VELAGAPUDI RAMAKRISHNA

SIDDHARTHA ENGINEERING COLLEGE

(AUTONOMOUS)

(Approved by AICTE, Autonomous, Accredited by NAAC at "A+" Grade & ISO 21001:2018 Certified, Affiliated to JNTUK)

Vijayawada – 520 007

SCHEME OF INSTRUCTION AND SYLLABUS
B.Tech in INFORMATION TECHNOLOGY
VR23 REGULATIONS

w.e.f 2023-2024

Department of Information Technology
(B. Tech. IT Programme Accredited by NBA)

VELAGAPUDI RAMAKRISHNA

SIDDHARTHA ENGINEERING COLLEGE

(An Autonomous, ISO 9001:2015Certified Institution)

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

(Sponsored by Siddhartha Academy of General & Technical Education)

Kanuru, Vijayawada

Andhra Pradesh - 520007, INDIA.

www.vrsiddhartha.ac.in

w.e.f. 2023-24

VR23

SCHEME OF INSTRUCTIONS AND SYLLABUS

of

B.TECH

in

INFORMATION TECHNOLOGY

w.e.f

2023-2024 (VR23)

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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

To provide excellent information technology and computer science education by building strong teaching and research environment.

DEPARTMENT MISSION

To offer high quality graduate and post graduate programs in information technology and computer science education and to prepare students for professional career or higher studies. The department promotes excellence in teaching, research, collaborative activities and positive contributions to society.

PROGRAM EDUCATIONAL OBJECTIVES (B.TECH IN IT)

PEO 1: Excel in Professional Career and / or higher education by acquiring knowledge in mathematical, computing and engineering principles.

PEO 2: Analyse real life problems, design computing systems appropriate to its solutions that are technically sound, economically feasible and socially acceptable.

PEO 3: Exhibit professionalism, ethical attitude, communication skills, team work in their profession and adopt to current trends by engaging in life learning.

PROGRAM OUTCOMES

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 modelling 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	**Apply the concepts of Data Science, Software Modeling and Networking for IT applications**
PSO2	**Discover mechanisms that would perform tasks related to Research, Education, Training and/or E-governance**

SCHEME OF INSTRUCTIONS

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

DEPARMENT OF INFORMATION TECHNOLOGY

SCHEME OF INSTRUCTIONS FOR FOUR YEAR UG PROGRAM(VR23)

SEMESTER I

S.No.	Category	Title	L/D	T	P	Credits
1	BS&H	Basic Sciences and Humanities Course	2	0	0	2
2	BS&H	Basic Sciences and Humanities Course	3	0	0	3
3	BS&H	Basic Sciences and Humanities Course	3	0	0	3
4	ES	EngineeringScience Course	3	0	0	3
5	ES	Introduction to Programming	3	0	0	3
6	BS&H	Basic Sciences and Humanities Course Lab	0	0	2	1
7	BS&H	Basic Sciences and Humanities Course Lab	0	0	2	1
8	ES	Engineering Lab	0	0	3	1.5
9	ES	Engineering Science Lab	0	0	3	1.5
10	BS&H	Health and wellness, Yoga and Sports	-	-	1	0.5
Total			**14**	**00**	**11**	**19.5**

SEMESTER II

S.No.	Category	Title	L/D	T	P	Credits
1	BS&H	Basic Sciences and Humanities Course	3	0	0	3
2	BS&H	Basic Sciences and Humanities Course	3	0	0	3
3	ES	Engineering Science Course	3	0	0	3
4	PC	Professional Core Course	3	0	0	3
5	ES	Engineering Science Course	1	0	4	3
6	ES	Engineering Science Lab	0	0	2	1
7	BS&H	Engineering Physics Lab	0	0	2	1
8	ES	Engineering Science Lab	0	0	3	1.5
9	PC	Professional Core Lab	0	0	3	1.5
10	BS&H	NSS/NCC/Scouts & Guides/ Community Service	-	-	1	0.5
11	BS&H	Introduction to Design Thinking	2	0	0	-
Total			**13**	**00**	**15**	**20.5**

DEPARTMENT OF INFORMATION TECHNOLOGY
SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME
[VR23]

SEMESTER III

S.No.	Course Code	Course Category	Title	L	T	P	Credits
1	23HS3101	Humanities & Science	Engineering Economics & Management	2	0	0	2
2	23HS3102	Basic Science & Humanities	Universal Human Values 2 – Understanding Harmony	2	1	0	3
3	23ES3303C	Engineering Science	Digital Logic and Computer Organization	2	1	0	3
4	23IT3304	Professional Core	Advanced Data Structures & Algorithms	2	1	0	3
5	23IT3305	Professional Core	Object Oriented Programming Through Java	3	0	0	3
6	23TP3106	Skill Enhancement Course	Logic & Reasoning	0	0	2	1
7	23IT3651	Skill Enhancement Course	Python Programming Lab	0	0	2	1
8	23IT3552	Professional Core	Advanced Data Structures Lab	0	0	3	1.5
9	23IT3553	Professional Core	Object Oriented Programming Through Java Lab	0	0	3	1.5
Total				**11**	**3**	**10**	**19**

DEPARTMENT OF INFORMATION TECHNOLOGY
SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME
[VR23]

SEMESTER IV

S.No.	Course Code	Category	Title	L	T	P	Credits
1	23BS4101B	Engineering Science	Discrete Mathematical Structures	3	0	0	3
2	23ES4102B	Engineering Science	Probability & Statistics	3	0	0	3
3	23IT4303	Professional Core	Operating Systems	2	1	0	3
4	23IT4304	Professional Core	Database Management Systems	2	1	0	3
5	23IT4305	Professional Core	Software Engineering	3	0	0	3
6	23TP4106	Soft Skills	English for Professionals	0	0	2	1
7	23MC4107	Audit Course	Environmental Science	2	0	0	--
8	23IT4651	Skill Enhancement course	Python with DJango	0	0	2	1
9	23ES4152	Engineering Science	Design Thinking & Innovation	1	0	2	2
10	23IT4353	Professional Core	Operating Systems & Software Engineering Lab	0	0	3	1.5
11	23IT4354	Professional Core	Database Management Systems Lab	0	0	3	1.5
Total				**16**	**2**	**12**	**22**

DEPARTMENT OF INFORMATION TECHNOLOGY
SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME
[VR23]

