “if construct”.

Suggested Experiments/Activities:***Tutorial 5:*** Branching and logical expressions***Lab5:*** Problems involving if-then-else structures.

- i. Write a C program to find the max and min of four numbers using if-else
- ii. Write a C program to generate electricity bill
- iii. Find the roots of the quadratic equation
- iv. Write a C program to simulate a calculator using switch case
- v. Write a C program to find the given year is a leap year or not

Week 6

Objective: Explore the full scope of iterative constructs namely while loop, do-while loop and loop in addition to structured jump constructs like break and continue including when each of these statements is more appropriate to use.

Suggested Experiments/Activities:***Tutorial 6:*** Loops, while and for loops***Lab6:*** Iterative problems e.g., the sum of series

- i. Find the factorial of given number using any loop
- ii. Find the given number is a prime or not
- iii. Compute sine and cos series
- iv. Checking a number palindrome
- v. Construct a pyramid of numbers

Unit III**Week 7**

Objective: Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

Suggested Experiments/Activities:***Tutorial 7:*** 1 D Arrays: searching.***Lab7:*** 1D Array manipulation, linear search.

- i. Find the min and max of a 1-D integer array
- ii. Perform linear search on 1D array
- iii. The reverse of a 1D integer array
- iv. Find 2's complement of the given binary number
- v. Eliminate duplicate elements in an array

Week 8

Objective: Explore the difference between other arrays and character arrays that can be used as Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

Suggested Experiments/Activities:***Tutorial 8:*** 2 D arrays, sorting and Strings.***Lab8:*** Matrix problems, String operations, Bubble sort.

- i. Addition of two matrices
- ii. Multiplication two matrices
- iii. Sort array elements using bubble sort
- iv. Concatenate two strings without built-in functions
- v. Reverse a string using built-in and without built-in string functions

Unit IV

Week 9

Objective: Explore pointers to manage a dynamic array of integers, including memory allocation and; value initialization, resizing changing and reordering the contents of an array memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gain experience processing command-line arguments received by C.

Suggested Experiments/Activities:

Tutorial 9: Pointers, structures and dynamic memory allocation.

Lab9: Pointers and structures, memory dereference.

- i. Write a C program to find the sum of a 1D array using malloc()
- ii. Write a C program to find the total, average of n students using structures
- iii. Enter n students data using calloc() and display failed students list
- iv. Read student name and marks from the command line and display the student details along with the total
- v. Write a C program to implement realloc()

Week 10

Objective: Experiment with C Structures, Unions, bit fields and self-referential structures (Singly linked lists) and nested structures.

Suggested Experiments/Activities:

Tutorial 10: Bitfields, Self-Referential Structures, Linked lists

Lab10: Bitfields, linked lists

Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the same without using bit- fields

- i. Create and display a singly linked list using self-referential structure
- ii. Demonstrate the differences between structures and unions using a C program
- iii. Write a C program to shift/rotate using bitfields
- iv. Write a C program to copy one structure variable to another structure of the same type

Unit V

Week 11

Objective: Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration.

Suggested Experiments/Activities:

Tutorial 11: Functions, call by value, scope and extent

Lab11: Simple functions using call by value, solving differential equations using Eulers theorem

- i. Write a C function to calculate NCR value
- ii. Write a C function to find the length of a string
- iii. Write a C function to transpose of a matrix
- iv. Write a C function to demonstrate numerical integration of differential equations using Euler's method

Week 12

Objective: Explore how recursive solutions can be programmed by writing recursive functions that can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

Suggested Experiments/Activities:

Tutorial 12: Recursion, the structure of recursive calls

Lab12: Recursive functions

- i. Write a recursive function to generate Fibonacci series
- ii. Write a recursive function to find the lcm of two numbers
- iii. Write a recursive function to find the factorial of a number
- iv. Write a C Program to implement Ackermann function using recursion
- v. Write a recursive function to find the sum of series

Week 13

Objective: Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers.

Suggested Experiments/Activities:

Tutorial 13: Call by reference, dangling pointers

Lab13: Simple functions using Call by reference, Dangling pointers

- i. Write a C program to swap two numbers using call by reference
- ii. Demonstrate Dangling pointer problem using a C program
- iii. Write a C program to copy one string into another using pointer
- iv. Write a C program to find no of lowercase, uppercase, digits and other characters using pointers

Week 14

Objective: To understand data files and file handling with various file I/O functions. Explore the differences between text and binary files.

Suggested Experiments/Activities:

Tutorial 14: File handling

Lab14: File operations

- i. Write a C program to write and read text into a file
- ii. Write a C program to write and read text into a binary file using fread() and fwrite()
- iii. Copy the contents of one file to another file
- iv. Write a C program to merge two files into the third file using command-line arguments
- v. Find no. of lines, words and characters in a file
- vi. Write a C program to print last n characters of a given file

TEXT BOOKS

1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw Hill.

E-RESOURCES

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice-Hall of India
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

23HS1153/23HS2153

Communicative English Lab

(Common to All Branches)

Course Category	Institutional Core	Credits	1
Theory	Practical	L-T-P	0-0-2
Prerequisites	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing, including Sentence construction abilities.	Continuous Eval Semester End Eval Total Marks	30 70 100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Understand the different aspects of the English language proficiency with emphasis on LSRW skills
2. Apply communication skills through various language learning activities
3. Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension
4. Evaluate and exhibit professionalism in participating in debates and group discussions

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				
2										3		2				
3										3		2				
4										3		2				

COURSE CONTENT

List of Topics

1. Vowels and Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing
6. Resume Writing, Cover Letter, SOP
7. Group Discussions-methods & practice

8. Debates – Methods & Practice
9. PPT Presentations/Poster Presentations
10. Interview Skills

SUGGESTED SOFTWARE

1. WALDEN
2. SOFTX
3. VISIONET

23ES1154

ENGINEERING WORKSHOP

Course Category	Engineering Sciences	Credits	1.5
Theory	Laboratory	L-T-P	0-0-3
Prerequisites	–	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Understand the basic joints using wood and familiarize with various fundamental aspects of house wiring, fitting and foundry.
2. Prepare basic models using sheet metal and practice joining of metals using various types of welding.
3. Familiarize with various advanced manufacturing processes such as injection moulding and 3D printing.
4. Understand the preparation of PCB and simple IOT applications using Arduino.

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			2		3											
2			2		3											
3			2		1											

COURSE CONTENT

PART-A

1. **Demonstration:** Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints. (2 classes)
 - (a) Half-Lap joint
 - (b) Bridle joint
 - (c) Demonstration of power tools.
3. **Sheet Metal Working:** Familiarity with different types of tools used in sheet metal working, developmentsof following sheet metal job from GI sheets. (2 classes)

- (a) Tapered tray
- (b) Conical funnel
- 4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises. (**2 classes**)
 - (a) V-fit
 - (b) Semi-circular fit
 - (c) Bicycle tire puncture and change of two-wheeler tyre
- 5. **Electrical Wiring:** Familiarity with different types of basic electrical circuits and make the following connections. (**1 class**)
 - (a) Parallel and series
 - (b) Two-way switch
 - (c) Godown lighting
 - (d) Tube light
- 6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sandmoulds for given Patterns. (**1 class**)
- 7. **Welding Shop:** Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint. (**1 class**)
- 8. **Advanced manufacturing processes:** Demonstration of injection moulding and 3 D printing processes. (**1 class**)
- 9. **Electronic Circuits:** Demonstration of preparation of simple electronic circuit (PCB) and testing its operation. (**1 class**)
- 10. **Basic IOT:** Demonstration of different components & pin configuration of Arduino board (**1 class**)
 - (a) Measure Temperature & Humidity
 - (b) Measure Distance

PART-B

GROUP ACTIVITY (2 classes)

- Students must prepare a Working model / Assembly using the knowledge gained from the above trades.

TEXT BOOKS

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published, 2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

REFERENCE BOOKS

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition.
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; At-ulPrakashan, 2021-22.

E-RESOURCES AND OTHER DIGITAL MATERIAL

1. <https://dsceme.files.wordpress.com/2016/08/workshop-practice-manual-2016-17-1.pdf>
2. <https://www.protosystech.com/rapid-prototyping.htm>
3. <https://www.arduino.cc/en/Tutorial/Foundations>
4. <https://www.tutorialspoint.com/arduino/>

23ES1155 IT WORKSHOP

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

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Perform Hardware troubleshooting
2. Understand Hardware components and inter dependencies
3. Safeguard computer systems from viruses/worms
4. Document/ Presentation preparation
5. Perform calculations using spreadsheets

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			2		3											
2			2		3											
3			2		1											

COURSE CONTENT

- **Task 1:** Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.
- **Task 2:** Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.
- **Task 3:** Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.
- **Task 4:** Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot

(VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

- **Task 5:** Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

Internet and World Wide Web

- **Task1:** Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email. If there is no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.
- **Task 2:** Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.
- **Task 3:** Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.
- **Task 4:** Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

LaTeX and WORD

- **Task1-Word Orientation:** The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeX and word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.
- **Task 2-Using La TeX and Word to create a project certificate. Features to be covered:** Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word.
- **Task 3:** Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

- **Task 4:** Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

EXCEL

- **Excel Orientation:** The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.
- **Task 1-Creating a Scheduler - Features to be covered:** Gridlines, Format Cells, Summation, auto fill, Formatting Text.
- **Task 2-Calculating GPA -. Features to be covered:** :- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function.
- **Task 3:** Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting.

LOOKUP/VLOOKUP

- **Task 3:** Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting.

POWER POINT

- **Task 1:** Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.
- **Task 2:** Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.
- **Task 3:** Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

AI TOOLS – ChatGPT

- **Task 1-Prompt Engineering:** Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.
 - Ex: Prompt: “You are a knowledgeable AI. Please answer the following question: What is the capital of France?”

- **Task 2-Creative Writing:** Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas.
 - Ex: Prompt: “In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality.”
- **Task 3-Language Translation:** Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.
 - Ex:Prompt: “Translate the following English sentence to French;;Hello, how are you doing today?”

REFERENCE BOOKS

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003.
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition.
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
5. LaTeX Companion, Leslie Lamport, PHI/Pearson.
6. IT Essentials PC Hardware and Software Companion Guide, David Anfinson and Ken Quamme. – CISCO Press, Pearson Education, 3rd edition
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition

SEMESTER II

23BS2101

DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

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

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Solve first order linear differential equations
2. Solve higher order linear differential equations with constant coefficients
3. Solve Partial differential equations
4. Evaluate the work done against field, circulation and flux using vector calculus

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			1											
2	3	2			1											
3	3	2			1											
4	3	2			1											

COURSE CONTENT

UNIT I-Differential equations of first order and first degree

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form, Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits.

UNIT II-Linear differential equations of higher order (Constant Coefficients)

Definitions, homogenous and non-homogenous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters, Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

UNIT III-Partial Differential Equations

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using

Lagrange's method, Homogeneous Linear Partial differential equations with constant coefficients.

UNIT IV-Vector Calculus

Scalar and vector point functions, vector operator Del, Del applies to scalar point functions- Gradient, Directional derivative, del applied to vector point functions- Divergence and Curl, vector identities.

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and related problems.

TEXT BOOKS

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition

REFERENCE BOOKS

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley Sons, 2018, 10th Edition.
2. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition (9th reprint)
4. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition
5. Advanced Engineering Mathematics, Michael Greenberg, Pearson publishers, 9th Edition
6. Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications, 2014, 3rd Edition (Reprint 2021)

E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. Prof. Srinivas Rao Manam, IIT Madras, Differential equations for engineers [English], Available: https://onlinecourses.nptel.ac.in/noc22_ma72/preview
2. Prof. Jitendra Kumar, IIT Kharagpur, Engineering Mathematics – I [English], Available: https://onlinecourses.nptel.ac.in/noc20_ma37/preview
3. Prof. Jitendra Kumar, IIT Kharagpur, Engineering Mathematics – II [English], Available: https://onlinecourses.nptel.ac.in/noc22_ma08/preview
4. Prof. Jitendra Kumar & Prof. Somesh Kumar, IIT Kharagpur, Advanced Calculus For Engineers [English], Available: https://onlinecourses.nptel.ac.in/noc22_ma75/preview
5. Prof. Denis Auroux, Massachusetts Institute of Technology: MIT Open Courseware, Multivariable Calculus, Available: <https://ocw.mit.edu>

23BS2102B CHEMISTRY

Course Category	Institutional Core	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	10 + 2 level Chemistry	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Apply the principles of quantum mechanics for determining structure and bonding of molecules
2. Apply the principles electrochemistry for its applications in chemical analysis, electrodes, electrochemical sensors and energy sources
3. Explain the mechanistic aspects of polymerisation and conduction, types, preparation, properties and applications of polymers
4. Compare different spectroscopic and chromatographic techniques for their application in qualitative and quantitative analysis
5. Choose engineering materials including nanomaterials based on their properties for their applications in various industrial fields

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														
2	2		3													
3	2				3											
4	2	3														
5	2				3		1									

COURSE CONTENT

UNIT I

Structure and Bonding Models:

Fundamentals of Quantum mechanics, Schrodinger wave equation, significance of Ψ and Ψ^2 , particle in one dimensional box, Molecular orbital theory, bonding in homo and heteronuclear diatomic molecules, energy level diagrams of O₂, N₂, NO and CO, calculation of bond order, - molecular orbitals of butadiene and benzene.

Engineering Materials: Semiconductors - Introduction, basic concept, applications, Superconductors - Introduction, basic concept, applications, Supercapacitors - Introduction, basic concept, classification, applications.

UNIT II***Electrochemistry:***

Electrochemical cell, Nernst equation, potential and emf calculations and numerical problems, potentiometry – potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, cell constant and specific conductance, conductometric titrations (acid-base titrations), Electrochemical sensors – potentiometric sensors and amperometric sensors-principle with examples.

Electrochemical Energy Systems:

Types of electrochemical energy systems - Primary cells – Zinc-air battery, Secondary cells – lithium-ion batteries – working of the batteries including cell reactions, Fuel cells – hydrogen-oxygen fuel cell- working of the cells, Polymer Electrolyte Membrane fuel cells (PEMFC).

UNIT III***Polymer Chemistry:***

Introduction to polymers, functionality of monomers, addition and condensation polymerization, mechanism of chain growth and step growth polymerization, coordination polymerization with specific examples. Plastics – Thermo and thermosetting plastics, preparation, properties and applications of PVC, Teflon, Bakelite, Nylon-6,6. Elastomers – Buna-S, Buna-N – Preparation, properties and applications. Conducting Polymers – Principle and examples, mechanism of conduction in undoped, doped polyacetylene and applications, Biodegradable polymers – polyglycolic acid (PGA), Polylactic acid (PLA).

UNIT IV***Instrumental Methods of Analysis:***

Electromagnetic spectrum, Interaction of radiation with matter, UV Visible Spectroscopy-principle, electronic transitions, Lambert-Beer's law, Instrumentation, applications, IR spectroscopy-principle, types of vibrations, selection rule, Instrumentation, Chromatography- basic principle and classification.

Nano materials:

Introduction, classification of nanomaterials. Properties and applications of fullerenes, carbon nanotubes, graphene and nanoparticles.

TEXT BOOKS

1. Engineering Chemistry, Jain and Jain, 17th Edition, Dhanpat Rai, 2018.
2. Engineering Chemistry, Prasantha Rath S. Aruna Kumari, Cengage Publishers, 2023.

REFERENCE BOOKS

1. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.
2. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
3. J.D. Lee, Concise Inorganic Chemistry, 5th Edition, Wiley Publications, Feb 2008

4. Textbook of polymer Science, Fred W. Billmeyer Jr, 3rd Edition.

E-RESOURCES AND OTHER DIGITAL MATERIALS:

1. https://onlinecourses.nptel.ac.in/noc24_ph02/preview
2. https://onlinecourses.nptel.ac.in/noc24_cy10/preview
3. https://www.youtube.com/watch?v=LMSTMBX_2F4
4. <https://www.youtube.com/watch?v=7jOSbtR8mTs&list=PLzPro5owUhRSV-ezegDDfuNpuJ2uU6jZ0>
5. https://onlinecourses.swayam2.ac.in/cec24_cy02/preview

23ES2103B

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

Course Category	Program Core	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	10 + 2 physics	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Apply different techniques to solve DC circuits
2. Understand the magnetic circuit concepts
3. Analyze the steady-state response, series, parallel AC circuits, mesh & nodal analysis, and resonance
4. Apply network theorems for AC & DC circuits
5. Demonstrate the working principles of basic Electronic devices, circuits and instrumentation System
6. Implementation of simple Combinational and Sequential circuits using Logic gates

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	3	3														
3	2	3			2											
4	2	3														
5	2	1	3	2												
6	2	1	3	2												

COURSE CONTENT

UNIT I-DC & AC Circuits

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R,

L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing phenomenon, Safety Precautions to avoid shock.

UNIT II-Machines and Measuring Instruments

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Voltage, Current, temperature sensors, basic block diagram of multimeter.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of “unit” used for consumption of electrical energy, calculation of electricity bill for domestic consumers.

UNIT III-SEMICONDUCTOR DEVICES

Introduction: Evolution of electronics, Vacuum tubes to nano electronics, Characteristics of PN Junction Diode, Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor, CB, CE, CC Configurations and Characteristics, Elementary Treatment of Small Signal CE Amplifier.

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator.

Amplifiers: Block diagram of Public Address system, Circuit diagram.

Electronic Instrumentation: Block diagram of an electronic instrumentation system.

UNIT IV-DIGITAL ELECTRONICS

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adders. Introduction to Flip flops, Registers and counters (Elementary Treatment only).

TEXT BOOKS (for UNITS I & II)

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition.
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020.
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017.
4. Basic Electrical and Electronics Engineering, S. K. Bhattacharya, Person Publications, 2018, Second Edition.

REFERENCE BOOKS (for UNITS I & II)

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition.
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020.
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017.
4. Basic Electrical and Electronics Engineering, S. K. Bhattacharya, Person Publications, 2018, Second Edition.

**E-RESOURCES AND OTHER DIGITAL MATERIALS
(for UNITS I & II)**

1. <https://nptel.ac.in/courses/108105053>
2. <https://nptel.ac.in/courses/10810807>

TEXT BOOKS (for UNITS III & IV)

1. R. L. Boylestad and Louis Nashlesky, Electronic Devices and Circuit Theory, Pearson Education, 2021.
2. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009. Resnick, Halliday and Krane, "Physics", 5th edition, Wiley India Pvt. Ltd, New Delhi, 2016.