SEMESTER V

S.No.	Course Code	Category	Title	L	T	P	Credits
1	23IT5301	Professional Core	Advanced Java	3	0	0	3
2	23IT5302	Professional Core	Computer Networks	3	0	0	3
3	23IT5303	Professional Core	Automata Theory & Compiler Design	3	0	0	3
4	23IT5404	Professional Elective - I	A. Object Oriented Analysis and Design B. Cyber Security C. Artificial Intelligence D. Microprocessors & Microcontrollers E. Data Warehousing & Data Mining F. 12 week MOOC Swayam/NPTEL course recommended by BoS	3	0	0	3
5	23IT5205	Open Elective I	A. Data Structures B. Principles of Operating Systems C. Computer Organization and Architecture D. Data Visualization	3	0	0	3
6	23IT5351	Professional Core Lab1	Advanced Java Lab	0	0	2	1
7	23IT5352	Professional Core Lab2	Computer Networks Lab	0	0	2	1
8	23IT5653	Skill Enhancement course	Full Stack Development-1	0	0	2	1
9	23IT5554	EPICS	Evaluation of Community Service Internship	-	-	-	2
10	23HS5155	Humanities and Social Sciences	Advanced Communication Skills Lab	0	0	2	1
11	23ES5156	Engineering Science	User Interface Design using Flutter/SWAYAM Plus-Android Application Development (with Flutter)	0	0	2	1
12	23TP5106	Soft Skills - 3	Personality Development	0	0	2	1
13	23MC5107A	Audit Course	Technical Paper Writing & IPR	2	0	0	0
Total				17	0	12	23

DEPARTMENT OF INFORMATION TECHNOLOGY
SCHEME OF INSTRUCTION FOR FOUR YEAR UG PROGRAMME
[VR23]

SEMESTER VI

S.No.	Course Code	Category	Title	L	T	P	Credits
1	23IT6301	Professional Core	Cloud Computing	3	0	0	3
2	23IT6302	Professional Core	Cryptography & Network Security	3	0	0	3
3	23IT6303	Professional Core	Machine Learning	3	0	0	3
4	23IT6404	Professional Elective-II	1. Software Testing Methodologies 2. Augmented Reality & Virtual Reality 3. DevOps 4. Generatvie AI 5. 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
5	23IT6405	Professional Elective-III	1. Software Project Management 2. Mobile Adhoc Networks 3. Natural Language Processing 4. Distributed Operating System 5. 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
6	23IT6206	Open Elective – II (NPTEL)		3	0	0	3
7	23IT6351	Professional Core	Cloud Computing Lab	0	0	3	1.5
8	23IT6352	Professional Core	Machine Learning Lab	0	0	3	1.5
9	23TP6107	Soft skills	Quantitative Aptitude	0	0	2	1
10	23MC6108A	Audit Course	Humanities Elective	2	0	0	-
		Total		**20**	**1**	**08**	**22**
		Mandatory Industry Internship of 08 weeks duration during summer vacation					

COURSES OFFERED FOR HONORS DEGREE IN IT

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

Suggested MOOC Courses for HONORS in IT
Student need to obtain 18 Credits by successfully completing the following

23HS3101- ENGINEERING ECONOMICS AND MANAGEMENT

Course Category:	Humanities and Social Sciences	**Credits:**	2
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-0-0
Prerequisites:	-	**Continuous Evaluation:**	30
		Semester End Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand various forms of organizations and principles of management
	CO2	Understand the various aspects of business economics.
	CO3	Perceive the knowledge on Human resources and Marketing functions
	CO4	Evaluate various alternatives economically.

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

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

Course Content

UNIT I:

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

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

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. **Depreciation:** Causes of depreciation, Factors influencing depreciation, common methods of Depreciation: Straight Line Method, Declining Balance Method, Sum of Year's Digits Method –Problems. **Economic Alternatives:** Methods of Evaluating Alternatives under Present worth method, Future worth method, Annual Equivalent method - Problems.
Text books and Reference books	**Text Book(s):** [1] M. Mahajan *Industrial Engineering and Production Management* Dhanpat Rai Publications, 2nd Edition. **[2]** Martand Telsang" Industrial & Business Management" S.Chand publications **Reference Books:** [1] R.Paneerselvam "Production and Operations Management" PHI [2]Philip Kotler & Gary Armstrong "Principles of Marketing" ,pearson prentice Hall,New Delhi,2012 Edition. [3] IM Pandey, "*Financial Management*" Vikas Publications 11th Edition [4] B.B Mahapatro, ***"Human Resource Management".***,New Age International ,2011
E-resources and other digital material	[1]https://www.toppr.com/guides/fundamentals-of-economics-and-management/supply/supply-function/ [2]https://keydifferences.com/difference-between-personnel-management-and-human-resource-management.html [3] http://productlifecyclestages.com/ [4] https://speechfoodie.com/cash-flow-diagrams/

23HS3102 -UNIVERSAL HUMAN VALUES-2: UNDERSTANDING HARMONY

Course Category:	Humanities and Social Sciences	**Credits:**	3
Course Type:	Mandatory course (suggested by AICTE)	**Lecture-Tutorial-Practice:**	2-1-0
Prerequisites:	None. Universal Human Values-I during induction program desirable.	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand and aware of themselves and their surroundings (family, society and nature).
	CO2	Handle problems with sustainable solutions, while keeping human relationships and human nature in mind.
	CO3	Exhibit critical ability and become sensitive to their commitment towards their understanding of human values, human relationship and human society.
	CO4	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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						1			2					
CO2			3											
CO3						2								
CO4								3				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: **Part-1: Understanding Harmony in Nature & Existence – Whole existence as Coexistence:** 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: Implications of the above Holistic Understanding of Harmony on Professional Ethics:** 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.)
Text books and Reference books	**Text Book(s):** [1] A Foundation Course in Human Values and Professional Ethics, R. R. Gaur, R. Sangal and G. P. Bagaria, Excel Books Private Limited, New Delhi (2010). [2] A Foundation Course in Human Values and Professional Ethics, R. R. Gaur, R. Asthana and G. P. Bagaria, 2nd revised edition Excel Books Private Limited, New Delhi (2019).

	Reference Books: [1] Jeevan Vidya: Ek Parichaya, A. Nagaraj, Jeevan Vidya Prakashan, Amarkantak (1999). [2] Human Values, A. N. Tripathi, New Age International Publishers, New Delhi (2004). [3] The Story of Stuff: The impact of overconsumption on the planet, our communities, and our health and how we can make it better, Annie Leonard, Free Press, New York (2010). [4] The story of my experiments with truth: Mahatma Gandhi Autobiography, Mohandas Karamchand Gandhi, B. N. Publishing (2008). [5] Small is beautiful: A study of economics as if people mattered, E. F. Schumacher, Vintage Books, London (1993). [6] Slow is beautiful: New Visions of Community, Cecile Andrews, New Society Publishers, Canada (2006). [7] Economy of Permanence, J. C. Kumarappa, Sarva-Seva-Sangh Prakashan, Varanasi (2017). [8] Bharat Mein Angreji Raj, Pandit Sunderlal, Prabhath Prakashan, Delhi (2018). [9] Rediscovering India, Dharampal, Society for Integrated Development of Himilayas (2003). [10] Hind Swaraj or Indian Home Rule, M. K. Gandhi, Navajivan Publishing House, Ahmedabad (1909). [11] India Wins Freedom: The Complete Version, Maulana Abul Kalam Azad, Orient Blackswan (1988). [12] The Life of Vivekananda and the Universal gospel, Romain Rolland, Advaitha Ashrama, India (2010). [13] Mahatma Gandhi: The Man who become one with the Universal Being, Romain Rolland, Srishti Publishers & Distributors, New Delhi (2002).
E-resources and other digital material	[1] Textbook-1: https://dokumen.pub/a-foundation-course-in-human-values-and-professional-ethics-firstnbsped-9788174467812.html [2] AICTE – SIP Youtube Channel: https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLAx6AhQ [3] AICTE – UHV Teaching Learning Material: https://fdp-si.aicte-india.org/download.php#1

23ES3303C– DIGITAL LOGIC AND COMPUTER ORGANIZATION

Course Category:	Engineering Science	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-1-0
Prerequisites:	-	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the digital logic design principles, register transfer operations, CPU & Memory organizations and Computer organization fundamentals.
	CO2	Design the hardwired and micro-programmed control units.
	CO3	Demonstrate the Fixed Point Arithmetic Operations and various Addressing Modes.
	CO4	Analyze different ways of communication with I/O devices and standard I/O interfaces.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3												1
CO2		1											1	3
CO3	3												1	3
CO4		1												1

Course Content

UNIT I:

Digital Logic Circuits: Logic Gates, Boolean Algebra, Map Simplification, Combinational Circuits, Flip Flops, Sequential Circuits.

Digital Components: Decoders, Multiplexers, Registers, Shift Registers, Binary Counters

Basic Structure of Computers: Computer Types, Functional Units, Basic Operational concepts, Software, Performance, Multiprocessors and Multi computers, Computer Generations.

UNIT II:

Register Transfer and Micro-Operations: Register Transfer Language, Register Transfer, Bus and memory Transfers, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift Unit.

Basic Computer Organization and Design: Instruction codes, Computer Registers, Computer Instructions, Timing and Control, Instruction cycle, Memory-Reference Instruction, Input-Output and Interrupt.

UNIT III:

Micro Programmed Control: Control Memory, Address Sequencing, Micro-Program example, Design of Control Unit.

Central Processing Unit: Introduction**,** General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Reduced Instruction Set Computer - CISC Characteristics, RISC Characteristics.

UNIT IV:

Computer Arithmetic: Addition and Subtraction, Multiplication Algorithms, Division Algorithms

Memory Organization: Memory Hierarchy, Associative Memory, Cache Memory

Input-Output Organization: Input-output Interface, Asynchronous Data Transfer,

	Modes of Transfer, Priority Interrupt, Direct Memory Access (DMA).
Text books and Reference books	**Text Book(s):** [1]. M.Morris Mano, "Computer System Architecture, Revised Third Edition, Pearson publications, 2020. [2]. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", Sixth Edition, McGraw Hill Publication, 2002. **Reference Books:** [1]. J.P.Hayes, "Computer Architecture and Organization" TMH, International Second Revised Edition, 1998 [2]. William Stallings, "Computer Organization and Architecture", Ninth Edition, Pearson/PHI, 2013 [3]. Andrew S. Tanenbaum, "Structured Computer Organization", Fifth Edition, PHI/Pearson, 2009
E-resources and other digital material	[1]. Prof.D.Roychoudhury, Department of Computer Science and Engineering,IITKharagpur **, "Lecture Series on Digital Systems", Nov 2008 https://www.youtube.com/watch?v=wXnVAcvJWDk** [2]. **Prof. S. Raman** CSE Department, **IIT Madras**. Computer Organization lecture series, NPTEL videos http://www.nptelvideos.com/course.php?id=396 [3]. Prof. Kamakoti, IIT, Chennai, May 2017 https://www.youtube.com/watch?v=MIWTxHbPBA0 [4]. Prof. Anshul Kumar, Department of Computer Science and Engineering, IIT Delhi. September 2008 http://www.infocobuild.com/education/audio-video-courses/computer-science/computer-architecture-kumar-iit-delhi.html [5]. Prof.P.K. Biswas, Department of Electronics and Electrical Communication Engineering, IITKharagpur. Introduction to Digital Computer Organization, 2009, Sep 24 https://www.youtube.com/watch?v=TH9nd-KdVHs

23IT3304 - ADVANCED DATA STRUCTURES AND ALGORITHMS

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-1-0
Prerequisites:	Data Structures	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Design an Algorithm and estimate the asymptotic performance of algorithms
	CO2	Synthesize design techniques and choose appropriate technique to solve problems.
	CO3	Analyze algorithm design techniques to provide optimal solution for given problem.
	CO4	Understand various operations on advanced tree data structures and asymptotic performance of algorithms.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3										2	1
CO2	1	2	3	2									1	1
CO3	1	2	3	2									1	3
CO4		3	2										3	2

Course Content

UNIT I:

Introduction: What is an algorithm**,** Algorithm Specification: Pseudo code Conventions, Performance Analysis: Space Complexity, Time Complexity, Asymptotic Notation (Big ―oh, Omega, Theta, Little ―oh).

Divide and Conquer: General method, Binary search, Finding the Maximum and Minimum, Merge sort, Quick sort, Strassen‘s matrix multiplication.

UNIT II:

Greedy method: General method, knapsack problem, Job Sequencing with deadlines, Minimum cost spanning trees: Prim‘s and Kruskal‘s algorithms, Single source shortest path problem.