REFERENCE BOOKS (for UNITS III & IV)

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009

**E-RESOURCES AND OTHER DIGITAL MATERIALS
(for UNITS III & IV)**

1. <https://embeddedengineers.files.wordpress.com/2015/09/electronic-devices-and-circuits-by-salivahanan.pdf>
2. <http://www.nptelvideos.in/2012/12/basic-electronics-drchitralekha-mahanta.html>
3. https://en.wikipedia.org/wiki/Digital_electronics

23PC2104A

DATA STRUCTURES

Course Category	Professional 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

Upon successful completion of the course, the student will be able to:

1. Demonstrate the role of data structures in organizing and accessing data efficiently
2. Understand various techniques for searching, sorting and hashing algorithms used to solve complex problems
3. Demonstrate the operations on linear data structures like stack, queue and linked list
4. Analyze various operations on nonlinear data structures – binary tree, and binary search tree

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	3	2	1	2												
3	2	2	1	2												
4	2	2	1	2												

COURSE CONTENT

UNIT I

Basic Concepts: Overview: System life cycle. Algorithm Specification, Data Abstraction, Performance Analysis, the Abstract Data Type.

Searching: Introduction to searching, Linear Search and Binary Search.

Sorting: Bubble Sort, Insertion Sort, Selection Sort.

UNIT II

Linked Lists: Linked lists, programming details, doubly linked lists, circularly linked lists, Examples: polynomial addition.

Stacks: Stack Model, Implementation of Stacks (arrays), Linked Stacks Applications: balancing the symbols, postfix expressions, infix to postfix conversion.

UNIT III

Queues: Queue Model, Array implementation of Queues, Applications of Queues: DFS, linked Queues, Types of Queues: Circular Queues, Dequeues.

Trees: Introduction, Binary Trees, Binary Tree traversals, Binary Search Tree – Definition, Search, Insertion, & Deletion.

UNIT IV

Graphs: Graph Abstract Datatype, Elementary Graph Operations- DFS, BFS.

Hashing: General idea, Hash Functions, separate chaining, open addressing, rehashing, extendable hashing.

TEXT BOOKS

1. BMark Allen Weiss , “Data Structures and algorithm analysis in C”, Pearson, 2nd Edition, 2016.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed , “Fundamentals of data structures in C”, University Press, 2020

REFERENCE BOOKS

1. Reema Thareja , “ Data Structures Using C ”, Second Edition, 2014, Oxford University Press.
2. Brad Miller and David Ranum , “Problem Solving with Algorithms and Data Structures” , 2013.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, “Introduction to Algorithms” , 3rd Edition, Mitpress.
4. YedidyahLangsam, Moshe J. Augenstein and Aaron M. Tenenbaum, “Data Structures using C and C++”, 2nd edition, Pearson Education, 1999.
5. Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with Applications”, 2nd edition, McGraw Hill, 2008.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. SudarshanIyengar: IIT Ropar, Data Structures and Algorithms, [NPTEL], (26, May, 2021) Available: <http://nptel.ac.in/>
2. Erik Demaine, Advanced Data Structures [MIT- OpenCourseWare], (26, May, 2021) Available: <http://ocw.mit.edu/>
3. Prof. Naveen Garg, IIT Delhi, Introduction to Data Structures and Algorithms, <https://nptel.ac.in/courses/106102064>

23ES2105

ENGINEERING GRAPHICS

Course Category	Institutional Core	Credits	3
Course Type	Theory & Practice	L-T-P	1-0-4
Prerequisites	NIL	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Understand the principles of engineering drawing, including engineering curves and scales
2. Draw and interpret orthographic projections of points, lines and planes in front, top and side views
3. Understand and draw projection of solids in various positions in first quadrant and Explain principles behind development of surfaces
4. Explain principles behind the Sections of solids, Prepare isometric views and conversion of simple solids

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				3									
2	3		3				3									
3	2		2				2									
4	1		1				1									

COURSE CONTENT

UNIT I

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions of regular polygons by general methods.

Curves: Construction of ellipse, parabola and hyperbola by general method and Involutives. Draw normal and tangent to Curves.

Scales: Plain scales and diagonal scales.

UNIT II

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in first quadrant only.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference

plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes.

Projections of Planes: Regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

UNIT III

Projections of Solids: Projections of solids(Prisms and Pyramids only) in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Projection of Solids with axis inclined to one reference plane and parallel to another plane.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

Computer graphics: Creating 2D & 3D drawings of objects including PCB and Transformations using Auto CAD (Not for end examination).

UNIT IV

Sections of Solids: Section planes perpendicular to VP and inclined to HP only, Sectional views (Front View and Top View only) and Sections of solids in simple position only.

Isometric Views: Draw an Isometric views of Simple solids.

Conversion of Views: Conversion of isometric views to orthographic views of Simple solids.

TEXT BOOKS

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

REFERENCE BOOKS

1. Engineering Drawing, Basant Agrawal and C M Agrawal, Tata McGraw Hill, 2009.
2. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
3. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc, 2009.
4. Engineering Drawing with an Introduction to Auto CAD, Dhananjay Jolhe , Tata McGraw Hill, 2017.

23BS1151 CHEMISTRY LAB

Course Category	Institutional Core	Credits	1
Laboratory	Lab	L-T-P	0-0-2
Prerequisites	Knowledge of chemistry practicals at Intermediate level	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Analyze acids from batteries and metal ions in solutions based on volumetric method
2. Apply standard procedures for preparation of nanomaterials, polymers and blueprinting
3. Analyze different solutions by applying various instrumental methods like conductometry, potentiometry, colorimetry, and chromatography

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	3															
3	2	3			2											

COURSE CONTENT

List of Experiments

1. Determination of strength of acid in Lead-acid battery
2. Determination of ferrous iron by dichrometry
3. Determination of ferrous iron by permanganometry
4. Conductometric titration of a strong acid vs. strong base
5. Verification of Lambert-Beer's law
6. Potentiometric titration of a redox reaction
7. Chemistry of blueprinting
8. Conductometric titration of a weak acid vs. strong base
9. Determination of cell constant and conductance of solutions
10. Preparation of nanomaterials – Precipitation method
11. Preparation of urea-formaldehyde resin
12. Separation of ions by paper chromatography

REFERENCE BOOKS

1. “Vogel’s quantitative chemical analysis”, 6th Edition, by J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar, Pearson Publications.

23PC2152A

DATA STRUCTURES LAB

Course Category	Professional core	Credits	1.5
Theory	Lab	L-T-P	0-0-3
Prerequisites	23ES1152-	Continuous Eval	30
	Computer Programming	Semester End Eval	70
	Lab	Total Marks	100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Analyze the role of linear data structures in organizing and accessing data efficiently in algorithms
2. Design, implement, and apply linked lists for dynamic data storage, demonstrating understanding of memory allocation
3. Develop programs using stacks to handle recursive algorithms, manage program states, and solve related problems
4. Apply queue-based algorithms for efficient task scheduling and breadth-first traversal in graphs and distinguish between dequeues and priority queues and apply them appropriately to solve data management challenges

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													
2	2	2	1													
3	2	1	1													
4	2	2	2													

COURSE CONTENT

Week 1: Programs on Searching operation

Objective: Able to perform array manipulations like reversing the elements in an array and applying searching techniques like linear search and binary search.

- Write a program to reverse an array.
- Write C Programs to implement the Searching Techniques – Linear & Binary Search

Week 2: Sorting Techniques Implementation

Objective: Able to apply various sorting techniques like bubble sort, selection sort and insertion sort on an array of elements.

- Write a C Program to implement sorting using Bubble sort.

- ii. Write a C Program to implement sorting using Selection sort
- iii. Write a C Program to implement sorting using Insertion sort

Week 3: Linked List Implementation

Objective: Able to implement basic linked list operations like inserting a node, deleting a node, displaying data in the nodes of a linked list.

- i. Implement a singly linked list and perform insertion, deletion and traversal operations

Week 4: Linked List Applications

Objective: Able to implement Linked list applications like polynomial addition, removal of duplicates.

- i. Create a program to detect and remove duplicates from a linked list
- ii. Implement a linked list to represent polynomials and perform addition

Week 5: Double Linked List and Circular Linked list Implementation

Objective: Able to implement various operations on doubly linked list and circular linked list.

- i. Implement a doubly linked list and perform various operations to insert, delete, and traverse to understand its properties and applications
- ii. Implement a circular linked list and perform insertion, deletion, and traversal

Week 6: Stack Operations

Objective: Able to implement various stack operations using arrays and linked lists.

- i. Implement a stack using arrays and implement push, pop and traversal
- ii. Implement a stack using linked lists and implement push, pop and traversal

Week 7: Queue Operations

Objective: Able to implement various queue operations using arrays and linked lists.

- i. Implement a queue using arrays to perform the insertion, deletion and traversal
- ii. Implement a queue using linked lists to perform the insertion, deletion and traversal

Week 8: Stack and Queue Applications

Objective: Able to implement stack and queue applications.

- i. Use a stack to evaluate an infix expression and convert it to postfix
- ii. Create a program to determine whether a given string is a palindrome or not
- iii. Implement a stack or queue to perform comparison and check for symmetry

Week 9: Binary Search Tree Implementation

Objective: Able to construct a BST, and perform operations on it.

- i. Implementing a BST using Linked List to create, insert and delete nodes
- ii. Implement BST Traversal techniques in-order, pre-order, and post-order

Week 10: Programs on hashing

Objective: Able to implement hash tables and various collision resolution techniques.

- i. Implement a hash table with collision resolution techniques
- ii. Write a program to implement a simple cache using hashing

Week 11: Programs on Graph data structures

Objective: Able to perform operations on graph.

- i. Describe the operations on graph ADT and implement algorithm for Depth first search
- ii. Describe the operations on graph ADT and implement algorithm for Breath first search

TEXT BOOKS

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2nd Edition.
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson- Freed, Silicon Press, 2008.

REFERENCE BOOKS

1. Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders
2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft
3. Problem Solving with Algorithms and Data Structures” by Brad Miller and David Ranum
4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
5. Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms by Robert Sedgewick

E-RESOURCES

1. SudarshanIyengar: IIT Ropar, Data Structures and Algorithms, [NPTEL], (26, May, 2021) Available: <http://nptel.ac.in/>
2. Erik Demaine, Advanced Data Structures [MIT- OpenCourseWare], (26, May, 2021) Available: <http://ocw.mit.edu/>
3. Prof. Naveen Garg, IIT Delhi, Introduction to Data Structures and Algorithms, <https://nptel.ac.in/courses/106102064>
4. Data Structures and applications on, [Geeksforgeeks], (25, May, 2021) Available: <https://www.geeksforgeeks.org/data-structures/>

23BS2154B

HEALTH AND WELLNESS, YOGA AND SPORTS

Course Category	Basic Science	Credits	0.5
Theory	Theory	L-T-P	0-0-1
Prerequisites	–	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Understand the importance of yoga and sports for Physical fitness and sound health
2. Demonstrate an understanding of health-related fitness components
3. Compare and contrast various activities that help enhance their health
4. Assess current personal fitness levels
5. Develop Positive Personality

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																
4																

COURSE CONTENT

Unit I

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity
Relationship between diet and fitness, Globalization and its impact on health, Body
Mass Index (BMI) of all age groups.

Activities

- i. Organizing health awareness programmes in community
- ii. Preparation of health profile
- iii. Preparation of chart for balance diet for all age groups

Unit II

Concept of yoga, need for and importance of yoga, origin and history of yoga in
Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and

meditation, stress management and yoga, Mental health and yoga practice.

Activities

- i. Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

Unit III

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities

- i. Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc. Practicing general and specific warm up, aerobics
- ii. Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running

Guidelines**General Guidelines**

Objective: Able to apply various sorting techniques like bubble sort, selection sort and insertion sort on an array of elements.

1. Institutes must assign slots in the Timetable for the activities of Health/ Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as many as Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

Evaluation Guidelines

1. Evaluated for a total of 100 marks.
2. A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totaling to 90 marks.
3. A student shall be evaluated by the concerned teacher for 10 marks by conducting viva voce on the subject.

REFERENCE BOOKS

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning, 2022.
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice.
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014.
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. – 3rd ed. Human Kinetics, Inc.2014.

23MC2106

DESIGN THINKING

(MANDATORY NON-CREDIT COURSE)

Course Category	Mandatory Course	Credits	0
Theory	Practice	L-T-P	2-0-0
Prerequisites	10+2 or Intermediate	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Understand the concepts of Design Thinking
2. Investigate a problem to determine its root cause
3. Able to develop design thinking skills and experiment with different solutions
4. Able to develop prototypes and can test

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	3						
1		3	3			2			3	3						
3		3	3	3	3	2			3	3		3				
4	3	3	3	3	3			2	3	3	2	3				

COURSE CONTENT

Unit I

Introduction to Design Thinking: Introduction to Design Thinking: Design Thinking Overview, Defining Design Thinking, Features and principles of Design thinking, Applications of Design Thinking.

Unit II

Modules of Design Thinking: Inspiration, methods & tools used in Explore and Empathize phases of Design Thinking, Case study-activity.

Unit III

Modules of Design Thinking: Inspiration, methods & tools used in Explore and Empathize phases of Design Thinking, Case study-activity.

Unit IV

Prototype and Test Techniques: Types of Prototypes, Exercise: Revise Franken

Prototype to Refined Prototype, Forms of Testing in Design Thinking, Prepare and Test of the Prototype.

TEXT BOOKS

1. Design Thinking: A guide to creative problem solving for everyone, Andrew Pressman, Routledge Taylor and Francis group, 2019, 1st edition.
2. “Design Thinking for Entrepreneurs and Small Businesses” by Beverly Rudkin Ingle, Apress.
3. “Design Thinking- The Guide Book” – Facilitated by the Royal Civil Service Commission, Bhutan.
4. Idris Mootee, “Design Thinking for Strategic Innovation”, John Wiley & Sons (2013).

REFERENCE BOOKS

1. Karmic Design Thinking - A Buddhism-Inspired Method to Help Create Human-Centered Products & Services, Dr Bala Ramadurai.
2. Design Thinking: A Beginners Perspective EB is written by Balagurusamy and published by Mc Graw-Hill Education India.
3. Design Thinking: A framework for applying Design Thinking in Problem Solving, Anujuna Agarwal Edition : 1st,2024.

E-RESOURCES AND OTHER DIGITAL MATERIAL

1. <https://www.arvindguptatoys.com/>
2. <https://honeybee.org/>
3. <https://dschool.stanford.edu/resources/getting-started-with-design-thinking>
4. <https://designthinking.ideo.com/>

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, 0/1 Knapsack 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 – Hotspots 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 – Wildlife 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>`, `<span>` 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., Papadimitriou 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

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 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	1.6.7, 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.

TEXT BOOKS

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 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 building blocks of Internet of Things.
2. Understand the application areas of IOT.
3. Understand Standards and Key Technologies in IoT.
4. Apply the steps of the design methodology in developing IoT applications using Raspberry Pi.

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												1	2	2	1.6.1, 1.7.1
4		2	2										2		3	2.7.1, 2.7.2, 3.6.2

COURSE CONTENT

UNIT I

Introduction: Introduction-Definition and Characteristics of IoT, Physical design of IoT – Things in IoT, IoT Protocols, Logical Design of IoT – IoT Functional Blocks, IoT communication models, IoT Enabling technologies- Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems.

UNIT II

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

UNIT III

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.

UNIT IV

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.

TEXT BOOKS

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 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.

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.

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.

23CS5554**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.

23HS5155

ADVANCED COMMUNICATION SKILLS LAB

Course Category	HSS	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.

23ES5156**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.

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.

23MC5107A

TECHNICAL PAPER WRITING AND IPR

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

COURSE OUTCOMES

1. Understand the basics of writing technical reports, technical sentence formation, using transitions, and appropriate tenses for technical writing.
2. Understand the use of drafts, illustrations, grammar, spelling, readability, and writing in plain English for effective technical documentation.
3. Apply the use of word processor tools such as Table of Contents, citations, footnotes, comments, macros, and document protection.
4. Understand the nature of Intellectual Property and explain the process of patenting and international cooperation on Intellectual Property.

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		3	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

Introduction: An introduction to writing technical reports, technical sentences formation, using transitions to join sentences, Using tenses for technical writing.

Planning and Structuring: Planning the report, identifying reader(s), Voice, Formatting and structuring the report, Sections of a technical report, Minutes of meeting writing.

UNIT II

Drafting report and design issues: The use of drafts, Illustrations and graphics.

Final edits: Grammar, spelling, readability and writing in plain English: Writing in plain English, Jargon and final layout issues, Spelling, punctuation and Grammar, Padding, Paragraphs, Ambiguity.

Proofreading and summaries: Proofreading, summaries, Activities on summaries.

Presenting final reports: Printed presentation, Verbal presentation skills, Introduction to proposals and practice.

UNIT III

Using word processor: Adding a Table of Contents, Updating the Table of Contents, Deleting the Table of Contents, Adding an Index, Creating an Outline, Adding Comments, Tracking Changes, Viewing Changes, Additions, and Comments, Accepting and Rejecting Changes, Working with Footnotes and Endnotes, Inserting citations and Bibliography, Comparing Documents, Combining Documents, Mark documents final and make them read only., Password protect Microsoft Word documents., Using Macros.

UNIT IV

Nature of Intellectual Property: Patents, Designs, Trade and Copyright.

Process of Patenting and Development: Technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property.

TEXT BOOKS

1. Kompal Bansal & Parshit Bansal, "Fundamentals of IPR for Beginner's", 1st Ed., BS Publications, 2016.
2. William S. Pfeiffer and Kaye A. Adkins, "Technical Communication: A Practical Approach", Pearson.
3. Ramappa,T., "Intellectual Property Rights Under WTO", 2nd Ed., S Chand, 2015.

REFERENCE BOOKS

1. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

2. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press, 2006.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Tony Buon — a psychologist, university lecturer, <https://www.udemy.com/course/reportwriting/>, Last Accessed on: 02/05/2025.
2. <https://www.udemy.com/course/professional-business-english-and-technical-report-writing/>, Last Accessed on: 02/05/2025.
3. Mark Morris — professional speechwriter, <https://www.udemy.com/course/betterbusinesswriting/>, Last Accessed on: 02/05/2025.

SEMESTER VI

23CS6301

COMPILER DESIGN

Course Category	PC	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS5303	Continuous Eval	30
	Formal Languages and Automata Theory	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Apply regular expressions and finite automata principles to design and implement a lexical analyzer for token recognition.
2. Apply top-down and bottom-up parsing techniques to analyze and construct parse structures for context-free grammars.
3. Apply syntax-directed definitions and translation schemes to generate intermediate code for programming constructs.
4. Apply and evaluate optimization and code generation techniques to produce efficient target machine code.