Dynamic Programming: General method, All pairs shortest Path problem, Single-source shortest paths: general weights, String Editing, 0/1 knapsack problem, Travelling salesperson problem.

UNIT III:

Backtracking: General method, 8-queens problem, sum of subsets, graph coloring, Hamiltonian cycles.

Branch and Bound: The General method, 0/1knapsack problem, Travelling Salesperson Problem

UNIT IV:

Trees: AVL trees: Creation, insertion and deletion operations and Applications**.**
B-Trees: Creation, insertion and deletion operations and Applications**.**
Splay Trees: A simple idea, splaying, Top-Down splay trees.
Red-Black trees: Definition and Properties, Searching a Red-Black Tree, Top-Down Insertion, Bottom-Up Insertion, Deletion operations.
Heap Trees(Priority queues): Min and Max Heaps, Operations and Applications
NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, the classes NP Hard and NP Complete.

Text books and Reference books	**Text Book(s):** [1]. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "FUNDAMENTALS OF DATA STRUCTURES in C++", 2nd edition, University Press. [2] Ellis. Horowitz, Sartaj Sahani, Sanguthevar Rajasekharan, "FUNDAMENTALS OF COMPUTER ALGORITHMS", 2nd edition, University Press. **Reference Books:** [1]. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", PHI learning Pvt.Ltd., New Delhi, 2010. [2]. Lee, Kent D., Hubbard, Steve, "Data Structures and Algorithms with Python", 1st edition, Springer International Publishing, 2015.
E-resources and other digital material	[1] SudarshanIyengar,AssistantProfessor,CSE department, IIT Ropar, Programming, Data Structures and Algorithms [NPTEL], (26, May, 2021) Available: https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-cs25/ [2] Erik Demaine, professor of Computer Science at the Massachusetts Institute of Technology , Advanced Data Structures [MIT- Open Course Ware], (26, May, 2021) Available: http://ocw.mit.edu/ [3] https://www.tutorialpoint.com/advanced_data_structures/index.asp [4] http://peterindia.net/Algorithms.html

. 23IT3305 - OBJECT ORIENTED PROGRAMMING THROUGH JAVA

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	23ES1103Programming for Problem Solving 23IT3303 Data Structures	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand object-oriented programming principles to build classes and create objects
	CO2	Analyze exception handling techniques to debug correctness and handle run time errors
	CO3	Apply the knowledge of generics, collections and multi-threading to solve the problems
	CO4	Demonstrate the knowledge of lambda expressions and stream API operations to solve the problems

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2												
CO2		2	3								2	1	2	
CO3	1	3	2								3	3	3	
CO4			2								2	2	3	

Course Content

UNIT I:

Introduction: An Overview of java, Data types, variables and arrays.

Classes and Objects: Class fundamentals, declaring objects, assigning object reference variables, introducing methods, constructors, this keyword, overloading methods, Understanding Static and Introducing final keywords.

String handling: The string constructors, string tokenizer class.

UNIT II:

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

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

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

UNIT III:

Generics: A Generic class with two type parameters, the general from of a generic class, Bounded types

Multithread Programming: The Java thread model, creating a thread, implementing runnable, extending thread, creating multiple threads, thread priorities

Collections Framework: Collections overview, the Collection interfaces: Collection, List and Set.

Collection Classes: ArrayList, LinkedList, HashSet,TreeSet

	UNIT IV: **Lambda Expressions:** Lambda Expression fundamentals, function interfaces, some lambda expression examples, Block lambda expressions, Passing lambda expressions as arguments. **Method References:** Method References to static methods, Method References to instance methods, Method References with generics. **Stream API:** Stream Basics: Stream interfaces, how to obtaining a Stream, A simple Stream examples, Reduction Operations, Using Parallel Streams, Mapping, Collecting, Iterators and Stream.
Text books and Reference books	**Text Book:** [1]. Herbert Schildt, "Java The Complete Reference", 12th Edition, McGraw-Hill, New Delhi, 2022. [2]. Debasis Samanta, "Joy with JAVA, Fundamentals of Object-Oriented Programming", Monalisa Sarma, Cambridge, 2023. **Reference Books:** [1]. Kathy Sierra & Bert Bates, Head First Java, Second edition, Shroff/O'Reilly, 2009. [2]. Berbert Schildt, Dale Skrien, "Java Fundamentals: A Comprehension Introduction, Special Indian Edition, McGraw-Hill Education India Pvt. Ltd, 2013. [3]. Paul J. Dietel and Dr.Harvey M. Deitel, "Java How to Program, 9th Edition, Prentice-Hall, Pearson Education, 2011. [4]. Timothy Budd, "Understanding Object Oriented Programming with Java", updated edition, Pearson Education, 2013.
E-resources and other digital material	[4] Prof. I. Sengupta. (19-05-2021), Department of Computer Science & Engineering, I.I.T.,Kharagpur, "Internet Technologies", NPTEL, http://nptel.ac.in/video.php?subjectid=106105084 [5] Mia Minnes, Leo Porter, Christine Alvarado, University of California, San Diego (19-05-2021) Object Oriented Programming In Java Available: https://www.coursera.org/learn/object-oriented-java [6] Cay Horstmann, Cheng-Han Lee, Sara Tansey, San Jose State University, (19-05-2021) Intro to Java Programming Available: https://eu.udacity.com/course/intro-to-javaprogramming--cs046

23TP3106 - LOGIC & REASONING

Course Category:	Institutional Core	**Credits:**	1
Course Type:	Learning by Doing	**Lecture-Tutorial-Practice:**	0- 0 - 2
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	0
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Think reason logically in any critical situation
	CO2	Analyze given information to find correct solution
	CO3	To reduce the mistakes in day to day activities in practical life
	CO4	Develop time management skills by approaching different shortcut methods
	CO5	Use mathematical based reasoning to make decisions
	CO6	Apply logical thinking to solve problems and puzzles in qualifying exams for companies and in other competitive exams

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						**2**								
CO2		**2**												
CO3								**2**						
CO4									**2**					
CO5	**2**													
CO6	1													

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
Text books and Reference books	**Text Book(s):** [1]. R. S. Aggarwal, " Verbal and non-verbal reasoning", Revised Edition, S Chand publication, 2017 ISBN:81-219-0551-6, [2]. Reasoning Guru Verbal & Non-Verbal Reasoning by Vikramjeeth, Multilingual Edition-2023. ISBN :978-9358706000 **Reference Books:**
E-resources and other digital material	