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	1.1.1, 1.3.1, 2.1.1, 2.1.3, 2.2.4
2	2	2	3	2									1	2	3	1.1.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 3.2.1, 3.3.1, 4.5.1
3	2	3	3										2	2	3	1.1.1, 1.3.1, 2.2.3, 2.2.4, 2.4.3, 3.2.1, 3.3.1
4		2	3	1									2	2	3	2.2.3, 2.2.4, 2.4.3, 3.2.1, 3.3.1, 4.5.1

COURSE CONTENT

UNIT I

Lexical Analysis: Language Processors, Structure of a Compiler, Lexical Analysis, The Role of the Lexical Analyzer, Bootstrapping, Input Buffering, Specification of Tokens, Recognition of Tokens, Lexical Analyzer Generator-LEX, Finite Automata, Regular Expressions and Finite Automata, Design of a Lexical Analyzer Generator.

Syntax Analysis: The Role of the Parser, Context-Free Grammars, Derivations, Parse Trees, Ambiguity, Left Recursion, Left Factoring.

UNIT II

Top Down Parsing: Pre Processing Steps of Top Down Parsing, Backtracking, Recursive Descent Parsing, LL (1) Grammars, Non-recursive Predictive Parsing, Error Recovery in Predictive Parsing.

Bottom Up Parsing: Introduction, Difference between LR and LL Parsers, Types of LR Parsers, Shift Reduce Parsing, SLR Parsers, Construction of SLR Parsing Tables, More Powerful LR Parsers, Construction of CLR (1) and LALR Parsing Tables, Dangling Else Ambiguity, Error Recovery in LR Parsing, Handling Ambiguity Grammar with LR Parsers.

UNIT III

Syntax Directed Translation: Syntax-Directed Definitions, Evaluation Orders for SDD's, Applications of Syntax Directed Translation, Syntax-Directed Translation Schemes, Implementing L-Attributed SDD's.

Intermediate Code Generation: Types of intermediate code, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking, Control Flow, Backpatching, Intermediate Code for Procedures.

Symbol Table: The contents of a symbol table, Data structures for symbol tables, Representing scope information.

UNIT IV

Code Optimization: The Principle Sources of Optimization, Basic Blocks, Optimization of Basic Blocks, Flow Graphs, Loop Optimization, Data-Flow Analysis, Peephole Optimization.

Run Time Environments: Storage Organization, Run Time Storage Allocation, Activation Records, Procedure Calls, Displays.

Code Generation: Issues in the Design of a Code Generator, Object Code Forms, Code Generation Algorithm, Register Allocation and Assignment. Code generation from DAG's.

TEXTBOOKS

1. A. V. Aho and J. D. Ullman, Principles of Compiler Design, 1st Edition, Reprint, Narosa Publishing House, 2002.
2. A. V. Aho, M. S. Lam, R. Sethi, and J. D. Ullman, Compilers: Principles, Techniques and Tools, 2nd Edition, Pearson, 2007.

REFERENCE BOOKS

1. K. C. Louden, Compiler Construction: Principles and Practice, 1st Edition, Cengage Learning, 1997.
2. A. W. Appel, Modern Compiler Implementation in C, Revised Edition, Cambridge University Press, 2004.

3. R. Allen and K. Kennedy, *Optimizing Compilers for Modern Architectures: A Dependence-Based Approach*, 1st Edition, Morgan Kaufmann, 2001.
4. J. R. Levine, T. Mason, and D. Brown, *Lex and Yacc*, 2nd Edition, O'Reilly & Associates, 1992.
5. K. Bansal and P. Bansal, *Fundamentals of IPR for Beginners*, 1st Edition, BS Publications, 2016.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. S. Chattopadhyay, *Compiler Design*, NPTEL, IIT Kharagpur, 2021. Available at: https://onlinecourses.nptel.ac.in/noc21_cs07/preview, Last Accessed on: 21/10/2025.

23CS6302

CLOUD COMPUTING

Course Category	PC	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS5302	Continuous Eval	30
	Computer Networks	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the fundamental concepts, architecture, and service/deployment models of cloud computing.
2. Understand cloud-enabling technologies such as distributed computing, SOA
3. Apply virtualization and container technologies to create scalable and secure cloud systems.
4. Apply advanced concepts in cloud computing to enable efficient automation and optimized cloud deployments.

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			3								3	2	2	1.7.1, 2.6.3, 5.5.2
2	2	3	2	2	3								3	3	2	1.7.1 2.6.4, 3.6.2, 4.6.1 3.7.1, 5.4.2
3	2	3		3	3								3	3	3	1.7.1, 2.8.3, 4.6.1, 5.6.1
4		2	3	2	3								2	3	3	2.6.4, 3.8.1, 4.6.1 5.5.1

COURSE CONTENT

UNIT I

Introduction to Cloud Computing Fundamentals: Cloud computing at a glance, defining a cloud, cloud computing reference model (IaaS, PaaS, SaaS), cloud deployment models (public, private, hybrid), utility Oriented computing, cloud computing characteristics and benefits, cloud service providers (Amazon Web Services, Microsoft Azure, Google AppEngine).

UNIT II

Cloud Enabling Technologies: Parallel and distributed computing, elements

of parallel computing, hardware architectures for parallel computing (SISD, SIMD, MISD, MIMD), elements of distributed computing, Components of A Distributed System, Models for Interprocess Communication, Technologies for distributed computing, remote procedure calls (RPC), service-oriented architecture (SOA), Web services.

UNIT III

Virtualization and Containers and Cloud Computing Challenges: Characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization and cloud Computing, pros and cons of virtualization, technology examples (XEN, VMware), building blocks of containers, container platforms (LXC, Docker), container orchestration, Docker Swarm and Kubernetes, public cloud VM (e.g. Amazon EC2) and container (e.g. Amazon Elastic Container Service) offerings. Economics of the cloud, cloud interoperability and standards, scalability and fault tolerance, federated clouds

UNIT IV

Advanced concepts in cloud computing: Cloud computing security, fundamentals of computer security, cloud security architecture, security in cloud deployment models. Serverless computing, Function-as-a-Service, serverless computing architecture, public cloud (e.g. AWS Lambda) and open-source (e.g. OpenFaaS) serverless platforms, Internet of Things (IoT), applications, cloud-centric IoT and layers, edge and fog computing, DevOps, infrastructure-as-code, quantum cloud computing.

TEXTBOOKS

1. Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, Shivananda Poojara, and Satish N. Srirama, Mastering Cloud Computing, 2nd Edition, McGraw Hill, 2024.
2. Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, 1st Edition, Morgan Kaufmann (Elsevier), 2012.

REFERENCE BOOKS

1. D. C. Marinescu, Cloud Computing: Theory and Practice, 2nd Edition, Elsevier, 2018.
2. K. Chandrasekharan, Essentials of Cloud Computing, 1st Edition, CRC Press, 2014.
3. Hideto Saito, Hui-Chuan Chloe Lee, Cheng-Yang Wu, DevOps with Kubernetes, 1st Edition, Packt Publishing, 2017.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. S. K. Ghosh, Cloud Computing, NPTEL Online Course, IIT Kharagpur, 2021. Available at: https://onlinecourses.nptel.ac.in/noc21_cs14/preview. Last Accessed on: 18/10/2025.

2. Stanford University's Technology Training, Introduction to Cloud Computing, <https://uit.stanford.edu/service/techtraining/class/introduction-cloud-computing>, Last Accessed on: 21/10/2025.
3. Microsoft Corporation, Azure Cloud Reference, Microsoft Learn, 2025. Available at: <https://learn.microsoft.com/en-us/azure/>, Last Accessed on: 19/10/2025.
4. Google Cloud Team, Google Cloud Documentation, Google Cloud, 2025. Available at: <https://cloud.google.com/docs> . Last Accessed on: 19/10/2025.

23CS6303

CRYPTOGRAPHY AND NETWORK SECURITY

Course Category	PC	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS5302	Continuous Eval	30
	Computer Networks	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand core principles and mathematical foundations of cryptography.
2. Apply symmetric encryption techniques for secure data communication.
3. Apply asymmetric encryption techniques with key management and authentication mechanisms for secure data communication.
4. Apply security mechanisms across network layers and implement basic system protection 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	2	1												1	2	1.2.1, 1.7.1, 2.5.2
2	2	3	3										2	2	3	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.4, 3.5.1, 3.6.1
3	2	3	3										2	2	3	1.2.1, 1.7.1, 2.5.1, 2.5.2, 2.5.3, 2.6.4, 2.8.3, 3.5.1, 3.6.1
4	2	3	2										2	2	3	1.2.2, 1.7.1, 2.5.2, 2.6.1, 2.6.5, 2.8.3, 3.6.1

COURSE CONTENT

UNIT I

Basic Principles: Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography- integer arithmetic, modular arithmetic, matrices, linear congruence, Mathematics of Symmetric Key Cryptography-algebraic structures, GF(2n) Fields, Introduction to Modern Symmetric Key Ciphers-modern block ciphers, modern stream ciphers, Introduction to Post Quantum Cryptography.

UNIT II

Symmetric Encryption Algorithms: Data Encryption Standard- DES structure, DES analysis, Security of DES, Multiple DES, Advanced Encryption Standard transformations, key expansions, AES ciphers, Analysis of AES, RC4.

Asymmetric Encryption Algorithms: Mathematics of Asymmetric Key Cryptography co-primes, primality testing, factorization, Asymmetric Key Cryptography, Chinese Remainder Theorem, RSA crypto system, Elliptic Curve Cryptography.

UNIT III

Message Integrity and Hash Functions: Message Integrity and Message Authentication code, Random Oracle model, Message authentication, Cryptographic Hash Functions-whirlpool, MD5, SHA-512.

Digital Signature & Key Management Protocols: Digital Signature Process, services, attacks, schemes, applications, Key Management-symmetric key distribution.

UNIT IV

Network Security-I: Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS.

Network Security-II: Security at the Network Layer: IPSec, security association, IKE, ISAKMP, System Security - Users, Trust, Trusted systems, Buffer Overflow, Malicious Software, Worms, Viruses, IDS, Firewalls.

TEXTBOOKS

1. William Stallings, Cryptography and Network Security, 7th Edition, Pearson, 2020.
2. Behrouz A. Forouzan, Debdeep Mukhopadhyay, Cryptography and Network Security, 3rd Edition, McGraw Hill, 2015.

REFERENCE BOOKS

1. Bernard Menezes, Network Security and Cryptography, 1st Edition, Cengage Learning, 2018.
2. Keith M. Martin, Everyday Cryptography, 1st Edition, Oxford University Press, 2016.
3. E. Harlow, Post-Quantum Cryptography: Securing the Future of Digital Security, 1st Edition, Everett Harlow Publishing, 2025.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Sourav Mukhopadhyay, IIT Kharagpur, NPTEL Course on Cryptography and Network Security, https://onlinecourses.nptel.ac.in/noc22_cs90/preview, Last Accessed On: 18/10/2025.
2. Dr. Manish Kumar, Coursera, Encryption and Cryptography Essentials, <https://>

[//www.coursera.org/learn/encryption-and-cryptography-essentials](https://www.coursera.org/learn/encryption-and-cryptography-essentials) ,
Last Accessed On: 18/10/2025.

23CS6404A

SOFTWARE TESTING METHODOLOGIES

Course Category	PE -II	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS4305	Continuous Eval	30
	Software Engineering	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the basic concepts of testing and apply path testing techniques using flow graphs.
2. Apply data flow and logic based testing techniques.
3. Apply reduction procedure and state testing.
4. Apply agile test automation principles for automation and develop basic Selenium WebDriver scripts.

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	2	1.6.1, 1.7.1, 2.5.3, 2.8.1, 4.4.2
2	2	2		1									1	1	3	1.2.1, 1.7.1, 2.5.3, 2.8.1, 4.4.2
3	3	2		1									1	1	3	1.2.1, 1.5.1, 1.7.1, 2.5.3, 2.8.1, 4.4.2
4	3	2		1	2'								1	1	3	1.2.1, 1.5.1, 1.7.1, 2.5.3, 2.8.1, 4.4.2

COURSE CONTENT

UNIT I

Introduction: Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs.

Flow graphs and Path testing: Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT II

Data Flow testing: Basics of data flow testing, strategies in data flow testing, application of data flow testing.

Logic Based Testing: Overview, decision tables, path expressions, kv charts, specifications.

UNIT III

Paths, Path products and Regular expressions: Path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection.

State, State Graphs and Transition testing: State graphs, good & bad state graphs, state testing, Testability tips.

UNIT IV

An Agile Test Automation Strategy: An Agile Approach to Test Automation, Automation of API, Web Services. Usability Testing, Exploratory Testing, Developing an Automation Strategy and Applying Agile Principles to Test Automation.

Introduction to Selenium: Using Selenium IDE, Managing User Interface Controls, Creating First Selenium WebDriver Script.

TEXTBOOKS

1. Boris Beizer, Software Testing Techniques, 2nd Edition, Dreamtech Press, New Delhi, India, 2003.
2. L. Crispin and J. Gregory, Agile Testing: A Practical Guide for Testers and Agile Teams. Addison-Wesley Professional, 2009.
3. N. Garg, Test Automation Using Selenium WebDriver with Java. 1st ed. CreateSpace Independent Publishing Platform, 2014.

REFERENCE BOOKS

1. K. V. K. K. Prasad, Software Testing Tools, 1st Edition, Dreamtech Press, New Delhi, India, 2008.
2. B. Marick, The Craft of Software Testing, 1st ed., Pearson Education, New Delhi, India, 2000.
3. SPD (O'Reilly), Software Testing Techniques, 1st Edition, SPD Publications, New Delhi, India, 2004.
4. E. Kit, Software Testing in the Real World: Improving the Process, 1st Edition, Pearson Education, New Delhi, India, 1995.
5. W. E. Perry, Effective Methods for Software Testing, 1st Edition, John Wiley and Sons, New York, USA, 2006.
6. G. J. Myers, The Art of Software Testing, 1st Edition, John Wiley and Sons, New York, USA, 2004.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Meenakshi D'Souza, Associate Professor, Department of Computer Science and Engineering, International Institute of Information Technology Bangalore

- (IIIT Bangalore), NPTEL Course: Software Testing (12-week course), https://onlinecourses.nptel.ac.in/noc25_cs113/preview , Last Accessed On: 26/10/2025.
2. Prof. Rajib Mall, Professor, Department of Computer Science and Engineering, Indian Institute of Technology Kharagpur (IIT Kharagpur), NPTEL Course: Software Testing (4-week course), https://onlinecourses.nptel.ac.in/noc25_cs66/preview , Last Accessed On: 26/10/2025.
 3. Mr. Kevin Wendt, Teaching Specialist, Department of Computer Science and Engineering, University of Minnesota (Twin Cities), Coursera Course: Introduction to Software Testing, <https://www.coursera.org/learn/introduction-software-testing> , Last Accessed On: 26/10/2025.

23CS6404B CYBER SECURITY

Course Category	PE-II	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS5302 Computer Networks	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the basic concepts, classifications, and attack methods of cybercrime.
2. Understand the basics of cybercrime investigation, digital evidence handling, and recovery techniques.
3. Apply computer forensic tools and techniques to analyze digital evidence across different platforms and devices.
4. Apply the provisions of cyber laws and the Indian IT Act to address and prevent cybercrimes.

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 to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrime, Cyberstalking, Cybercafe and Cybercrimes.

Cyber Attacks and Mobile Security: Botnets, Attack Vector, Proliferation of Mobile and Wireless Devices, Security Challenges Posed by Mobile Devices, Attacks on Mobile/Cell Phones, Network and Computer Attacks.

UNIT II

Tools and Methods Used in Cybercrime: Proxy Servers and Anonymizers,

Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, Sniffers, Spoofing, Session Hijacking Buffer over flow, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Identity Theft (ID Theft), Foot Printing and Social Engineering, Port Scanning, Enumeration.

Cyber Crime Investigation: Introduction, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.

UNIT III

Computer Forensics and Investigations: Understanding Computer Forensics, Preparing for Computer Investigations.

Current Computer Forensics Tools: Evaluating Computer Forensics Tools, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Graphics and Network Forensics, E-mail Investigations, Cell Phone and Mobile Device Forensics.

UNIT IV

Cyber Crime Legal Perspectives: Introduction, Cybercrime and the Legal Landscape around the World, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act.

Cyberlaw and Indian Legal Framework: Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment, Cyberlaw, Technology and Students: Indian Scenario.

TEXTBOOKS

1. Sunit Belapure, Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, 1st Edition, Wiley, 2011.
2. Nelson Phillips, Steuart Enfinger, Computer Forensics and Investigations, 1st Edition, Cengage Learning, New Delhi, 2009.

REFERENCE BOOKS

1. Michael T. Simpson, Kent Backman, James E. Corley, Hands-On Ethical Hacking and Network Defense, 1st Edition, Cengage Learning, 2019.
2. John R. Vacca, Computer Forensics: Computer Crime Investigation, 1st Edition, Firewall Media, New Delhi, 2005.
3. Alfred Basta, Nadine Basta, Mary Brown, Ravinder Kumar, Cyber Security and Cyber Laws, 1st Edition, Cengage Learning, 2018.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. R. S. Thakur, Netaji Subhas Open University, Swayam Course: Cyber Security, https://onlinecourses.swayam2.ac.in/nou19_cs08/preview , Last Accessed On: 05/10/2025.
2. Indian Computer Emergency Response Team (CERT-In), CERT-In Guidelines, <http://www.cert-in.org.in/> , Last Accessed On: 05/10/2025.
3. Dr. Edward G. Amoroso, Coursera Course: Introduction to Cybersecurity and Cyber Attacks, Coursera, <https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks> , Last Accessed On: 05/10/2025.
4. Stanford University, Computer Security Research Group, Free Online Videos on Computer Security, <https://computersecurity.stanford.edu/free-online-videos> , Last Accessed On: 05/10/2025.
5. Prof. Nickolai Zeldovich, Massachusetts Institute of Technology (MIT), Course: 6.858 Computer Systems Security, MIT OpenCourseWare, <https://ocw.mit.edu> , License: Creative Commons BY-NC-SA, Last Accessed On: 05/10/2025.

23CS6404C DEVOPS

Course Category	PE -II	Credits	3
Course Type	Theory	L-T-P	3 -0-0
Prerequisites	23CS4305	Continuous Eval	30
	Software Engineering	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the basics of Devops and its history.
2. Understand the concepts of container and its lifecycle, dockerfile, and multi containers orchestration.
3. Apply Kubernetes components and resources to efficiently deploy, manage, and scale containerized applications.
4. Apply robust monitoring and logging solutions for containerized applications and manage Kubernetes resources.