23IT3651 – PYTHON PROGRAMMING LAB

Course Category:	Skill Enhancement Course	**Credits:**	1
Course Type:	Learning by Doing	**Lecture-Tutorial-Practice:**	0-0-2
Prerequisites:	-	**Continuous Evaluation:**	100
		Semester end Evaluation:	-
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Develop python programs on control flow statements and strings.
	CO2	Design solutions to a variety of problems using python built-in Data Structures.
	CO3	Apply object-oriented concepts, error handing mechanisms in python.
	CO4	Analyze and visualize using NumPy, Pandas and Matplotlib in python.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2			2	2				1	1	2			
CO2	2	1			2				1	1	2			
CO3	2	2		1	2				1	1	2			
CO4	3	3		3	3				3	2	2	3		

Course Content

UNIT I:

Basics of Python Programming: Features, History, future of python, writing and executing first python program, Literal constants, variables and identifiers, data types, input operation, comments, reserved words, indentation, operators and expressions, expressions, Type conversion.

Decision control statements: Introduction, Selection/conditional branching statements, Basic loop structures/iterative statements, Nested loops, break, continue and pass statements.

Strings: Concatenating, appending and multiplying strings, immutability, String formatting operator, built-in string methods and function, slice operation.

UNIT II:

Functions and Modules: Introduction, function declaration and definition, function definition, function call, variable scope and lifetime, the return statement, recursive functions, modules, packages in python.

Lists: Access and update values in lists, nested and cloning lists, basic list operations, List methods, using lists as Stack and Queues, list comprehensions, loping in lists.

Tuple: Creating tuple, utility of tuples, accessing values in a tuple, updating tuple, deleting elements in tuple, basic tuple operations.

Sets: Creating a Set and set operations

Dictionaries: Creating a dictionary, accessing values, add, modify, delete, sort items in a dictionary, looping over a dictionary.

UNIT III:

Classes and Objects: Introduction, classes and objects, class method and self-argument, init() method, class and object variables, del() method, other special methods, public and private data members, private methods, calling a class method from another class method, built-in class attributes, garbage collection, class and static methods, operator overloading.

Inheritance: Introduction, inheriting classes in python, types of inheritance, composition/containership/complex objects, abstract classes and interfaces, Meta class.

	Error and Exception Handling: Introduction to errors and exceptions, handling exceptions, multiple except blocks, multiple exceptions in a single block, except block without exception, the else clause, raising exceptions, built-in and user-defined exceptions, the finally block.
	UNIT IV: **NumPy Basics:** Introduction to numpy, The NumPy ndarray: A Multidimensional Array Object, Universal Functions: Fast Element-wise Array Functions. **Getting Started with pandas:** Introduction to Pandas Data Structures, Essential Functionalities, Summarizing and computing descriptive statistics. **Plotting and Visualization:** A brief Matplotlib API Primer, Plotting with Pandas and seaborn.
Text books and Reference books	**Text Book(s):** [1]. ReemaThareja,"Python Programming Using Problem Solving Approach", Oxford University Press, 2019. [2]. Wes McKinney, "Python for Data Analysis", Oreilly, Second Edition, 2017. **Reference Books:** [1]. Zed Shah, "Learn PythonThe Hard Way", Third edition, Addison-Wesley, 2013. [2]. Charles Severance, " Python for Informatics- Exploring Information", 1st edition Shroff Publishers, 2017. [3]. John V. Guttag, "Introduction to Computation and Programming Using Python", The MIT Press, 2013 [4]. W.Chun , "Core Python Programming", 2nd Edition, Prentice Hall, 2006. [5]. Vamsi Kurama, "Python Programming, A modern approach", Pearson, 2018.
E-resources and other digital material	[1]. Charles Severance: University of Michigan,Python for Everybody [COURSERA]. (05-01-2021), Available: https://www.coursera.org/ [2]. Prof. SudarshanIyengar, IIT Ropar, Prof. Yayati Gupta, IIIT Dharwad, The Joy Of Computing Using Python [NPTEL], (05-01-2021), [3]. Available:https://nptel.ac.in/courses/106/106/106106182/# [4]. Prof KannanMoudgalya, Professor, IIT Bombay, Python 3.4.3, [SWAYAM],(05-01-2021),Available: https://onlinecourses.swayam2.ac.in/aic20_sp33/preview. [5]. Corey Schafer,Python OOP Tutorials - Working with Classes, (05-01- 2021), Available: Python OOP Tutorials - Working with Classes – YouTube [6]. Prof. Ragunathan Rengasamy, IIT Madras, Python for Data Science [NPTEL], Available: https://onlinecourses.nptel.ac.in/noc22_cs32/preview

23IT3352 - ADVANCED DATA STRUCTURES AND ALGORITHMS LAB

Course Category:	Program core	**Credits:**	1.5
Course Type:	Lab	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	23PC2104 - Data Structures Programming language	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes

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

CO1	Demonstrate the divide and conquer technique with time complexity analysis
CO2	Demonstrate the divide and conquer technique with time complexity analysis
CO3	Design the algorithms for optimization problems using greedy or dynamic programming
CO4	Demonstrate backtracking technique
CO5	Perform operations on balanced data structures - AVL and B-trees
CO6	Solve scenario based problems using appropriate data structure and design technique

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1										3	
CO2	2	2	1										1	2
CO3	2	1	1										2	2
CO4	2	2	2										3	1
CO5	2	1	1										1	2
CO6	2	3	3									2	2	2

Course Content

Week 1: Programs on Time complexity Analysis techniques

a. Design an algorithm for the given problem and analyze the time complexity of the algorithm.
b. Design an algorithm for the given problem and analyze the time complexity of the algorithm.