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										1	2	2	1.6.1, 2.7.1, 3.5.3
2		1	3		2								1	2	2	2.5.2, 3.8.2, 5.5.2
3		1	3		3								1	3	3	2.7.1, 3.6.2, 5.6.2
4		1	2		3								1	3	3	2.2.2, 3.8.3, 5.4.2

COURSE CONTENT

UNIT I

Devops and History: The Devops Equation, Devops as Folk Model, The Old View and the New View, Devops Compact, Developer as Operator, Advent of Software Engineering, Advent of Proprietary Software and Standardization, Age of the Network, Beginnings of a Global Community, Age of Applications and the Web, Growth of Software Development Methodologies, Open Source Software, Proprietary Services, Agile Infrastructure, Beginning of Devopsdays, Current State of Devops.

Devops Misconceptions and Anti-Patterns: Common Devops Misconceptions, Devops Anti-Patterns, Four Pillars of Effective Devops.

UNIT II

Container and Container Life Cycle: Resource Isolation, Linux Container

Concept, Containerized Delivery, Installing Docker for Ubuntu, CentOS, macOS, Container life cycle – Docker Basics, Layer, Image, Container, and Volume, Distributing Images, Connect Containers.

Dockerfile and Multi-Containers Orchestration: Writing your first Dockerfile, Dockerfile Syntax, Organizing a Dockerfile, Piling up Containers, Docker Compose Overview, Composing Containers.

UNIT III

Kubernetes Components: Master components – API Server (kube-apiserver), Controller Manager (kube-controller-manager), etcd, Scheduler (kube-scheduler), Node components – Kubelet, Proxy (kube-proxy), Docker, Interaction between Kubernetes master and nodes.

Kubernetes Resources: Preparing the Environment, Kubectl, Kubernetes Objects – Namespace, Name, Label and Selector, Annotation, Pods, ReplicaSet (RS) and ReplicationController (RC), Deployments, Services, Volumes, Secrets, ConfigMap, Using ConfigMap via Volume, Using ConfigMap via Environment Variables.

UNIT IV

Kubernetes Volume and Resource Management: Container Volume Lifecycle, Sharing Volume between Containers within a Pod, Stateless and Stateful Applications, Kubernetes Persistent Volume and dynamic provisioning, Replicating Pods with a Persistent Volume using StatefulSet, Persistent Volume examples, Resource Quality of Service, Configuring the BestEffort Pod, Configuring as the Guaranteed Pod, Configuring as Burstable Pod, Monitoring Resource Usage.

Kubernetes on GCP: GCP Components – VPC, Subnets, Firewall Rules, VM Instance, Load Balancing, Persistent Disk. Setting up first Kubernetes Cluster on Google Container Engine, Node Pool, Multi Zone Cluster, Cluster Upgrade, Kubernetes Cloud Provider – StorageClass, L4 LoadBalancer, L7 LoadBalancer (ingress).

TEXTBOOKS

1. Jennifer Davis, Ryn Daniels, Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale, 1st Edition, O'Reilly Media, 2016. [Unit I]
2. Hideto Saito, Hui-Chuan Chloe Lee, Cheng-Yang Wu, DevOps with Kubernetes: Accelerating Software Delivery with Container Orchestrators, Packt Publishing Ltd, 2019. [Unit II, III, IV]

REFERENCE BOOKS

1. Mirco Hering, DevOps for the Modern Enterprise: Winning Practices to Transform Legacy IT Organizations, IT Revolution Press, 2018.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. The Linux Foundation, Coursera Course: Introduction to DevOps, <https://www.>

- coursera.org/learn/intro-to-devops , Last Accessed On: 27/10/2025.
2. LevelUp360 DevOps Team, Udemy Course: DevOps Fundamentals – CI/CD with AWS, Docker, Ansible, and Jenkins, <https://www.udemy.com/course/devops-fundamentals-aws> , Last Accessed On: 27/10/2025.

23CS6404D

MACHINE LEARNING

Course Category	PE -II	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS5301 Data Warehousing and Data Mining	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the fundamentals of Machine Learning and Nearest neighbour based models.
2. Apply models based on Decision trees and Bayes rule
3. Apply linear discriminant techniques for solving classification problems in machine learning.
4. Analyze clustering techniques and algorithms to identify data patterns.

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	1		1								1	2	2	1.2.1, 1.6.1, 1.7.1, 2.5.1, 2.5.3, 3.5.1, 5.4.1, 5.4.2
2	3	3	1		1								1	2	3	1.2.1, 1.6.1, 1.7.1, 2.5.1, 2.5.3, 3.5.1, 5.4.1, 5.4.2
3	3	3	2	1	1								2	2	3	1.2.1, 1.2.2, 1.6.1, 1.7.1, 2.5.2, 2.5.3, 3.5.1, 4.4.2, 5.4.1, 5.4.2
4	3	3	2	2	1								1	2	4	1.2.1, 1.2.2, 1.6.1, 1.7.1, 2.5.2, 4.4.2, 2.5.3, 3.5.1, 5.4.1, 5.4.2

COURSE CONTENT

UNIT I

Introduction to Machine Learning: Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of

Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Data Sets.

Nearest Neighbor-Based Models: Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, KNN Classifier, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

UNIT II

Models Based on Decision Trees: Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression.

The Bayes Classifier: Introduction to the Bayes Classifier, Bayes’ Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification — Class Conditional Independence and Naive Bayes Classifier (NBC).

UNIT III

Linear Discriminants for Machine Learning: Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Backpropagation for Training an MLP.

UNIT IV

Clustering: Introduction to Clustering, Partitioning of Data, Matrix Factorization — Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

TEXTBOOKS

1. M. N. Murthy, V. S. Ananthanarayana, Machine Learning Theory and Practice, Universities Press (India), 2024.

REFERENCE BOOKS

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2017.
2. Peter Harrington, Machine Learning in Action, Dreamtech Press, 2012.
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, 2nd Edition, Pearson, 2019.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Massachusetts Institute of Technology (MIT), MIT OpenCourseWare: Introduction to Machine Learning (6.036), <https://ocw.mit.edu/courses/6-036> , Last Accessed On: 25/10/2025.

2. Andrew Ng, Stanford University, Coursera Course: Machine Learning, <https://www.coursera.org/learn/machine-learning> , Last Accessed On: 25/10/2025.
3. Prof. S. Babu, Prof. B. Ravindran, Indian Institute of Technology Madras (IIT Madras), NPTEL Course: Machine Learning, <https://nptel.ac.in/courses/106106202> , Last Accessed On: 25/10/2025.

23CS6405A

SOFTWARE PROJECT MANAGEMENT

Course Category	PE- III	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS4305 Software engineering	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the principles of conventional software management.
2. Apply the principles of modern software management to implement iterative life cycle phases and manage related artifacts effectively.
3. Apply iterative process planning methods and software process metrics to assess and improve project control and performance.
4. Apply Agile and DevOps practices to enhance automation, collaboration, and continuous software delivery in software projects.

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	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	3	3										1	2	3	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1
4	2	2	3										1	2	3	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1

COURSE CONTENT

UNIT I

Conventional Software Management: The waterfall model, conventional software management performance.

Evolution of Software Economics: Software economics, pragmatic software cost estimation.

Improving Software Economics: Reducing software product size, improving software processes, improving team effectiveness, improving automation, achieving required quality, peer inspections.

UNIT II

The Old Way and the New: Principles of conventional software engineering, principles of modern software management, transitioning to an iterative process.

Life Cycle Phases: Engineering and production stages, inception, elaboration, construction, transition phases.

Artifacts of the Process: The artifact sets, management artifacts, engineering artifacts, programmatic artifacts.

Workflows of the Process: Software process workflows, iteration workflows.

UNIT III

Checkpoints of the Process: Major milestones, minor milestones, periodic status assessments.

Iterative Process Planning: Work breakdown structures, planning guidelines, cost and schedule estimating, iteration planning process, pragmatic planning.

Project Control and Process Instrumentation: The seven core metrics, management indicators, quality indicators, life cycle expectations, pragmatic software metrics, metrics automation.

UNIT IV

Agile Methodology: Adapting to Scrum, patterns for adopting Scrum, sprint planning, iterating towards agility.

Fundamentals of DevOps: Architecture, deployments, orchestration, need, instance of applications, DevOps delivery pipeline, DevOps ecosystem.

DevOps Adoption in Projects: Technology aspects, Docker, Agile capabilities, Tool Stack implementation, People Aspect, Processes.

TEXTBOOKS

1. Walker Royce, Software Project Management, 1st Edition, Pearson Education Asia (PEA), 2005.
2. Mike Cohn, Succeeding with Agile: Software Development Using Scrum, 1st Edition, Addison-Wesley, 2010.
3. Gene Kim, John Willis, Patrick Debois, and Jez Humble, The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, 1st Edition, O'Reilly Publications, 2016.

REFERENCE BOOKS

1. Bob Hughes and Mike Cotterell, Software Project Management, 3rd Edition, Tata McGraw Hill, 2004.
2. Joel Henry, Software Project Management, 1st Edition, Pearson Education Asia (PEA), 2005.
3. Pankaj Jalote, Software Project Management in Practice, 1st Edition, Pearson Education Asia (PEA), 2005.
4. Robert K. Wysocki, Effective Software Project Management, 1st Edition, Wiley,

2006.

5. Kathy Schwalbe, Project Management in IT, 1st Edition, Cengage Learning, 2009.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. R.Mall and D.P. Mohapatra, NPTEL Course: Software Project Management, <https://archive.nptel.ac.in/courses/106/105/106105218/>, Last Accessed On: 30/10/2025.

23CS6405B

MOBILE ADHOC NETWORKS

Course Category	PE- III	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS5302	Continuous Eval	30
	Computer Networks	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the fundamental concepts of cellular and ad hoc wireless networks.
2. Analyze various routing and transport layer protocols for ad hoc wireless networks
3. Analyze the security requirements, attacks, and secure routing mechanisms in MANETs
4. Analyze the architecture, protocols, and operating systems used in wireless sensor 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	3	2	2										1	3	2	1.2.1, 1.6.1, 1.7.1, 2.5.2, 3.5.1
2	2	3	3										1	3	4	1.6.1, 1.7.1, 2.5.2, 2.6.4, 3.5.1
3	2	3	3										1	3	4	1.7.1, 2.5.2, 2.6.4, 3.5.1
4	2	2	3										1	3	4	1.6.1, 1.7.1, 2.5.2, 2.6.4, 3.5.1

COURSE CONTENT

UNIT I

Introduction to Ad Hoc Wireless Networks: Cellular and Ad Hoc Wireless Networks, Characteristics of MANETs, Applications of MANETs, Issues and Challenges of MANETs, Ad Hoc Wireless Internet.

MAC Protocols for Ad Hoc Wireless Networks: Issues, Design Goals and Classifications of the MAC Protocols.

UNIT II

Routing and Transport Layer Protocols for Ad Hoc Wireless Networks:

Issues in Designing a Routing Protocol, Classifications of Routing Protocols, Topology-based versus Position-based Approaches, Issues and Design Goals of a Transport Layer Protocol, Classification of Transport Layer Solutions, TCP over Ad Hoc Wireless Networks, Solutions for TCP over Ad Hoc Wireless Networks, Other Transport Layer Protocols.

UNIT III

Security in Ad Hoc Wireless Networks :– Security in Ad Hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing in Ad Hoc Wireless Networks, Cooperation in MANETs, Intrusion Detection Systems.

UNIT IV

Wireless Sensor Networks and Security: Wireless Sensor Networks and Security – Basics of Wireless Sensors and Applications, The Mica Mote, Sensing and Communication Range, Design Issues, Energy Consumption, Clustering of Sensors, Applications, Data Retrieval in Sensor Networks – Classification of WSNs, MAC Layer, Routing Layer, Transport Layer, High-level Application Layer Support, Adapting to the Inherent Dynamic Nature of WSNs, Security in WSNs, Key Management in WSNs, Secure Data Aggregation in WSNs, Sensor Network Hardware – Components of Sensor Mote, Sensor Network Operating Systems – TinyOS, LA-TinyOS, SOS, RETOS, Imperative Language – nesC, Dataflow Style Language – TinyGALS.

TEXTBOOKS

1. C. Siva Ram Murthy and B. S. Murthy, Ad Hoc Wireless Networks – Architectures and Protocols, 1st Edition, Pearson Education, 2004.
2. Carlos Corderio and Dharma P. Aggarwal, Ad Hoc and Sensor Networks – Theory and Applications, 2nd Edition, World Scientific Publications / Cambridge University Press, March 2006.

REFERENCE BOOKS

1. Feng Zhao and Leonidas Guibas, Wireless Sensor Networks: An Information Processing Approach, 1st Edition, Elsevier Science Imprint, Morgan Kaufmann Publishers, 2005, Reprint 2009.
2. Subir Kumar Sarkar et al., Wireless Ad Hoc Mobile Wireless Networks – Principles, Protocols and Applications, 1st Edition, Auerbach Publications, Taylor & Francis Group, 2008.
3. Charles E. Perkins, Ad Hoc Networking, 1st Edition, Pearson Education, 2001.
4. Shih-Lin Wu and Yu-Chee Tseng, Wireless Ad Hoc Networking, 1st Edition, Auerbach Publications, Taylor & Francis Group, 2007.
5. Fei Hu and Xiaojun Cao, Wireless Sensor Networks – Principles and Practice, 1st Edition, An Auerbach Book, CRC Press, Taylor & Francis Group, 2010.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Sudip Misra – NPTEL Course on Wireless Ad Hoc and Sensor Networks, <https://nptel.ac.in/courses/106/105/106105160/>, Last Accessed On: 28/10/2024.
2. Prof. David Koilpillai – NPTEL Course on Introduction to Wireless and Cellular Communications, <https://nptel.ac.in/courses/106/106/106106167/>, Last Accessed On: 28/10/2024.
3. Massachusetts Institute of Technology OpenCourseWare – Principles of Wireless Communications (6-452), <https://ocw.mit.edu/courses/6-452-principles-of-wireless-communications-spring-2006/>, Last Accessed On: 28/10/2024.

23CS6405C

NATURAL LANGUAGE PROCESSING

Course Category	PE- III	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS5303: Formal Languages and Automata Theory	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the fundamentals of natural language processing.
2. Understand the word level analysis methods.
3. Apply syntactic, semantic, and pragmatic analysis concepts to process natural language.
4. Apply various NLP applications and tools in real time 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	3		3								1	1	2	1.2.1, 2.1.1, 2.2.3, 2.4.3, 3.1.1, 5.4.1
2	2	2	3		3								1	1	2	1.2.1, 2.1.3, 2.4.1, 3.2.1, 5.4.1
3	2	2	3		3								1	1	3	1.2.1, 2.1.3, 2.4.1, 3.1.1, 3.2.1, 5.4.1, 5.4.2
4	2	2	2		3								1	1	3	1.2.1, 2.1.3, 2.4.1, 3.2.1, 5.4.1, 5.4.2

COURSE CONTENT

UNIT I

Introduction: Origins and challenges of NLP, Language Modeling: Grammar-based LM, Statistical LM, Regular Expressions, Finite-State Automata, English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II

Word Level Analysis: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff, Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging, Hidden Markov and

Maximum Entropy models

UNIT III

Syntactic Analysis: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar, Dependency Grammar, Syntactic Parsing, Ambiguity Dynamic Programming parsing, Shallow parsing, Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs, Feature structures, Unification of feature structures.

Semantics And Pragmatics: Requirements for representation, First, Order Logic, Description Logics, Syntax-Driven Semantic analysis, Semantic attachments, Word Senses, Relations between Senses, Thematic Roles, selectional restrictions.

UNIT IV

NLP Applications: Machine Translation, Rule-based, Statistical, and Neural approaches to translation, Google Translate and modern systems, challenges in translation (ambiguity, context, idioms).

Sentiment Analysis: Understanding sentiment in text, Applications in social media, product reviews, and customer feedback. NLP Tools: NLP libraries, NLTK, spaCy, Stanford NLP Penn Treebank, WordNet, PropBank, FrameNet

TEXTBOOKS

1. Daniel Jurafsky, James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, 3rd Edition, Pearson, 2025.
2. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, 1st Edition, O'Reilly Media, 2009.

REFERENCE BOOKS

1. Breck Baldwin, Language Processing with Java and LingPipe Cookbook, Atlantic Publishers, 1st Edition, 2015.
2. Richard M. Reese, Natural Language Processing with Java, 1st Edition, O'Reilly Media, 2015.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Łukasz Kaiser, Natural Language Processing Specialization, Coursera, DeepLearning.AI, 2022. Available at: <https://www.coursera.org/specializations/natural-language-processing> , Last Accessed on: 25/10/2025.
2. Martin Jocqueviel, Modern Natural Language Processing in Python, Udemy, 2024. Available at: <https://www.udemy.com/course/modern-nlp> , Last Accessed on: 25/10/2025.

23CS6405D

DISTRIBUTED OPERATING SYSTEMS

Course Category	PE- III	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, models, and communication mechanisms in distributed operating systems.
2. Apply remote procedure call mechanisms for inter-process communication in distributed systems.
3. Apply distributed shared-memory and synchronization techniques for coordinating concurrent processes.
4. Analyze resource, process, and file management strategies for efficient distributed operating 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	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	3	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1
4	2	2	3	2									1	2	4	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1 4.1.1

COURSE CONTENT

UNIT I

Introduction: Distributed Computing Systems, Evolution and Models of Distributed Systems, Characteristics and Goals of Distributed Operating Systems, Design Issues in Distributed Operating Systems, Introduction to Distributed Computing Environment (DCE).

Message Passing: Concepts, Desirable Features, Synchronization, Buffering, Multidatagram Messages, Encoding/Decoding, Process Addressing, Failure Handling, and

Group Communication.

UNIT II

RPC: Concept and Model of RPC, Transparency in RPC and Implementation Mechanisms, Stub Generation and RPC Messages, Marshaling/Unmarshaling Arguments and Results, Server Management, Call Semantics, and Exception Handling, Client–Server Binding and Security in RPC, Lightweight RPC and Optimization for Performance.

UNIT III

Distributed Shared Memory (DSM): Concepts, Architecture, and Design Issues, Structure and Consistency Models, Replacement Strategy and Thrashing, Advantages and Limitations of DSM.

Synchronization: Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock Handling, and Election Algorithms

UNIT IV

Resource Management: Task Assignment, Load Balancing, and Load Sharing.

Process Management: Process Migration and Threads in Distributed Systems.

Distributed File Systems: File Models, File Sharing Semantics, Caching, Replication, and Fault Tolerance, Atomic Transactions and Design Principles.

TEXTBOOKS

1. Pradeep K. Sinha, Distributed Operating Systems: Concepts and Design, PHI Learning Pvt. Ltd., 2007.

REFERENCE BOOKS

1. Ajay D. Kshemkalyani, Mukesh Singhal, Distributed Computing: Principles, Algorithms and Systems, 1st Edition, Cambridge University Press, 2008.
2. Sunita Mahajan, Seema Shah, Distributed Computing, 1st Edition, Oxford University Press, 2015.
3. Andrew S. Tanenbaum, Distributed Operating Systems, 1st Edition, Pearson Education, 2013.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Dr. Rajiv Misra, Distributed Systems, NPTEL Online Certification, Indian Institute of Technology Patna, 2021. Available at: https://onlinecourses.nptel.ac.in/noc21_cs87/preview , Last Accessed On: 26/10/2025.

23CS6351

CLOUD COMPUTING LAB

Course Category	PC	Credits	1.5
Course Type	Laboratory	L-T-P	0-0-3
Prerequisites	23CS5352	Continuous Eval	30
	Computer Networks	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Apply cloud service and deployment models on platforms such as AWS, OpenStack, and Google App Engine.
2. Apply virtualization and container technologies for deploying applications using tools like VirtualBox, Docker, and Kubernetes.
3. Analyse the process of developing and deploying web and serverless applications using frameworks such as Flask, Docker, and OpenFaaS.
4. Analyse cloud resource scheduling and performance through simulation using CloudSim or similar 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	3	2		2	3								3	2	3	1.7.1, 2.6.4, 4.5.1, 5.4.1
2	2	3	2	2	3								3	3	3	1.7.1, 2.6.3, 2.6.4, 2.8.3, 2.8.4, 3.7.1, 4.6.1, 5.6.2
3	2	3	3	2	3								3	3	4	1.7.1, 2.5.2, 2.6.3, 4.6.1, 5.4.1
4	2	2		3	3								3	3	4	1.7.1, 2.6.3, 2.8.4, 3.7.1, 4.6.1, 5.5.1

COURSE CONTENT

Task 1: Introduction to Cloud Computing – exploring service models and deployment models.

Task 2: Lab on web services and inter-process communication (IPC) using messaging/publish-subscribe.

Task 3: Installation of VirtualBox /VMware Workstation with multiple OS flavors (Linux/Windows).

Task 4: Configure and test a C compiler in a virtual machine and execute sample programs.

Task 5: Create and configure an Amazon EC2 instance, deploy a web server, and associate an IP address (port 80). Or Perform the same using OpenStack.

Task 6: Install Google App Engine and develop simple web applications using Python/Java.

Task 7: Start a Docker container, set up a web server (Apache2/Flask), and map host directories as data volumes

Task 8: Demonstrate file transfer between virtual machines and between containers.

Task 9: Launch a virtual machine using TryStack (Online OpenStack Demo).

Task 10: Install a Hadoop single-node cluster and execute a WordCount application.

Task 11: Utilize OpenFaaS for event-driven function invocation (serverless computing).

Task 12: Simulate a cloud environment using CloudSim and implement a custom scheduling algorithm.

REFERENCE BOOKS

1. Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, Mastering Cloud Computing, 2nd Edition, McGraw Hill, 2024.
2. Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, Distributed and Cloud Computing, Elsevier, 2012.
3. Dan C. Marinescu, Cloud Computing: Theory and Practice, 2nd Edition, Elsevier, 2018.
4. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2011.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Amazon Web Services, AWS Documentation, Amazon, Available at: <https://docs.aws.amazon.com/> , Last Accessed On: 25/10/2025.
2. Docker Inc., Docker Reference Documentation, Available at: <https://docs.docker.com/reference/> , Last Accessed On: 25/10/2025.
3. Google Cloud, Google Cloud Platform – App Engine Documentation, Available at: <https://cloud.google.com/appengine/docs> , Last Accessed On: 25/10/2025.
4. OpenFaaS Project, OpenFaaS Documentation, Available at: <https://docs.openfaas.com/> , Last Accessed On: 25/10/2025.
5. Cloudbus Research Group, CloudSim Tutorials, University of Melbourne, Available at: <https://cloudbus.org/cloudsim/> , Last Accessed On: 25/10/2025.
6. Prof. Rajkumar Buyya, Cloud Computing, NPTEL Online Certification, Indian Institute of Technology Madras, Available at: <https://nptel.ac.in/courses/106105220> , Last Accessed On: 25/10/2025.

23CS6352

CRYPTOGRAPHY AND NETWORK SECURITY LAB

Course Category	PC	Credits	1.5
Course Type	Laboratory	L-T-P	0-0-3
Prerequisites	23CS5352	Continuous Eval	30
	Computer Networks	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Apply basic bitwise operations for simple string encryption.
2. Apply classical ciphers for secure communication.
3. Analyze modern symmetric and asymmetric cryptographic algorithms.
4. Apply cryptographic libraries for encryption, decryption, and secure key exchange.

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	3	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: Write a C program that contains a string (char pointer) with a value 'World'. The program should XOR each character in this string with 0 and displays the result.

Task 2: Write a C program that contains a string (char pointer) with a value 'World'. The program should AND or and XOR each character in this string with 127 and display the result.

Task 3: Write a Java program to perform encryption and decryption using the following algorithms: a) Ceaser Cipher b) Substitution Cipher c) Hill Cipher

Task 4: Write a Java program to implement the DES algorithm logic .

Task 5: Write a C/JAVA program to implement the BlowFish algorithm logic.

Task 6: Write a C/JAVA program to implement the Rijndael algorithm logic.

Task 7: Using Java Cryptography, encrypt the text “Hello world” using BlowFish. Create your own key using Java key tool.

Task 8: Write a Java program to implement RSA Algorithm

Task 9: Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).

Task 10: Calculate the message digest of a text using the SHA-1 algorithm in JAVA

TEXTBOOKS

1. Behrouz A. Forouzan and Debdeep Mukhopadhyay, Cryptography and Network Security, 3rd Edition, McGraw Hill, 2015.
2. William Stallings, Cryptography and Network Security, 4th Edition, Pearson Education, 2006.
3. Keith M. Martin, Everyday Cryptography, 1st Edition, Oxford University Press, 2016.

REFERENCE BOOKS

1. Bernard Meneges, Network Security and Cryptography, 1st Edition, Cengage Learning, 2018.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Sourav Mukhopadhyay, Professor, Department of Mathematics, Indian Institute of Technology Kharagpur, NPTEL Online Certification Course on Cryptography and Network Security, Available at: https://onlinecourses.nptel.ac.in/noc22_cs90/preview , Last Accessed On: 18/10/2025.
2. Dr. Manish Kumar, Encryption and Cryptography Essentials, Coursera Online Course, Available at: <https://www.coursera.org/learn/encryption-and-cryptography-essentials>, Last Accessed On: 18/10/2025.

23TP6107

QUANTITATIVE APTITUDE

Course Category	SS-4	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. Solve various Basic Mathematics problems by following different methods.
2. Follow strategies in minimizing time consumption in problem solving Apply short-cut methods to solve problems.
3. Confidently solve any mathematical problems and utilize these mathematical skills both in their professional as well as personal life.
4. Analyze, summarize and present information in quantitative forms including table, graphs and formulas.

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														
3	2															
4				2												

COURSE CONTENT

UNIT I

Numerical Ability I: Number System, HCF and LCM, Average, Ratio and Proportion.

Numerical Ability II: Problems on Ages, Partnership, Percentages, Profit and Loss, Allegation.

UNIT II

Arithmetical Ability I: Time and Work, Pipes and Cistern, Chain Rule.

Arithmetical Ability II: Time and Distance, Problems on Trains, Boats and Streams.

UNIT III

Arithmetical Ability III: Simple Interest and Compound Interest, Calendar and Clock.

Logical Ability: Permutations and Combinations, Probability, Cubes.

UNIT IV

Mensuration: Areas, Volumes.

Data Interpretation: Tabulation, Bar Graphs, Pie Charts, Line Graphs.

TEXTBOOKS

1. R. S. Aggarwal, “Quantitative Aptitude”, Revised Edition, S. Chand Publication, 2017, ISBN: 8121924987.

SEMESTER VII

23CS7301

DEEP LEARNING

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

COURSE OUTCOMES

1. Understand the fundamentals of Deep Learning and Machine Learning, including key models, techniques, evaluation methods, and challenges.
2. Apply deep learning concepts and neural network techniques using tools like Keras for classification tasks.
3. Apply CNN, RNN (LSTM, GRU), and PyTorch concepts for deep learning tasks.
4. Apply deep learning techniques in applications like machine vision and NLP, and advanced models such as GANs and autoencoders.

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	1											1	1	2	1.2.1, 1.7.1, 2.8.1
2	1	2	2		2								2	2	3	1.2.1, 1.7.1, 2.8.1, 3.6.2, 5.5.2
3	1	2	3		2								1	1	3	1.2.1, 1.7.1, 2.5.2, 3.6.2, 5.5.2
4	1	2	2		2								1	1	3	1.2.1, 1.7.1, 2.8.1, 3.6.2, 5.5.2

COURSE CONTENT

UNIT I

Fundamentals of Deep Learning: Artificial Intelligence, History of Machine Learning, Probabilistic Modelling, Early Neural Networks, Biological Neuron, Idea of Computational Units, McCulloch Pits unit and Thresholding Logic, Linear Perceptron, Perceptron Learning Algorithm, Linear Separability, Convergence theorem for Perceptron Learning algorithm.

UNIT II

Feed Forward Neural Networks: Multi layer perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, auto encoders. Deep Neural Networks: Difficulty of training deep neural networks, Greedy layer wise training.

UNIT III

Convolutional Neural Networks: Two Dimensional Structural Visual imagery, Computational Complexity, Convolutional Layers, Multichannel Convolution Operation.

Recurrent Neural Networks: : Introduction to RNN, Long Short-Term Memory (LSTM), Bidirectional LSTM.

PyTorch Tensors: Deep Learning with PyTorch.

UNIT IV

Interactive Applications of Deep Learning: Machine Vision, Natural Language Processing, Generative Adversarial Networks, Deep Reinforcement Learning.

Deep Learning Research: Autoencoders, Deep Generative Models: Boltzmann Machines, Restricted Boltzmann Machines, Deep Belief Networks.

TEXTBOOKS

1. I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, 1st Edition, MIT Press, 2016.
2. F. Chollet, Deep Learning with Python, 1st Edition, Manning Publications, 2017.
3. J. Krohn, G. Beyleveld, A. Bassens, Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence, 1st Edition, Addison-Wesley Professional, 2019.
4. S. Weidman, Deep Learning from Scratch, 1st Edition, O'Reilly Media, Inc., 2019.

REFERENCE BOOKS

1. B. Yegnanarayana, Artificial Neural Networks, PHI Learning Pvt. Ltd, 2009.
2. G. H. Golub, C. F. Van Loan, Matrix Computations, 4th Edition, JHU Press, 2013.
3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. S. Iyengar, P. Padmavati, Deep Learning, NPTEL, IIT Ropar and Punjab Engineering College, 2022. Available at: https://onlinecourses.nptel.ac.in/no_c22_cs22/preview, Last Accessed on: 04/05/2026.

23HS7102

HUMAN RESOURCES & PROJECT MANAGEMENT

Course Category	MC	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 fundamental concepts of Human Resource Management including planning, recruitment, selection, training and performance appraisal
2. Analyze HRD practices such as training methods, career development, group dynamics and HR accounting
3. Apply project management principles including project life cycle, scheduling and resource allocation
4. Analyze different project types and implement appropriate management strategies including leadership and conflict resolution

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									1		1		2	
2	2	3	2	2					1	2	2			1	4	
3	3	2	3	2					1	2	3		1		3	
4	3	3	4	3					1	3	2			1	4	

COURSE CONTENT

UNIT I

Human Resource Management: Nature, Scope and Concept of HRM, Functions of HRM, Role of HR Manager, Emerging Trends in HRM (E-HRM), HR Audit Models, Ethical Aspects of HRM.

HR Planning and Development: Demand and Supply Forecasting, Job Design, Recruitment, Sources of Recruitment, Selection Procedure, HRD Models, Training and Development, Methods of Training, Career Development and Counselling, Group Dynamics, HR Accounting, Performance Appraisal and Methods.

UNIT II

Basics of Project Management: Concept, Project Environment, Types of Projects, Project Life Cycle, Project Proposals, Project Networks (DPR), Project Appraisal and Selection.

Project Planning and Monitoring: Resource Management, Monitoring Project Progress, 80-20 Rule, Production Technology, Communication Matrix.

UNIT III

Project Types and Strategies: Infrastructure Projects, Industrial Projects, Service Projects, Social Projects and their Management Challenges.

Scheduling and Resource Allocation: Project Scheduling Techniques, Resource Allocation Strategies.

UNIT IV

Project Implementation and Control: Forms of Project Organization, Prerequisites for Successful Implementation, Project Planning and Control.

Project Evaluation and Leadership: Human Aspects of Project Management, Conflict Resolution, Leadership in Projects, Project Review, Performance Evaluation, Abandonment Analysis.

TEXTBOOKS

1. R. L. Mathis, J. H. Jackson, M. R. Tripathy, Human Resource Management, Cengage Learning, 2016.
2. S. Pande, S. Basak, Human Resource Management: Text and Cases, 2nd Edition, Vikas Publishing, 2016.
3. S. R. Clegg, T. Skyttermoen, A. L. Vaagaasar, Project Management, 1st Edition, Sage Publications, 2021.
4. K. Nagarajan, Project Management, 8th Edition, New Age International Publishers, 2017.

REFERENCE BOOKS

1. P. Subba Rao, Personnel and Human Resource Management: Text and Cases, Himalaya Publications, 2013.
2. K. Aswathappa, Human Resource and Personnel Management, Tata McGraw Hill, 2013.
3. P. Chandra, Projects: Planning, Analysis, Selection, Financing, Implementation and Review, Tata McGraw Hill, 1998.
4. V. Desai, Project Management, 4th Edition, Himalaya Publications, 2018.
5. L. Balakrishnan, Gowri, Project Management, Himalaya Publishing House, 2022.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. A. Malik, Principles of Human Resource Management, NPTEL, IIT Kharagpur, 2021. Available at: https://onlinecourses.nptel.ac.in/noc21_mg21/previ

- ew, Last Accessed on: 05/05/2026.
2. A. Ramesh, Project Management, NPTEL, IIT Roorkee, 2026. Available at: <https://nptel.ac.in/courses/110107430>, Last Accessed on: 05/05/2026.
 3. G. Parente, Strategic HRM: Talent, Performance and Compensation Design, Coursera, 2026. Available at: <https://www.coursera.org/learn/strategic-hrm-talent-performance-compensation-design>, Last Accessed on: 05/05/2026.

23CS7403A

SOFTWARE ARCHITECTURE & DESIGN PATTERNS

Course Category	PE-IV	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS4305: Software Engineering	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the basic concepts to identify state behavior of real world objects
2. Apply Object Oriented Analysis and Design concepts to solve complex problems
3. Apply various UML models using the appropriate notation for specific problem context
4. Analyze models to Show the importance of systems analysis and design in solving complex problems using case studies

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	3	1.7.1, 2.5.2, 2.6.3, 2.6.4, 2.8.4, 3.7.1
4	2	2	2										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

Introduction: Object-oriented Paradigm, Object Oriented Approach, Object oriented Software development, Key concepts of object oriented design other related concepts, Modular design and encapsulation, Cohesion and Coupling, Modifiability and Testability, Code Security, benefits of paradigm, Dealing with drawbacks of the paradigm, Reduced Performance, Complexity of the System, Learning the Object Oriented Paradigm.

Basics of Object Oriented Programming: : Implementing Classes, Constructors, Printing an object, Sharing Data across all objects, Creating and Working with related Classes, Defining and working with collections, Creating a collection class,

Implementation of Student Linked List, Interfaces, Improve Reuse with an interface, Array implementation of Lists.

UNIT II

Modelling Object Oriented Systems: Diagrams to describe an Object Oriented System, Building a User Interface Model, Requirement for an ATM system, Detailed Use Case for the ATM, Building a logical Model, A logical Model for ATM System, A Logical Model for a College Registration System.

Analysing a System: Gathering the requirements, Library Case Study, Building User Interaction Model, Use Case Analysis, Detailed Use Case for the Library System, Defining conceptual classes and Relationship, Identifying the relationships between the Classes, Using the knowledge of the domain.

UNIT III

Interactive Systems and MVC Architecture: Introduction, The MVC architectural pattern, Analyzing a simple drawing program, Specifying the Requirements, Defining the User Interface, Detailed use cases for drawing operations, Drawing the shapes.

Designing the Drawing Program: Shape representation, Interaction between Model, View and Controller, Interface dependent Controller and View, Design to support undo and redo system, Grouping, Ungrouping and shape collection, Selecting, deleting and moving, Controller Structure, Sequence Diagrams for shape manipulation, Implementation, Starting a program, Drawing a line, Selecting shapes, Grouping and Moving.

UNIT IV

Introduction to Design Patterns: Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog.

Design Pattern Catalog: Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Structural Patterns: Adapter, Bridge, Composite, Decorator, Facade, Flyweight, Proxy, Behavioral Patterns: Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, State.

TEXTBOOKS

1. B. Dathan, S. Ramnath, Object-Oriented Analysis, Design and Implementation: An Integrated Approach, 3rd Edition, Universities Press, 2024.
2. E. Gamma, R. Helm, R. Johnson, J. Vlissides, Design Patterns: Elements of Reusable Object-Oriented Software, Reprint Edition, Pearson Education India, 2023.

REFERENCE BOOKS

1. F. Bachmann, R. Meunier, H. Rohnert, Pattern-Oriented Software Architecture, Volume 1, 1st Edition, 1996.

2. W. J. Brown, Anti Patterns: Refactoring Software, Architectures and Projects in Crisis, John Wiley, 1998.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. S. Iyer, P. Prasad, T. G. Lakshmi, Software Conceptual Design, NPTEL, 2022. Available at: https://onlinecourses.nptel.ac.in/noc22_cs39/preview, Last Accessed on: 19/04/2026.
2. University of Alberta, Software Design and Architecture Specialization, Coursera, 2026. Available at: <https://www.coursera.org/specializations/software-design-architecture>, Last Accessed on: 19/04/2026.
3. Refactoring Guru, Design Patterns Tutorial, Refactoring Guru, 2026. Available at: <https://refactoring.guru/design-patterns>, Last Accessed on: 19/04/2026.