Week 2&3: Programs on Divide And Conquer Technique

a. Sorting techniques: Merge Sort and Quick Sort
b. Find the minimum and maximum in a given array of elements
c. Design experiment using Divide and Conquer Technique

Week 4&5: Programs on Greedy Method

a. Implement fractional Knapsack problem
b. Find minimum cost spanning tree using Prims and Kruskals Algorithms
c. Implement Single Source Shortest Path problem
d. Implement job sequencing with deadlines problem

Week 6: Programs on Dynamic Programming

a. Implementation of all Pairs shortest path problem.
b. Implementation of travelling salesperson Problem.
c. Implementation of 0/1 Knapsack Problem

Week 7&8: Programs on Backtracking

	a. Implement N-Queens Problem b. Implement sum of subsets problem c. Implement Graph coloring problem d. Implement Hamiltonian cycle problem **Week 9: AVL tree and applications** a. Implementation of AVL tree operations. b. Design experiment using AVL-Tree **Week 10:B- tree and applications** a. Insert and delete operations on B-tree b. Design experiment using B-Tree **Week 11:** Design experiments/scenario based problem solving using Advanced Data structures **Week 12:** Design experiments/scenario based problem solving using Algorithm Design Strategies
Text books and Reference books	**Text Book(s):** [1]. Horowitz Sahni and Anderson-Freed, "Fundamentals of Data Structures in C", 2nd edition, Universities Press, 2011. [2]. Mark Allen Weiss, "Data structure and Algorithm Analysis in C", 2nd edition, Addison Wesley Publication, 2010. **Reference Books:** [1]. YedidyahLangsam, Moshe J. Augenstein and Aaron M. Tenenbaum, "Data Structures using C and C++", 2nd edition, Pearson Education, 1999. [2]. Data Structures: A Pseudocode Approach with C, 2nd Edition, R. F. Gilberg and B. A. Forouzan, Cengage Learning
E-resources and other digital material	[1]. Erik Demaine, Advanced Data Structures, [MIT- OpenCourseWare]. (26, May, 2021). Available: http://ocw.mit.edu/ [2]. Dr. Naveen Garg, Department of Computer Science & Engineering ,IIT Delhi, Lecture Series on Data Structures and Algorithms [NPTEL], (26,May,2021) Available: https://nptel.ac.in/courses/106/102/106102064/ [3]. Data Structures and applications on, [Geeksforgeeks], (25, May, 2021) Available: https://www.geeksforgeeks.org/data-structures/ [4]. Data Structures and challenges [Hacker rank], (25,May,2021) Available: https://www.hackerrank.com/domains/data-structures

23IT3353- OBJECT ORIENTED PROGRAMMING THROUGH JAVA LAB

<table>
<tr><td>Course Category:</td><td colspan="2">Programme Core</td><td colspan="2">Credits:</td><td>1.5</td></tr>
<tr><td>Course Type:</td><td colspan="2">Lab</td><td colspan="2">Lecture-Tutorial-Practice:</td><td>0-0-3</td></tr>
<tr><td rowspan="3">Prerequisites:</td><td colspan="2" rowspan="3">23ES1103-Programming for Problem Solving
23IT2104 - Data Structures</td><td colspan="2">Continuous Evaluation:</td><td>30</td></tr>
<tr><td colspan="2">Semester end Evaluation:</td><td>70</td></tr>
<tr><td colspan="2">Total Marks:</td><td>100</td></tr>
<tr><td rowspan="5">Course Outcomes</td><td colspan="5">Upon successful completion of the course, the student will be able to:</td></tr>
<tr><td>CO1</td><td colspan="4">Design solutions to applications using object-oriented approach using Java</td></tr>
<tr><td>CO2</td><td colspan="4">Implement java technology to solve runtime errors and test the correctness of programs using exception handling</td></tr>
<tr><td>CO3</td><td colspan="4">Develop java applications to make use of collections frameworks and Stream API to solve real world problems</td></tr>
<tr><td>CO4</td><td colspan="4">Design graphical user interface applications using Java Swings</td></tr>
</table>

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2										3		2	1
CO2		2	3								2		3	1
CO3		2	2						3		2	2	2	2
CO4		2	2						2		1	3	2	3

Course Content

Week 1:

1. Create a class Hello which can contains all the primitive datatypes: byte, int,short, long, float, double, char,
   a. print all the default values
   b. set the values to them and print those values
2. Create a class Vehicle which contains the data members vno, vname, company, typefuel member functions
   insertDetails()
   getDetails()
3. Create a class employee with the data members int eno, String ename, float esal
   Member Functions:
   setEmployee() - to set the values to the employee
   displayEmployee()- to display the values
4. Write a class called Bank with the data members acno, actype, name, bal, Member functions
   Insert CustomerDetails()- method to insert the values to the variables
   Deposit Amount()-ask the user to enter the amount to deposit and add the amount enteredto the bal
   Withdraw Amount() - ask the user to enter the amount to withdraw and update the amount entered to the b.

Week 2:

1. Write a program to implement method overloading to compute area of Rectangle, square and triangle
2. Write a program to implement function overloading to read the employee details like eno, esal, eaddress and display the information.
3. Write a program to implement constructor overloading to compute area of Rectangle, square and triangle.
4. Define a class to represent a bank account. Include the following Data Member
   a. Name of the depositor
   b. Account Number
   C. Type of Account
   Member Functions
   e. To assign Initial value using constructor overloading
   f To deposit an amount
   g. To withdraw amount after checking the balance
   h. To display name and balance.

Week 3:

1. A travel agent book tickets in rail to Mumbai to its customers. Create a class Railway with the variables pass_name, age,no_of_tickets, price, total amount. The Manager of the travel agent wants to know how many tickets and how many customers the agent has booked.
2. Write a java program for For MOVIE TICKET RESERVATION assuming that movie is A rated movie and it shouldn't allow the children below 18 and identify the current status of the seats available and should also display when the house is full.
3. Write a java program for movie ticket reservation. Assuming that the number of tickets available are 10. use the codisplay(), to display the availability of tickets. The datamembers are name , movie name, numberof ticket needed, cofull display house full.
4. Write a java program to count the number of object created using static.

Week 4:

1. Create a program that reads the string "object-oriented programming using Java". Find the number of words/tokens in the string. Also print all the tokens that presents in the string.
2. Create a program that reads a string "It sometimes, happens that, while using, Microsoft Word you, hicave to transfer, copied table, to normal line – you need, to have your words, in one line separated, by let's say commas. While this procedure, would require, lot of clicking, and manual deleting, Microsoft Word possesses, a function that allows, you to do this automatically, disregarding how, many words you, need to transform".
3. Create a program that asks the user to enter the two string with different lengths and check whether the two strings are equal or not. Also check the last index and first index of the strings.
4. Write a Java program to check if two strings are anagrams of each other or not.