23CS7403B

BLOCKCHAIN TECHNOLOGY

Course Category	PE -IV	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS6303:	Continuous Eval	30
	Cryptography and	Semester End Eval	70
	Network Security	Total Marks	100

COURSE OUTCOMES

1. Understand the fundamentals of blockchain technology, including its components, types, consensus mechanisms, and cryptocurrencies.
2. Apply the concepts of public blockchain systems and smart contracts in real-world platforms like Bitcoin and Ethereum.
3. Apply the principles of private and consortium blockchains to design permissioned blockchain-based solutions.
4. Analyze security, scalability, and application challenges of blockchain across various domains.

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	1										3	1	2	1.2.1, 1.2.2, 2.8.1, 3.8.1
2	2	3	2										2	2	3	1.2.1, 1.2.2, 2.8.1, 3.8.1
3	3	2	1										2	2	3	1.2.1, 1.2.2, 2.6.3, 3.8.1
4	2	2											3	2	4	1.2.1, 1.2.2, 2.6.3

COURSE CONTENT

UNIT I

Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future.

Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol.

Cryptocurrency: Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency

Usage.

UNIT II

Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain.

Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

UNIT III

Private Blockchain System: Introduction, Key Characteristics of Private Block chain, Private Blockchain, Private Block chain Examples, Private Block chain and Open Source, E-commerce Site Example, Various Commands in E-commerce Block chain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permission ed Blockchain, Byzantine Fault, Multichain.

Consortium Blockchain: Introduction, Key Characteristics of Consortium Block chain, Need of Consortium Block chain, Hyperledger Platform, Overview of Ripple, Overview of Corda.

UNIT IV

Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contracts (DApps), Security Aspects in Hyperledger Fabric.

Applications of Blockchain: Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real Estate, Blockchain in Supply Chain, Blockchain and IoT, Limitations and Challenges of Blockchain.

TEXTBOOKS

1. C. Subramanian, A. A. George, A. K. Abhilash, M. Karthikeyan, Blockchain Technology, Universities Press, 2020.

REFERENCE BOOKS

1. M. Swan, Blockchain Blueprint for a New Economy, 1st Edition, O'Reilly Media, 2015.
2. J. S. Arun, J. Cuomo, N. Gaur, Blockchain for Business, 1st Edition, Addison-Wesley (Pearson), 2019.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. S. Chakraborty, S. Sural, Blockchain Technology, NPTEL, IIT Kharagpur, 2026. Available at: https://onlinecourses.nptel.ac.in/noc26_cs34/preview, Last Accessed on: 24/04/2026.

2. S. Shukla, Introduction to Blockchain Technology and Applications, NPTEL, IIT Kanpur, 2020. Available at: https://onlinecourses.nptel.ac.in/noc20_cs01/preview, Last Accessed on: 24/04/2026.
3. B. Ramamurthy, Blockchain Basics, Coursera, University at Buffalo, 2026. Available at: <https://www.coursera.org/learn/blockchain-basics>, Last Accessed on: 24/04/2026.
4. G. Gensler, Blockchain and Money, MIT OpenCourseWare, MIT, 2018. Available at: <https://ocw.mit.edu/courses/15-s12-blockchain-and-money-fall-2018/>, Last Accessed on: 24/04/2026.

23CS7403C

AUGMENTED REALITY & VIRTUAL REALITY

Course Category	PE-IV	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS3305:	Continuous Eval	30
	Object Oriented Programming	Semester End Eval	70
	Through Java	Total Marks	100

COURSE OUTCOMES

1. Understand the fundamental concepts of Augmented Reality including displays, tracking systems, computer vision, and software architectures
2. Understand the concepts of Virtual Reality including geometric models, viewing transformations, light behaviour, and optics
3. Understand the physiology of human vision, visual perception principles, and visual rendering techniques in VR/AR
4. Apply concepts of motion dynamics, the vestibular system, user interaction, locomotion, and auditory rendering in virtual environments

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, 2.6.1, 2.7.1
2	1	2											1	1	2	1.2.1, 1.6.1, 2.6.1, 2.7.1
3	1	2											1	1	2	1.2.1, 1.6.1, 2.6.1, 2.7.1
4	1	2											1	1	3	1.2.1, 1.6.1, 2.6.1

COURSE CONTENT

UNIT I

Introduction to Augmented Reality: Augmented Reality, History of Augmented Reality, Examples, Related Fields.

Displays and Tracking: Multimodal Displays, Visual Perception, Requirements and Characteristics, Tracking, Calibration, Characteristics of Tracking Technology, Stationary Tracking Systems.

Computer Vision for Augmented Reality: Marker Tracking, Multiple-Camera Infrared Tracking, Outdoor Tracking.

Software Architectures: AR Application Requirements, Software Engineering Requirements, Distributed Object Systems.

UNIT II

Introduction to Virtual Reality: Defining Virtual Reality, History of VR, Human Physiology and Perception.

The Geometry of Virtual Worlds: Geometric Models, Axis-Angle Representations of Rotation, Viewing Transformations.

Light and Optics: Basic Behavior of Light, Lenses, Optical Aberrations, The Human Eye, Cameras, Displays.

UNIT III

The Physiology of Human Vision: From the Cornea to Photoreceptors, From Photoreceptors to the Visual Cortex, Eye Movements, Implications for VR.

Visual Perception: Perception of Depth, Perception of Motion, Perception of Color.

Visual Rendering: Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates, Immersive Photos and Videos.

UNIT IV

Motion in Real and Virtual Worlds: Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection.

Interaction: Motor Programs and Remapping, Locomotion, Social Interaction.

Audio: The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering.

TEXTBOOKS

1. W. R. Sherman, A. B. Craig, Understanding Virtual Reality: Interface, Application, and Design, 2nd Edition, Morgan Kaufmann (Elsevier), 2019.
2. D. Schmalstieg, T. Hollerer, Augmented Reality: Principles and Practice, 1st Edition, Pearson Education India, 2016.

REFERENCE BOOKS

1. R. K. Maurya, Computer Graphics with Virtual Reality Systems, 3rd Edition, Wiley, 2018.
2. G. C. Burdea, P. Coiffet, Virtual Reality Technology, 2nd Edition, Wiley, 2017.
3. K. S. Hale, K. M. Stanney, Handbook of Virtual Environments, 2nd Edition, CRC Press, 2015.
4. A. B. Craig, W. R. Sherman, J. D. Will, Developing Virtual Reality Applications: Foundations of Effective Design, Morgan Kaufmann, 2009.
5. K. O'Connell, Designing for Mixed Reality, O'Reilly Media, Inc., 2016.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Samit Bhattacharya, Foundation for Virtual and Augmented Reality Systems, NPTEL, IIT Guwahati, 2026. Available at: https://onlinecourses.nptel.ac.in/noc26_cs03/preview, Last Accessed on: 28/04/2026.
2. Prof. M. Manivannan, Prof. Anna LaValle, Prof. Steven LaValle, Foundations of Virtual Reality, NPTEL, IIT Madras & University of Oulu, 2025. Available at: https://onlinecourses.nptel.ac.in/noc25_cs87/preview , Last Accessed on: 28/04/2026.

23CS7403D**FOUNDATIONS OF GENERATIVE AND AGENTIC AI**

Course Category	PE-IV	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS5404B: Artificial Intelligence	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the concepts of Generative AI, Variational Autoencoders, generative language model foundations, and Responsible AI practices.
2. Apply GAN-based image generation models and multimodal architectures for AI driven image and text processing applications.
3. Apply agentic AI frameworks, large language models, and their role in intelligent decision-making systems.
4. Apply LLM frameworks, retrieval systems, and prompt engineering techniques for designing AI-driven workflows and 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	2											2	1	2	1.2.1, 1.3.1, 1.7.1 2.1.1
2	3	2											2	1	3	1.2.1, 1.3.1, 1.7.1, 2.1.1
3	3	3	2										3	2	3	1.2.1, 2.1.1, 2.2.1, 3.1.1, 3.2.1
4	3	3	3										3	3	3	1.2.1, 1.7.1, 2.1.1, 2.2.1, 2.7.2, 3.7.1

COURSE CONTENT**UNIT I**

Introduction to Generative AI: Generative AI, Historical Overview of Generative Modelling, Difference between Generative AI and Discriminative Modelling, Importance of Generative Models in AI.

Types of Generative Models: GANs, Variational Autoencoders (VAEs), Autoregressive Models, Vector Quantized Diffusion Models, Transformer Architecture, Encoder and Decoder, Attention Mechanisms.

Responsible AI: Key Principles of Responsible AI, Responsible AI to Benefit Society, Case Studies: Real-world Examples of Responsible AI Implementation.

UNIT II

Generation of Images using GANs: Introduction to Generative Adversarial Networks, Deep Convolutional GAN (DCGAN), The Discriminator, The Generator, Training the DCGAN, Analysis of DCGAN, Conditional GAN Architecture.

Variational Autoencoders (VAEs): Autoencoders, Autoencoder Architecture, The Encoder, The Decoder, Joining the Encoder to the Decoder, Reconstructing Images, Visualizing the Latent Space, Generating New Images.

Multimodal Models: DALL·E 2 Architecture, The Text Encoder, CLIP, The Prior, The Decoder, Imagen Architecture, Examples of Stable Diffusion, Flamingo, Vision Encoder, Perceiver Resampler.

UNIT III

Agentic AI Tools and Frameworks: The Seven-Layer Agentic AI Architecture, Features and Comparison of Agentic AI Frameworks, Main Features of Sample Agentic Frameworks, Comparative Analysis of Agentic AI Frameworks, Challenges of Agentic AI Frameworks.

Large Language Models: Basics, Significance of Large Language Models, Working of Large Language Models, Importance of Pre-trained Language Models, Evaluation of Language Models, Risks and Limitations of Large Language Models.

UNIT IV

LLM Frameworks and Retrieval Systems: Introduction to LangChain, Components of LangChain, Schema, Text, ChatMessages, Models, BERT, GPT-3, LaMDA, GPT-4, Prompts, Indexes, Document Loaders, Text Splitters, Vector Stores, Retrievers, Memory, Applications of LangChain, Retrieval Augmented Generation (RAG), Workflow.

Prompt-Driven Agent Behavior: Defining Prompt Engineering, Iterative Journey to Great Prompts, Revising Prompts using Reinforcement Learning from Human Feedback (RLHF), Prompt Engineering of the Future, Challenges in Crafting Effective Prompts.

TEXTBOOKS

1. D. Foster, Generative Deep Learning, 2nd Edition, O'Reilly Media, 2024.
2. A. Rehmani, Generative AI for Everyone, BlueRose Publishers, 2024.
3. K. Huang (Ed.), Agentic AI: Theories and Practices, 1st Edition, Springer, 2025.

REFERENCE BOOKS

1. R. S. Sutton and A. G. Barto, Reinforcement Learning: An Introduction, 2nd Edition, MIT Press, 2018.
2. J. Alammar and M. Grootendorst, Hands-On Large Language Models, 1st Edition,

O'Reilly Media, 2024.

3. D. Rothman, Transformers for Natural Language Processing and Computer Vision, 3rd Edition, Packt Publishing, 2024.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Andrew Ng, Generative AI for Everyone, DeepLearning.AI and Coursera, 2024. Available at: <https://www.coursera.org/learn/generative-ai-for-everyone>, Last Accessed On: 15/05/2026.
2. Hugging Face Inc., Hugging Face Course: Open Source AI and Large Language Models, Hugging Face, 2025. Available at: <https://huggingface.co/learn>, Last Accessed On: 15/05/2026.
3. LangChain Inc., LangChain Documentation, LangChain, 2025. Available at: <https://python.langchain.com/docs/>, Last Accessed On: 15/05/2026.
4. Andrew Ng, Agentic AI, DeepLearning.AI, <https://learn.deeplearning.ai/courses/agenticaai/information>, Last Accessed On: 30/04/2026.
5. Dr. Jules White, Agentic AI and AI Agents: A Primer for Leaders, Coursera, <https://www.coursera.org/learn/agenticaai>, Last Accessed On: 30/04/2026.
6. V. K. Sneha, Getting Started with Agentic AI, Great Learning Academy, <https://www.mygreatlearning.com/academy/learn-for-free/courses/getting-started-with-agenticaai>, Last Accessed On: 30/04/2026.

23CS7404A

AGILE METHODOLOGIES

Course Category	PE -V	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23CS4305: Software Engineering	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand agile philosophy, agile values, and agile adoption in software development environments.
2. Apply Scrum practices to enable effective teamwork, collaboration, and iterative project delivery.
3. Apply XP practices, values, and principles to implement incremental design in software development.
4. Analyze Lean and Kanban methodologies to optimize workflow, manage process flow, and continuously improve software development practices.

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	1.7.1
2		2	2										2	1	3	2.6.3, 2.6.4, 2.8.3, 2.8.4, 3.7.1
3		3	2										2	1	3	2.6.3, 2.6.4, 2.8.3, 2.8.4, 3.7.1
4		3	3										2	2	4	2.6.3, 2.6.4, 2.8.3, 2.8.4, 3.7.1

COURSE CONTENT

UNIT I

Learning Agile: Agile, Getting Agile into Your Brain, Understanding Agile Values, A Fractured Perspective, The Agile Manifesto, Understanding the Elephant, Where to Start with a New Methodology.

The Agile Principles: The 12 Principles of Agile Software, The Customer Is Always Right, Delivering the Project, Better Project Delivery for the E-book Reader Project, Communicating and Working Together.

UNIT II

Scrum and Self-Organizing Teams: The Rules of Scrum, I Can Haz Scrum, Everyone on a Scrum Team Owns the Project, Status Updates Are for Social Networks, The Whole Team Uses the Daily Scrum, Feedback and the Visibility-Inspection-Adaptation Cycle, The Last Responsible Moment, Sprinting into a Wall, Sprints, Planning, and Retrospectives.

Scrum Planning and Collective Commitment: Not Quite Expecting the Unexpected, User Stories, Velocity, and Generally Accepted Scrum Practices, Victory Lap, Scrum Values Revisited.

UNIT III

XP and Embracing Change: Going into Overtime, The Primary Practices of XP, The Game Plan Changed but We Are Still Losing, The XP Values Help the Team Change Their Mindset, An Effective Mindset Starts with the XP Values, The Momentum Shifts, Understanding the XP Principles Helps You Embrace Change.

XP, Simplicity, and Incremental Design: Code and Design, Make Code and Design Decisions at the Last Responsible Moment, Final Score.

UNIT IV

Lean, Eliminating Waste, and Seeing the Whole: Lean Thinking, Creating Heroes and Magical Thinking, Eliminate Waste, Gain a Deeper Understanding of the Product, Deliver as Fast as Possible.

Kanban, Flow, and Continuous Improvement: The Principles of Kanban, Improving Your Process with Kanban, Measure and Manage Flow, Emergent Behavior with Kanban.

TEXT BOOKS

1. A. Stellman, J. Greene, Head First Agile, 1st Edition, O'Reilly Media, 2017.

REFERENCE BOOKS

1. K. Rubin, Essential Scrum: A Practical Guide to the Most Popular Agile Process, 1st Edition, Addison-Wesley, 2013.
2. A. Stellman, J. A. Hart, Learning Agile, 1st Edition, O'Reilly Media, 2015.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. R. Mall, Software Engineering, NPTEL, IIT Kharagpur, 2026. Available at: <http://nptel.ac.in/courses/106105182/>, Last Accessed on: 21/04/2026.
2. M. P. Ganesh, C. Dey, Working in Contemporary Teams, NPTEL, IIT Madras, 2026. Available at: <https://nptel.ac.in/courses/110106167/>, Last Accessed on: 21/04/2026.

23CS7404B

ROBOTIC PROCESS AUTOMATION

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

COURSE OUTCOMES

1. Understand the fundamentals and concepts of Robotic Process Automation (RPA).
2. Apply sequence and control flow structures to automate tasks.
3. Understand various mouse and keyboard automation activities in RPA.
4. Apply the design, deployment, and management of Assistant bots based on keyboard events.

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	2	1.6.1, 2.6.3, 5.4.1
2	3	2	2		3								3	2	3	1.7.1, 2.6.4, 3.7.1, 5.4.1
3	2	2		1	3								2	3	2	1.7.1, 2.6.4, 4.4.2, 5.4.1
4	3	3	3	2	3								3	3	3	1.7.1, 2.6.4, 3.7.1, 4.4.2, 5.4.1

COURSE CONTENT

UNIT I

Introduction: Scope and techniques of automation, Robotic process automation, Benefits of RPA, Components of RPA, RPA platforms, UiPath studio, UiPath Robot, UiPath orchestrator, the future of automation.

Record and Play: UiPath Stack, Types of Robots, the user interface, Quick Access Toolbar, Different panels, Task recorder, Step by step examples using recorder. Sequence, Activities, Control flow, various types of loops, decision making, step by step example using sequence and flow chart, step by step example using sequence and control flow.

UNIT II

Data Manipulation and Controls: Variables and Scope, Collections, Arguments, Data table usage, clipboard management, File operations, CSV/Excel to data table and vice versa. Finding and attaching windows, finding the control, techniques for a waiting for a control, act on controls, mouse and keyboard activities, working with UiExplorer, Handling events, Screen scraping, OCR

UNIT III

Assistant Bots: Assistant bots, Monitoring system event triggers, Hotkey trigger, Mouse trigger, System trigger Monitoring image and element triggers, Example of monitoring email, Example of monitoring a copying event and blocking it - Launching an assistant bot on a keyboard event.

Exception Handling: Exception Handling, common exceptions, logging and taking screenshots, Debugging techniques, collecting crash dumps, error reporting.

UNIT IV

Deploying and Maintaining the Bot: Publishing using publish utility, publish a workflow in UiPath, Overview of Orchestration server, using orchestration server to control bots, using orchestration server to deploy bots, license management, publishing and managing updates.

TEXTBOOKS

1. A. M. Tripathi, Learning Robotic Process Automation, Packt Publishing, 2018.

REFERENCE BOOKS

1. Frank Casale , Rebecca Dilla, Heidi Jaynes , Lauren Livingston, “Introduction to Robotic Process Automation: a Primer”, Institute of Robotic Process Automation, 1st Edition 2015.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant”, Independently Published, 1st Edition 2018.
3. Srikanth Merianda,”Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation”, Consulting Opportunity Holdings LLC, 1st Edition 2018.
4. Lim Mei Ying, “Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes”, Packt Publishing, 1st Edition 2018.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. UiPath, Robotic Process Automation, [Online]. Available: <https://www.uipath.com/rpa/robotic-process-automation> , Last accessed on: 15-02-2026.
UiPath Academy, UiPath Academy, [Online]. Available: <https://www.academy.uipath.com> , Last accessed on: 18-01-2026.

23CS7404C

COMPUTER VISION

Course Category	PE-V	Credits	3
Course Type	Theory	L-T-P	3-0-0
Prerequisites	23BS1101: Linear Algebra & Calculus	Continuous Eval	30
	23BS2101: Differential Equations Vector Calculus.	Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand image formation, radiometry, shading, and color representation in computer vision.
2. Apply filtering, transforms, texture analysis, and feature extraction for image processing.
3. Apply multi-view geometry and segmentation methods for scene and object understanding.
4. Apply model fitting, tracking, and camera calibration techniques in vision 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	2											1	2	2	1.6.1, 1.7.1, 2.6.1, 2.6.2
2	2	3	2										1	2	3	1.2.1, 1.6.1, 2.5.3, 2.6.3, 2.6.4, 3.5.1, 3.6.1
3	2	3	2										1	2	3	1.2.1, 1.6.1, 2.5.3, 2.6.3, 2.6.4, 3.5.1, 3.6.1
4	2	3	2										1	2	3	1.2.1, 1.6.1, 2.5.3, 2.6.3, 2.6.4, 3.5.1, 3.6.1

COURSE CONTENT

UNIT I

Image Formation and Radiometry: Pinhole Cameras, Light in Space, Light on Surfaces, Important Special Cases, Qualitative Radiometry, Sources and Their

Effects.

Shading and Color: Local Shading Models, Application: Photometric Stereo, Interreflections and Global Shading Models, The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.

UNIT II

Linear Filters and Transforms: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial and Frequency Domain Transforms: DFT, DCT, DWT, Sampling and Aliasing.

Feature Extraction and Texture: Representing Texture, Edge Detection: Canny, LoG, Hough Transform, Corner Detection: Orientation Histogram, SIFT, SURF, HOG, Scale-Space Analysis: Image Pyramids, Gabor Filters.

UNIT III

Geometry of Multiple Views: Two Views, Stereopsis Reconstruction, Human Stereopsis, Binocular Fusion.

Segmentation and Object Detection: Segmentation, Grouping and Gestalt Principles, Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Region Growing, Edge-Based Segmentation, Graph Cut, Mean Shift, Texture Segmentation, Object Detection using Viola-Jones Algorithm.

UNIT IV

Model Fitting and Tracking: Fitting Lines, Fitting Curves, Expectation Maximization Algorithm, Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association.

Geometric Camera Models and Calibration: Elements of Analytical Euclidean Geometry, Camera Parameters and Perspective Projection, Affine Cameras and Affine Projection Equations, Geometric Camera Calibration using Least-Squares Parameter Estimation.

TEXTBOOKS

1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, 3rd Edition, Addison-Wesley, 2008.
2. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, 2nd Edition, PHI Learning (Indian Edition), 2009.

REFERENCE BOOKS

1. E. R. Davies, Computer and Machine Vision: Theory, Algorithms and Practicalities, 4th Edition, Elsevier (Academic Press), 2013.
2. R. Szeliski, Computer Vision: Algorithms and Applications, 1st Edition, Springer, 2011.
3. R. Hartley, A. Zisserman, Multiple View Geometry in Computer Vision, 2nd Edi-

tion, Cambridge University Press, 2004.

4. K. Fukunaga, Introduction to Statistical Pattern Recognition, 2nd Edition, Academic Press (Morgan Kaufmann), 1990.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. P. K. Biswas, Digital Image Processing, NPTEL, IIT Kharagpur. Available at: <https://nptel.ac.in/courses/117105135>, Last Accessed on: 05/05/2026.
2. J. Mukhopadhyay, Computer Vision, NPTEL, IIT Kharagpur. Available at: <http://nptel.ac.in/courses/106105216>, Last Accessed on: 05/05/2026.
3. V. N. Balasubramanian, Deep Learning for Computer Vision, NPTEL, IIT Hyderabad. Available at: <https://nptel.ac.in/courses/106106224>, Last Accessed on: 05/05/2026.

23CS7404D

CYBER PHYSICAL SYSTEMS

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

COURSE OUTCOMES

1. Understand the basics of symbolic synthesis for cyber-physical systems.
2. Apply security and synchronization techniques in cyber-physical systems.
3. Analyze real-time scheduling methods in cyber-physical systems.
4. Apply model integration concepts in cyber-physical 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	3				2								1	2	2	1.2.1, 1.7.1, 5.4.1
2		3			2								3	2	3	2.5.1, 2.5.2, 2.6.1, 5.4.2,
3		3		2									3	1	4	2.5.1, 2.5.2, 2.5.3, 2.6.3, 4.6.2
4			2		3								3	3	3	3.7.1, 5.4.2, 5.5.2, 5.6.1, 5.6.2

COURSE CONTENT

UNIT I

Symbolic Synthesis for Cyber-Physical Systems: Introduction and Motivation, Preliminaries, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models.

Advanced Techniques in Symbolic Synthesis: Construction of Symbolic Models, Continuous-Time Controllers, Software Tools.

UNIT II

Security of Cyber-Physical Systems: Introduction and Motivation, Cyber Security Requirements, Attack Models, Countermeasures, System-Theoretic Approaches.

Synchronization in Distributed Cyber-Physical Systems: Challenges in Cyber-Physical Systems, Complexity-Reducing Techniques for Synchronization, Formal Soft-

ware Engineering, Distributed Consensus Algorithms, Synchronous Lockstep Execution, Time-Triggered Architecture, Related Technologies, Advanced Techniques.

UNIT III

Real-Time Scheduling for Cyber-Physical Systems: Introduction and Motivation, Basic Techniques, Scheduling with Fixed Timing Parameters, Memory Effects, Multiprocessor and Multicore Scheduling, Accommodating Variability and Uncertainty, Managing Other Resources, Rhythmic Task Scheduling.

UNIT IV

Model Integration in Cyber-Physical Systems: Introduction and Motivation, Causality, Semantic Domains for Time, Interaction Models for Computational Processes.

Advanced Modeling and Integration Techniques: Semantics of CPS DSMLs, ForSpec, Syntax of CyPhyML, Formalization of Semantics, Formalization of Language Integration.

TEXTBOOKS

1. R. Kumar, D. De Niz, M. Klein, Cyber-Physical Systems, 1st Edition, Addison-Wesley Professional, 2016.
2. R. Alur, Principles of Cyber-Physical Systems, 1st Edition, MIT Press, 2015.

REFERENCE BOOKS

1. E. A. Lee, S. Seshia, Introduction to Embedded Systems: A Cyber-Physical Systems Approach, 2nd Edition, MIT Press, 2017.
2. A. Platzer, Logical Foundations of Cyber-Physical Systems, 2nd Edition, Springer, 2018.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Foundations of Cyber-Physical Systems, NPTEL, IIT Kharagpur, 2026. Available at: https://onlinecourses.nptel.ac.in/noc26_cs41/preview, Last Accessed on: 05/05/2026.
2. D. Damopoulos, Security and Trustworthiness of Modern Cyber-Physical Systems, YouTube/Class Central, 2024. Available at: <https://www.classcentral.com/classroom/youtube-security-and-trustworthiness-of-modern-cyber-physical-systems-dr-dimitrios-damopoulos-138002>, Last Accessed on: 05/05/2026.
3. Cyber-Physical Systems Design and Analysis, Udacity, 2024. Available at: <https://www.udacity.com/course/cyber-physical-systems-design-analysis--u49876>, Last Accessed on: 05/05/2026.
4. Cyber-Physical Systems: Modeling and Simulation, Coursera, University of California, Santa Cruz, 2024. Available at: <https://www.coursera.org/learn/cyber-physical-systems-1>, Last Accessed on: 05/05/2026.

23CS7205A**OBJECT ORIENTED PROGRAMMING THROUGH JAVA**

Course Category	OE-III	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: 14/04/2026.
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: 28/04/2026.
3. Prof. Owen Astrachan, Object Oriented Programming in Java, Duke University, <https://www.coursera.org/specializations/object-oriented-programming>, Last Accessed On: 21/04/2026.
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: 14/04/2026.
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: 04/05/2026.

23CS7205B

DATA SCIENCE WITH PYTHON

Course Category	OE-III	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 fundamentals of Data Science including its process, algorithms, classification, data exploration techniques, descriptive statistics, and visualization methods.
2. Apply classification, regression, and association analysis techniques to analyze datasets and solve predictive and pattern discovery problems.
3. Apply clustering techniques and evaluate machine learning models using performance metrics such as confusion matrix, ROC, AUC, and lift curves.
4. Apply recommendation systems and time series forecasting methods for prediction, recommendation, and performance evaluation in real-world data science 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	2											1	1	2	1.2.1, 1.7.1, 2.5.2
2	1	2	2										1	1	3	1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1, 3.6.1
3	2	2											1	1	2	1.2.1, 1.7.1 2.5.2, 2.6.4, 2.8.1
4	1	2	2										1	1	3	1.2.1, 1.7.1, 2.5.2, 2.6.4, 2.8.1, 3.6.1

UNIT I

Introduction to Data Science: AI, Machine Learning and Data Science, What is Data Science, Case for Data Science, Data Science Classification, Data Science Algorithms, Roadmap for Data Science.

Data Science Process: Prior Knowledge, Data Preparation, Modeling, Application, Knowledge.

Data Exploration: Objectives of Data Exploration, Datasets, Descriptive Statistics, Data Visualization, Roadmap for Data Exploration.

UNIT II

Classification: Decision Trees, Rule Induction, k-Nearest Neighbors, Naïve Bayesian Methods, Artificial Neural Networks.

Regression Methods: Linear Regression, Logistic Regression.

Association Analysis: Market Basket Analysis, Mining Association Rules, Apriori Algorithm.

UNIT III

Clustering: Types of Clustering Techniques, K-Means Clustering, DBSCAN Clustering.

Model Evaluation: Confusion Matrix, ROC and AUC, Lift Curves, Model Implementation and Evaluation.

UNIT IV

Recommendation Engines: Collaborative Filtering, Content-Based Filtering, Hybrid Recommenders.

Time Series Forecasting: Time Series Decomposition, Smoothing Methods, Regression Based Methods, Machine Learning Methods, Performance Evaluation.

TEXTBOOKS

1. V. Kotu, B. Deshpande, Data Science: Concepts and Practice, 2nd Edition, Morgan Kaufmann, 2019.
2. J. Han, J. Pei, M. Kamber, Data Mining: Concepts and Techniques, 3rd Edition, Elsevier, 2011.

REFERENCE BOOKS

1. G. James, D. Witten, T. Hastie, R. Tibshirani, An Introduction to Statistical Learning, 1st Edition, Springer, 2013.
2. W. McKinney, Python for Data Analysis, 2nd Edition, O'Reilly Media, 2017.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Data Science for Engineers, NPTEL, IIT Madras, 2026. Available at: https://onlinecourses.nptel.ac.in/noc26_cs65/preview, Last Accessed on: 02/05/2026.
2. Python for Data Science, NPTEL, IIT Madras, 2025. Available at: https://onlinecourses.nptel.ac.in/noc25_cs104/preview, Last Accessed on: 02/05/2026.
3. Introduction to Machine Learning, NPTEL, IIT Madras. Available at: <https://nptel.ac.in/courses>, Last Accessed on: 02/05/2026.

23CS7205C

AI TOOLS AND APPLICATIONS

Course Category	OE-III	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 fundamentals of Artificial Intelligence, its evolution, core technologies, ecosystem, and role in society.
2. Apply AI tools and technologies for text generation, image generation, search, recommendation, and productivity applications in real-world domains.
3. Apply AI-driven automation, conversational AI, computer vision, speech and language processing, and emerging AI technologies.
4. Apply responsible AI practices by addressing ethical concerns, bias, transparency, security risks, regulations, and future trends in Artificial Intelligence.

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 to Artificial Intelligence: Journey of Artificial Intelligence, Evolution of AI, What is AI, Narrow AI and Artificial General Intelligence (AGI), AI vs

Traditional Programming.

Core Technologies of AI: Machine Learning, Pattern Recognition, Natural Language Processing, Computer Vision.

AI Ecosystem and Foundations: Types of AI Systems, Intelligent Applications and Role of AI in Society.

UNIT II

AI Tools and Technologies: AI-powered Chatbots and Virtual Assistants, Text Generation Tools, Image Generation Tools, AI Search and Recommendation Tools, AI-based Productivity and Content Creation Tools.

AI in Real-world Systems: AI in Banking and Finance, Insurance, Healthcare, Retail and E-commerce, Manufacturing, Entertainment, Agriculture and Education.

UNIT III

AI-driven Automation and Applications: Conversational AI, Computer Vision Applications, Speech and Language Processing, Smart Systems and Intelligent Decision Support.

Emerging AI Technologies: Generative AI, Human–AI Interaction, AI-enabled Automation and Intelligent Workflows.

UNIT IV

Challenges and Responsible AI: Data Privacy, Bias and Fairness, Transparency and Explainability, Ethical Concerns, Accountability, Security Risks and Regulation Standards.

Future of AI: Job Transformation, Interoperability, Resource Challenges, Future Opportunities and Trends in Artificial Intelligence.

TEXTBOOKS

1. Goswami, S., Das, A. K., & Chakrabarti, A., AI for Everyone: A Beginner's Handbook for Artificial Intelligence (AI), Pearson, 2024.
2. Russell, S., and Norvig, P., Artificial Intelligence: A Modern Approach, Pearson, 4th Edition, 2021.
3. Kapoor, A., and Gulli, A., Generative AI with Python and TensorFlow 2: Build Intelligent Applications using Generative Models, Packt Publishing, 2023.

REFERENCE BOOKS

1. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans, Farrar, Straus and Giroux, 2019.
2. Michael Wooldridge, A Brief History of Artificial Intelligence: What It Is, Where We Are, and Where We Are Going, Flatiron Books, 2021.
3. Margaret A. Boden, Artificial Intelligence: A Very Short Introduction, Oxford University Press, 2nd Edition, 2018.
4. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pear-

son, 4th Edition, 2021.

5. Kris Jamsa, Introduction to Artificial Intelligence, Jones & Bartlett Learning, 2nd Edition, 2024.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Amit Sheth, Introduction to Artificial Intelligence, Department of Computer Science and Engineering, I.I.T. Kharagpur, Swayam, NPTEL, https://onlinecourses.nptel.ac.in/noc25_cs53/preview, Last Accessed On: 15/05/2026.
2. Andrew Ng, AI For Everyone, DeepLearning.AI, Coursera, <https://www.coursera.org/learn/ai-for-everyone>, Last Accessed On: 15/05/2026.
3. OpenAI, ChatGPT and Generative AI Resources, OpenAI, <https://openai.com/>, Last Accessed On: 15/05/2026.
4. Google Cloud, Introduction to Generative AI, Google Cloud Skills Boost, https://www.cloudskillsboost.google/course_templates/536, Last Accessed On: 15/05/2026.
5. IBM Skills Network, Introduction to Artificial Intelligence (AI), IBM Cognitive Class, <https://cognitiveclass.ai/courses/introduction-to-artificial-intelligence-ai>, Last Accessed On: 15/05/2026.

PROMPT ENGINEERING

Course Category	SEC	Credits	2
Course Type	Theory & Lab	L-T-P	0-1-2
Prerequisites	-	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand fundamental concepts of prompt engineering and prompt design principles
2. Apply advanced prompting techniques including few-shot, role-based and structured prompting and evaluate prompt outputs for accuracy, ethics, safety and robustness.
3. Analyze structured outputs and reasoning strategies for solving complex problems using LLMs
4. Analyze retrieval-augmented and agent-based systems using modern frameworks.

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	1											1	1	2	1.2.1, 1.7.1, 2.8.1
2	1	2	2										1	1	3	1.2.1, 1.7.1, 2.8.1, 3.6.2
3	1	2	3										1	1	4	1.2.1, 1.7.1, 2.5.2, 3.6.2
4	1	2	3										1	1	4	1.2.1, 1.7.1, 2.8.1, 3.6.2

COURSE CONTENT

UNIT I

Foundations of Prompt Engineering: Definition of prompt engineering, Distinction between prompt engineering and model fine-tuning, Motivation and benefits of prompt engineering, Core principles of effective prompt design, Anatomy of a prompt, Setting up the Python environment for LLM interaction, Iterative prompting lifecycle, Common prompt pitfalls and remediation.

Lab Experiments:

- Environment & Connectivity: Install required packages (e.g., transformers, openai); securely configure the API key; run a simple “Hello, world” prompt to verify model access.
- Baseline vs. Enhanced Prompts: Execute a naïve prompt (“Write a one-paragraph bio of Ada Lovelace.”) and an enhanced prompt that adds role framing, specificity, and explicit format instructions; compare both outputs for relevance, completeness, and style.
- Iterative Refinement on a Simple Task: Summarize the plot of the Shakespearean play Romeo and Juliet in two sentences through three rounds of prompt tweaking:
 - a. Minimal instruction.
 - b. Addition of length and style constraints
 - c. Specification of key content elements (setting and theme)Document how each iteration changes and improves the result.
- Diagnosing Prompt Failures & Edge Cases: Craft a vague or contradictory prompt; analyze the failure mode (ambiguity, missing context, or format errors); refine the prompt by adding examples or clarifying instructions.

UNIT II

Advanced Prompt Patterns, Techniques & Ethical Evaluation: Enhanced prompt anatomy: contextual detail and explicit output specifications, Few-shot in-context prompting, Prompt structuring and template design, Role-based prompting to establish personas or system behavior, Negative prompting to filter or suppress undesired content, Constraint specification and instruction enforcement (e.g., length, format), Iterative prompt refinement and optimization.

Lab Experiments:

- Few-Shot vs. Zero-Shot Comparison: Design and execute a zero-shot prompt and a few-shot prompt (with 2–3 exemplar input-output pairs) for a chosen text task (e.g., sentiment classification or translation); compare outputs for accuracy, consistency, and adherence to examples.
- Role-Based & Negative Prompting: Craft a role-based prompt to establish a specific persona (e.g., “You are a financial advisor...”); then create a negative prompt to suppress undesired content (e.g., “Do not mention any brand names”); evaluate how each influences the model’s response.
- Constraint Specification & Iterative Refinement: Select an open-ended task (e.g., summarizing a technical article); issue a basic prompt; identify failures in length or format; refine the prompt by adding explicit constraints (word count, bullet format, etc.); document improvements over two refinement cycles.

- Prompt Evaluation & Ethics Workshop: Select two prompts and generate multiple outputs, evaluate them using manual heuristic checks for accuracy, relevance and format compliance; apply LLM-as-Judge prompts to automate evaluation; design a prompt injection test such as “Ignore previous instructions,” analyze the response and refine prompts to improve robustness.