Week 5:

1. Create a class person with the filed firstname, lastname. Use parameterized method to set the values to the variables at runtime. Create sub class Employee with the variable eno, edept, esal. Create parameterized method

for setting the data and default method for display the information.

2. Create a class named Employee with the following details Data members:
   (a) name (b) address (c) age (d) gender
   Methods:
   (a) Display() to show the employee details
   Create another class FullTimeEmployee that inherits the Employee class:
   a. Data members : Salary Designation
   Method:
   Display() to show the salary and designation along with other employee details.
3. Write a java program for the bank which provides different interest rates for different time periods for the costumers. If the time limit is <2 years the interest is 5% per annum. If the time limit is between 2 and 4 years the interest rate is 8% per annum. If the time limit is >4years the interest rate is 10%per annum. Identify the inheritance and also use method over riding for display method and a parameterized constructor.
4. Create a Abstract class called shaped use this class to store two double data type values that could be used to compute the area of figures. Drive two specific class called triangle and rectangle from the base class shape.

Week 6:

1. Write a program to access the methods of one package methods in another packages: Create a bank class and implement the methods of deposit() and withdraw(). Access these in another package.
2. Create an interface called Vehicle with the methods set Vehicle(int, String, String, double), display(). Create a subclass Veh with the members vehno, vehname, vehprice. Implement the interface to the class. Create three objects to the class.
3. Create an interface A with the methods sum(int, int), mul(double, double, double). Create a subclass B which implements only sum(int, int). Create a subclass C which implements mul (double, double, double). Display the sum and multiplication values.
4. Write a java program having an interface called figure in the abstract method area. Design a class called diagram with 3 data members length, breadth and height. Write a program to calculate the perimeter and volume of the figure using the interface. Derive a class dimensions that implements interface figure and class diagram and display the area, perimeter and volume using Multiple Inheritance concept.
5. Create a class Bank with deposit and withdrawal method. Derive two class hdfc bank and sbi bank and override the methods using dynamic method dispatcher.

Week 7:

1. Create a class that reads an array of integers to holds the marks of student in five subjects. Display the values of array upto the array index 6.
2. Create a class that can raise ArithmeticException and ArraylndexOutOfBoundsException. Use try, catch; try,catch use try and multiple catch use nested try(try-try-catch)catch.
3. Create a class that reads sno, sname, javamarks, totalmarks. Compute the % of marks obtained by the user. Raise the exception in case of total marks is 0. Print the sname character by character. Raise an exception by printing the character at index which is not there.
4. Create a class Emp with eno, ename,esal. If esal is <1000 then raise an exception that" he will not eligible for promotion". Otherwise print the

employee details.

Week 8:

1. Implement generic class which will take list of numbers or names and sort them.
2. Create multiple threads Hello and Welcome which prints "Hello Java" and "Hello Dotnet" using Runnable interface for 10 and 20 times.
3. Create a thread using Thread class to print "java programming Lab" for every 1 Second. Check the Status of the thread before and after.
4. Write a program to access the methods of one package methods in another packages:
   a. Create two classes IT and CSE which extends Thread class each. Inside each of the class, print Hello IT and Hello CSE for 5 and 10 times.
   b. Create multiple threads that display welcome to it and welcome to seca for every 5 and 10 seconds. Also write a for loop to print welcome to vrsec forevery 15 secs

Week 9:

1. Write a java program to push the elements from back into a Linked List and sort them in ascending order
2. Write a java program clone an ArrayList to another ArrayList in Java?
3. Write a java program to perform various operations on Deques.
4. Write a program that creates a LinkedList object of 10 characters, then creates a second LinkedList object containing a copy of the first list, but in reverse order.

Week 10:

1. Develop a program using label (swing) to display the message "GFG WEB Site Click"
2. Write a program to create three buttons with caption OK, SUBMIT, CANCEL.
3. Program to create a translucent frame and control its translucency with the help of a JSlider.
4. Write a program to create JComboBox and Swing Menus.

Week 11:

1. Write a program to Check if a String Contains Only Alphabets in Java Using Lambda Expression
2. Write a program to Converting ArrayList to HashMap in Java 8 using a Lambda Expression
3. Write a program to Perform area of Rectangle using Lambda expressions
4. Write a program to Perform Linear search using Lambda expressions

Week 12:

1. Write a program demonstrates a static method reference.
2. Write a program demonstrate string operations using a method reference to an instance method
3. Write a java program to print the Fibonacci values upto the given integer using streams.
4. Write a program that generates an infinite stream of random numbers between 0 and 100, limits the stream to 10 numbers, and prints them.

	Case Studies: 1. Simulate the bank, college, library applications using java 2. Develop GUI based application using handle events raised by the application 3. Develop GUI based application using java swings to various applications bank, college, library.
Text books and Reference books	**Text Books:** [1]. Herbert Schildt, "Java The Complete Reference", 11th Edition, McGraw-Hill Education, New Delhi, 2019. **Reference Books:** [1] Kathy Sierra & Bert Bates, Head First Java, Second edition, Shroff/O'Reilly, 2009 [2] Herbert Schildt, Dale Skrien, "Java Fundamentals: A Comprehension Introduction", Special Indian Edition, McGraw-Hill Education India Pvt. Ltd, 2013. [3] Paul J. Dietel and Dr.Harvey M. Deitel, "Java How to Program", 9th Edition, Prentice-Hall, Pearson Education, 2011. [4] Timothy Budd, "Understanding Object Oriented Programming with Java" , Updated edition, Pearson Education, 2013.
E-resources and other digital material	[1]. Prof. I. Sengupta. (19-05-2021), Department of Computer Science & Engineering, I.I.T.,Kharagpur, "Internet Technologies", NPTEL, http://nptel.ac.in/video.php?subjectId=106105084 [2]. Mia Minnes, Leo Porter, Christine Alvarado, University of California, San Diego (19-05-2021) Object Oriented Programming in Java Available: https://www.coursera.org/learn/object-oriented-java [3]. Cay Horstmann, Cheng-Han Lee, Sara Tansey, San Jose State University, (19-05-2021) Intro to Java Programming Available https://eu.udacity.com/course/intro-to- java-programming--cs046

SEMESTER IV

23ES3102- DISCRETE MATHEMATICAL STRUCTURES

Course Category:	Engineering Science	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Set theory, functions	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the logical inference and counting techniques
	CO2	Solve problems on recurrence relations and generating functions
	CO3	Infer abstract algebra and evaluate the algebraic structures
	CO4	Analyze the properties, types and applications of graphs.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3			3				3					
CO2	3	3			3				3					
CO3	3	3			1				1					
CO4	3	1							1					

Course Content

UNIT I:

The Foundations: Logic and Proofs-Propositional Logic, Propositional equivalences, Predicates and Quantifiers, Rules of inference, Introductions to proofs. Normal forms(PDNF, PCNF).