UNIT III

Structured Output, Reasoning Techniques Agents, & Multimodal AI: Importance of structured outputs for real-world applications, Prompting for specific formats such as lists, tables and Markdown, Generating valid JSON and YAML using explicit instructions, Eliciting chain-of-thought reasoning in zero-shot prompts, Decomposing complex tasks into manageable sub-tasks.

Lab Experiments:

- Structured Format Prompting: Instruct the model to output information as bullet lists and Markdown tables (e.g., “List three benefits of daily exercise in a Markdown table with columns ‘Benefit’ and ‘Description’”); verify that the output matches the requested structure.
- JSON/YAML Generation: Provide a brief dataset description (e.g., three books with title, author and publication year) and prompt the model to produce valid JSON or YAML; use a parser to validate syntax and refine the prompt if errors occur.
- Chain-of-Thought & Task Decomposition: Present a multi-step problem (e.g., a logic puzzle) and apply zero-shot chain-of-thought prompting (e.g., “Let’s think step by step. Explain your reasoning before the final answer”); decompose the problem into sequential sub-questions, collect partial answers, combine them and compare accuracy against a direct-answer baseline.
- Building a Simple LLM Agent: Register a tool such as a calculator function and design prompts that instruct the agent to invoke it when required; implement using LangChain or function-calling APIs and test with queries requiring tool usage.
- Multimodal Prompting Exploration: Generate images using detailed text prompts and provide the generated image to an image-understanding model with an appropriate prompt; compare the returned caption with the original prompt to evaluate alignment.

UNIT IV

Retrieval-Augmented Generation & LangChain Workflows: Limitations of LLM internal knowledge, Need for external data sources, Introduction to Retrieval-Augmented Generation, Overview of RAG architecture including indexing and retrieval with generation, Introduction to LangChain for LLM applications, Basics of LangChain Expression Language, Document loading and text splitting, Fundamentals of embeddings and vector stores, Building retrieval-generation pipelines.

Lab Experiments:

- Building a Simple LCEL Chain: Create a minimal LCEL script that accepts a fixed instruction (e.g., “Summarize this text”), passes it to an LLM and prints the result; verify end-to-end execution.
- Basic Data Indexing for RAG: Load a small collection of documents, split into uniform chunks (e.g., 200 tokens), generate embeddings for each chunk and store them in an in-memory vector store; inspect the results for consistency.
- Constructing & Running a Basic RAG Chain: Build a pipeline that receives a user query, retrieves the top-k relevant chunks, constructs a combined prompt with context and query, sends it to the LLM and returns the answer; test with sample queries and compare factual accuracy against a prompt without retrieval.

INDIAN CONSTITUTION

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

COURSE OBJECTIVES

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

COURSE CONTENT

UNIT I

History of Making of the Indian Constitution: History, Drafting Committee (Composition and Working).

Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT II

Contours of Constitutional Rights and Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III

Organs of Governance: Parliament (Composition, Qualifications, Disqualifications, Powers and Functions), Executive (President, Governor, Council of Ministers), Judiciary (Appointment and Transfer of Judges, Qualifications, Powers and Functions).

UNIT IV

Local Administration: District Administration (Role and Importance), Municipalities (Mayor and Elected Representatives), Panchayati Raj (Zila Panchayat, Block Level, Village Level Administration), Importance of Grassroot Democracy. **Election Commission:** Role and Functioning, Chief Election Commissioner and Election

Commissioners, State Election Commission. Welfare Bodies for SC/ST/OBC and Women.

TEXTBOOKS

1. Government of India, “The Constitution of India (Bare Act)”, Government Publications, 1950.
2. S. N. Busi and B. R. Ambedkar, “Framing of Indian Constitution”, 1st Edition, 2015.

REFERENCE BOOKS

1. M. P. Jain, “Indian Constitutional Law”, 7th Edition, LexisNexis, 2014.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Subhash Kashyap, “Indian Constitution”, NPTEL, Available: <https://nptel.ac.in/>, Last Accessed On: 05/05/2026.
2. National Portal of India, “Constitution of India”, Available: <https://www.india.gov.in>, Last Accessed On: 05/05/2026.

23CS7551

DEEP LEARNING LAB

Course Category	PC	Credits	1
Course Type	Laboratory	L-T-P	0-0-2
Prerequisites	23CS3304: Advanced	Continuous Eval	30
	Data Structures &	Semester End Eval	70
	Algorithms Analysis	Total Marks	100

COURSE OUTCOMES

1. Apply deep neural networks to solve real world problems .
2. Analyze appropriate pre-trained model to solve real time problem
3. Analyze the results of two different deep learning models.
4. Analyze the deep learning models for optimized solutions.

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	1											1	1	3	1.2.1, 1.7.1, 2.8.1
2	1	2	2										1	1	4	1.2.1, 1.7.1, 2.8.1, 3.6.2
3	1	2	3		2								1	1	4	1.2.1, 1.7.1, 2.5.2, 3.6.2, 5.5.2
4	1	2	3		2								1	1	4	1.2.1, 1.7.1, 2.8.1, 3.6.2, 5.5.2

COURSE CONTENT

Task 1: Implement a Multi-Layer Perceptron (MLP) algorithm for MNIST hand-written digit classification.

Task 2: Design a Multi-Layer Perceptron for classifying movie reviews (Binary Classification) using IMDB dataset.

Task 3: Design a Neural Network for movie reviews classification (Binary Classification) using IMDB dataset.

Task 4: Design a Neural Network for news wires classification (Multiclass Classification) using Reuters dataset.

Task 5: Build a Convolutional Neural Network (CNN) for MNIST handwritten digit classification.

- Task 6:** Build a Convolutional Neural Network (CNN) for simple image classification (Dogs vs Cats).
- Task 7:** Use pre-trained Convolutional Neural Networks (LeNet, AlexNet) for image classification.
- Task 8:** Use a pre-trained Convolutional Neural Network (VGG16) for image classification.
- Task 9:** Implement Recurrent Neural Network (RNN) for sentiment analysis on movie reviews.
- Task 10:** Implement Bidirectional LSTM for sentiment analysis on movie reviews.
- Task 11:** Implement Generative Adversarial Networks (GANs) to generate realistic images using MNIST / Fashion MNIST / human face datasets.
- Task 12:** Implement Autoencoders for image denoising on MNIST / Fashion MNIST or suitable datasets.

TEXT BOOKS

1. Ian Good fellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 1st Edition, 2016.

REFERENCE BOOKS

1. R. Rojas, Neural Networks: A Systematic Introduction, 1st edition, Berlin, Germany: Springer-Verlag, 1996.
2. C. M. Bishop, Pattern Recognition and Machine Learning, 1st edition, New York, NY, USA: Springer, 2007.
3. F. Chollet, Deep Learning with Python, 1st edition, Shelter Island, NY, USA: Manning Publications Co., 2017.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Sanatan Sukhija, Introduction to Deep learning, https://onlinecourses.nptel.ac.in/noc22_cs35/preview, Last accessed on: 19/04/2026.
2. Ian Goodfellow , Adversarial Deep Learning, <https://www.youtube.com/watch?v=0cbPg1VtsSM>, Last accessed on: 19/04/2026.

23CS7551

MINI PROJECT - II

Course Category	PC	Credits	1
Course Type	Laboratory	L-T-P	0-0-2
Prerequisites	23CS3304: Advanced	Continuous Eval	30
	Data Structures &	Semester End Eval	70
	Algorithms Analysis	Total Marks	100

COURSE OUTCOMES

1. Apply deep neural networks to solve real world problems .
2. Analyze appropriate pre-trained model to solve real time problem
3. Analyze the results of two different deep learning models.
4. Analyze the deep learning models for optimized solutions.

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	1											1	1	3	1.2.1, 1.7.1, 2.8.1
2	1	2	2										1	1	4	1.2.1, 1.7.1, 2.8.1, 3.6.2
3	1	2	3		2								1	1	4	1.2.1, 1.7.1, 2.5.2, 3.6.2, 5.5.2
4	1	2	3		2								1	1	4	1.2.1, 1.7.1, 2.8.1, 3.6.2, 5.5.2

COURSE CONTENT

Task 1: Implement a Multi-Layer Perceptron (MLP) algorithm for MNIST hand-written digit classification.

Task 2: Design a Multi-Layer Perceptron for classifying movie reviews (Binary Classification) using IMDB dataset.

Task 3: Design a Neural Network for movie reviews classification (Binary Classification) using IMDB dataset.

Task 4: Design a Neural Network for news wires classification (Multiclass Classification) using Reuters dataset.

Task 5: Build a Convolutional Neural Network (CNN) for MNIST handwritten digit classification.

- Task 6:** Build a Convolutional Neural Network (CNN) for simple image classification (Dogs vs Cats).
- Task 7:** Use pre-trained Convolutional Neural Networks (LeNet, AlexNet) for image classification.
- Task 8:** Use a pre-trained Convolutional Neural Network (VGG16) for image classification.
- Task 9:** Implement Recurrent Neural Network (RNN) for sentiment analysis on movie reviews.
- Task 10:** Implement Bidirectional LSTM for sentiment analysis on movie reviews.
- Task 11:** Implement Generative Adversarial Networks (GANs) to generate realistic images using MNIST / Fashion MNIST / human face datasets.
- Task 12:** Implement Autoencoders for image denoising on MNIST / Fashion MNIST or suitable datasets.

TEXT BOOKS

1. Ian Good fellow and Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 1st Edition, 2016.

REFERENCE BOOKS

1. R. Rojas, Neural Networks: A Systematic Introduction, 1st edition, Berlin, Germany: Springer-Verlag, 1996.
2. C. M. Bishop, Pattern Recognition and Machine Learning, 1st edition, New York, NY, USA: Springer, 2007.
3. F. Chollet, Deep Learning with Python, 1st edition, Shelter Island, NY, USA: Manning Publications Co., 2017.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. Prof. Sanatan Sukhija, Introduction to Deep learning, https://onlinecourses.nptel.ac.in/noc22_cs35/preview, Last accessed on: 19/04/2026.
2. Ian Goodfellow , Adversarial Deep Learning, <https://www.youtube.com/watch?v=0cbPg1VtsSM>, Last accessed on: 19/04/2026.

MINORS

DATA STRUCTURES AND ALGORITHMS

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

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Understand the role of data structures in organizing and accessing data efficiently
2. Understand various techniques for searching, sorting and hashing algorithms used to solve complex problems.
3. Apply the operations on linear data structures like stack, queue and linked list.
4. Apply various operations on nonlinear data structures – binary tree, and binary search tree.

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, 4.4.1
2	3	2	1	2											2	1.6.1, 1.7.1, 2.6.1, 2.7.1, 3.5.1, 4.4.1
3	2	2	1	2											3	1.6.1, 1.7.1, 2.6.1, 2.7.1, 3.5.1, 4.4.1
4	2	2	1	2											3	1.6.1, 1.7.1, 2.6.1, 2.7.1, 3.5.1, 4.4.1

COURSE CONTENT

UNIT I

Basic Concepts: Overview: System life cycle. Algorithm Specification, Data Abstraction, Performance Analysis, the Abstract Data Type.

Searching: Introduction to searching, Linear Search and Binary Search.

Sorting: Bubble Sort, Insertion Sort, Selection Sort.

UNIT II

Linked Lists: Linked lists, programming details, doubly linked lists, circularly linked lists, Examples: polynomial addition.

Stacks: Stack Model, Implementation of Stacks (arrays), Linked Stacks Applications:

balancing the symbols, postfix expressions, infix to postfix conversionr.

UNIT III

Queues: Queue Model, Array implementation of Queues, Applications of Queues: DFS, linked Queues, Types of Queues: Circular Queues, Dequeues.

Trees: Introduction, Binary Trees, Binary Tree traversals, Binary Search Tree – Definition, Search, Insertion, & Deletion.

UNIT IV

Graphs: Graph Abstract Datatype, Elementary Graph Operations- DFS, BFS.

Hashing: General idea, Hash Functions, separate chaining, open addressing, rehashing, extendable hashing.

TEXT BOOKS

1. BMark Allen Weiss , “Data Structures and algorithm analysis in C” , Pearson, 2nd Edition, 2016.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed , “Fundamentals of data structures in C” , University Press, 2020

REFERENCE BOOKS

1. Reema Thareja , “ Data Structures Using C ”, Second Edition, 2014, Oxford University Press.
2. Brad Miller and David Ranum , “Problem Solving with Algorithms and Data Structures” , 2013.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, “Introduction to Algorithms” , 3rd Edition, Mitpress.
4. YedidyahLangsam, Moshe J. Augenstein and Aaron M. Tenenbaum, “Data Structures using C and C++” , 2nd edition, Pearson Education, 1999.
5. Jean Paul Trembley and Paul G. Sorenson, “An Introduction to Data Structures with Applications”, 2nd edition, McGraw Hill, 2008.

E-RESOURCES AND OTHER DIGITAL MATERIALS

1. SudarshanIyengar: IIT Ropar, Data Structures and Algorithms, [NPTEL], (26, May, 2021) Available: <http://nptel.ac.in/>
2. Erik Demaine, Advanced Data Structures [MIT- OpenCourseWare], (26, May, 2021) Available: <http://ocw.mit.edu/>
3. Prof. Naveen Garg, IIT Delhi, Introduction to Data Structures and Algorithms, <https://nptel.ac.in/courses/106102064>.

DATA STRUCTURES AND ALGORITHMS LAB

Course Category	Minors	Credits	1.5
Theory	Lab	L-T-P	0-0-3
Prerequisites	23ES1152-	Continuous Eval	30
	Computer Programming	Semester End Eval	70
	Lab	Total Marks	100

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

1. Analyze the role of linear data structures in organizing and accessing data efficiently in algorithms
2. Design, implement, and apply linked lists for dynamic data storage, demonstrating understanding of memory allocation
3. Develop programs using stacks to handle recursive algorithms, manage program states, and solve related problems
4. Apply queue-based algorithms for efficient task scheduling and breadth-first traversal in graphs and distinguish between dequeues and priority queues and apply them appropriately to solve data management challenges

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, 4.4.1
2	3	2	1	2											2	1.6.1, 1.7.1, 2.6.1, 2.7.1, 3.5.1, 4.4.1
3	2	2	1	2											3	1.6.1, 1.7.1, 2.6.1, 2.7.1, 3.5.1, 4.4.1
4	2	2	1	2											3	1.6.1, 1.7.1, 2.6.1, 2.7.1, 3.5.1, 4.4.1

COURSE CONTENT

Week 1: Programs on Searching operation

Objective: Able to perform array manipulations like reversing the elements in an array and applying searching techniques like linear search and binary search.

- i. Write a program to reverse an array.
- ii. Write C Programs to implement the Searching Techniques – Linear & Binary Search

Week 2: Sorting Techniques Implementation

Objective: Able to apply various sorting techniques like bubble sort, selection sort and insertion sort on an array of elements.

- i. Write a C Program to implement sorting using Bubble sort.
- ii. Write a C Program to implement sorting using Selection sort
- iii. Write a C Program to implement sorting using Insertion sort

Week 3: Linked List Implementation

Objective: Able to implement basic linked list operations like inserting a node, deleting a node, displaying data in the nodes of a linked list.

- i. Implement a singly linked list and perform insertion, deletion and traversal operations

Week 4: Linked List Applications

Objective: Able to implement Linked list applications like polynomial addition, removal of duplicates.

- i. Create a program to detect and remove duplicates from a linked list
- ii. Implement a linked list to represent polynomials and perform addition

Week 5: Double Linked List and Circular Linked list Implementation

Objective: Able to implement various operations on doubly linked list and circular linked list.

- i. Implement a doubly linked list and perform various operations to insert, delete, and traverse to understand its properties and applications
- ii. Implement a circular linked list and perform insertion, deletion, and traversal

Week 6: Stack Operations

Objective: Able to implement various stack operations using arrays and linked lists.

- i. Implement a stack using arrays and implement push, pop and traversal
- ii. Implement a stack using linked lists and implement push, pop and traversal

Week 7: Queue Operations

Objective: Able to implement various queue operations using arrays and linked lists.

- i. Implement a queue using arrays to perform the insertion, deletion and traversal
- ii. Implement a queue using linked lists to perform the insertion, deletion and traversal

Week 8: Stack and Queue Applications

Objective: Able to implement stack and queue applications.

- i. Use a stack to evaluate an infix expression and convert it to postfix
- ii. Create a program to determine whether a given string is a palindrome or not
- iii. Implement a stack or queue to perform comparison and check for symmetry

Week 9: Binary Search Tree Implementation

Objective: Able to construct a BST, and perform operations on it.

- i. Implementing a BST using Linked List to create, insert and delete nodes
- ii. Implement BST Traversal techniques in-order, pre-order, and post-order

Week 10: Programs on hashing

Objective: Able to implement hash tables and various collision resolution techniques.

- i. Implement a hash table with collision resolution techniques
- ii. Write a program to implement a simple cache using hashing

Week 11: Programs on Graph data structures

Objective: Able to perform operations on graph.

- i. Describe the operations on graph ADT and implement algorithm for Depth first search
- ii. Describe the operations on graph ADT and implement algorithm for Breath first search

TEXT BOOKS

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2nd Edition.
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson- Freed, Silicon Press, 2008.

REFERENCE BOOKS

1. Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders
2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft
3. Problem Solving with Algorithms and Data Structures” by Brad Miller and David Ranum
4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
5. Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms by Robert Sedgewick

E-RESOURCES

1. SudarshanIyengar: IIT Ropar, Data Structures and Algorithms, [NPTEL], (26, May, 2021) Available: <http://nptel.ac.in/>
2. Erik Demaine, Advanced Data Structures [MIT- OpenCourseWare], (26, May, 2021) Available: <http://ocw.mit.edu/>
3. Prof. Naveen Garg, IIT Delhi, Introduction to Data Structures and Algorithms, <https://nptel.ac.in/courses/106102064>
4. Data Structures and applications on, [Geeksforgeeks], (25, May, 2021) Available: <https://www.geeksforgeeks.org/data-structures/>

PRINCIPLES OF OPERATING SYSTEMS

Course Category	Minors	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.

PRINCIPLES OF DATABASE MANAGEMENT SYSTEMS

Course Category	Minors	Credits	4.5
Course Type	Theory	L-T-P	3-0-3
Prerequisites	23PC2104A: Data Structures	Continuous Eval	30
		Semester End Eval	70
		Total Marks	100

COURSE OUTCOMES

1. Understand the concepts of database systems.
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.

PRINCIPLES OF SOFTWARE ENGINEERING

Course Category	Minors	Credits	3
Course Type	Theory	L-T-P	3-0-3
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.