Counting Techniques: Basics of counting, Pigeonhole principle, Generalized permutations and combinations.

UNIT II:

Advanced Counting Techniques: Recurrence Relations- Solving Linear recurrence relations-Solving homogeneous recurrence relations with constant coefficients-Solving Non homogeneous recurrence relations with constant coefficient.

Relations and Functions: Relations and their Properties, functions- one to one and onto functions, equivalence relation, partial order relations, POSET and Hasse diagrams.

UNIT III:

Group Theory: Groups- definition of a group, examples and elementary properties, sub groups, group homomorphism.

UNIT IV:

Graph Theory: Basic concepts, Isomorphism and sub graphs, planar graphs, Euler's formula, Multi graphs and Euler's circuits, Hamiltonian graphs, Grin-berg's theorem, Graph coloring, Chromatic number

Text books and Reference books

Text Book(s):

[1]. J.L Mott and A.Kandel, Discrete Mathematics for Computer scientists and Mathematicians, 2nd edition, PHI.

[2]. N.ChandraShekharan and M.Umaparvathi , Discrete Mathematics ,PHI 2010

Reference Books:

[1]. Kenneth H Rosen, Discrete Mathematics and Applications, 6th edition, McGrahill

[2]. Ralph P. Grimaldi, Discrete and Combinatorial Mathematics, 4th edition(2003), Pearson education

E-resources and other digital material	[1]. Kamala Krithivasan, IIT Madras, Discrete Mathematical Structures [NPTEL], (26,may,2021)Available: http://nptel.ac.in/syllabus/syllabus.php?subjectId=106106094 [2]. DominikScheduer, Assistant Professor, Department of CSE, Shanghai Jiao Tong Univeristy Discrete Mathematics [COURSERA].,(26,may,2021) Available: https://www.coursera.org/learn/discrete-mathematics [3]. Dr. Kamala Krithivasan, IIT Madras, Discrete Mathematical Structures,[NPTEL],(26,may,2021)http://www.infocobuild.com/education/audio-video-courses/computerscience/DiscreteMathematicalStructures-IIT-Madras/lecture-16.html

23ES4102B – PROBABILITY & STATISTICS

Course Category:	Engineering Science	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	-	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Examine Probability distributions with random variables.
	CO2	Apply random phenomena of sample to test the Hypothesis concerning means.
	CO3	Infer the Hypothesis concerning variance and proportions.
	CO4	Examine the Quality improvement, control charts and reliability to improve Statistical skills.

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	**3**	**3**	**-**	**2**										
CO2	**3**	**3**	**-**	2										
CO3	**3**	**3**		2										
CO4	**3**	**3**		2										

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:

The Statistical Content of Quality Improvement Programs: Quality Control- Control Charts for Measurements - Control Charts for Attributes.

Applications to Reliability and Life Testing: Reliability - Failure – Time Distributions – The Exponential Model in Reliability.

Text books and Reference books	**Text Book(s):** [1]. Probability and Statistics for Engineers Eighth edition by Richard A. Johnson Prentice Hall of India. **Reference Books:** [1]. Probability & Statistics for Engineers & Scientist by R.E. Walpole, R.H.Myers&S.L.Myers, Sixth Edition, Prentice Hall of India / Pearson Education. [2]. Probability and Statistics, Purna Chandra Biswal, Pearson Education Prentice Hall of India 2007. [3]. Probability and Statistics by T.K.V.Iyengar, B.Krishna Gandhi, S.Ranganatham, M.V.S.S.N.PrasadS.Chand.
E-resources and other digital material	[1]. probweb.berkeley.edu/teaching.html [2]. statsci.org/teaching.html [3]. video lectures.nptel.iitm.ac.in

23IT4303– OPERATING SYSTEMS

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-1-0
Prerequisites:	20ES1103 : Programming for Problem Solving	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes

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

CO1	Outline the concepts of operating system services, Process, Multithreading, file, directory and RAID structures.
CO2	Apply Page Replacement, CPU scheduling algorithms and Disk Scheduling algorithms
CO3	Develop appropriate solutions to solve problems related to primary , secondary memory management, Inter process communication and deadlocks
CO4	Identify suitable file allocation, free space management and security measures for a given scenario

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1											1	1
CO2	3	2											2	1
CO3	1	3											2	1
CO4	2	2											1	1

Course Content

UNIT I

Introduction: Operating System – User View, System View, Operating System Operations, Operating-System Structure, Operating-System Services, System Calls.

Process Concept: Process Concept, Process Scheduling, Operations on Processes, Inter Process Communication.

Multithreaded Programming: Overview, Multicore Programming, Multi-Threading Models, Threading Issues.

UNIT II

Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms

Synchronization: Background, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, 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: Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging.

Virtual Memory Management: Background, Demand Paging, Copy-on-Write, Page Replacement-FIFO, LRU, OPTIMAL, Thrashing.

UNIT IV:

File System: File Concept, Access Methods, Directory and Disk Structure.

Implementing File Systems: Allocation Methods, Free-Space Management.

Mass-Storage Structure: Overview of Mass-Storage Structure, Disk Scheduling,

	RAID Structure. **Security**- Protection Goals, Access Matrix, Access Control, Revocation of Access rights.
Text books and Reference books	**Text Book(s):** [2]. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, "Operating System Concepts", 9th ed, John Wiley &Sons (Asia) Pvt. Ltd, 2018. **Reference Books:** [1]. Dhananjay M. Dhamdhere, "Operating Systems: A Concept-Based Approach", 3rd edition, McGraw-Hill Education India Pvt. Ltd, 2017. [2]. William Stallings, "Operating System: Internals and Design Principles", 8th ed, Prentice Hall ,2014. [3]. Andrew S. Tanenbaum, "Modern Operating Systems", 4th ed, Pearson , 2016.
E-resources and other digital material	[1]. Prof. Chester Rebeiro Department of CSE,IITM "Introduction to Operating Systems" [NPTEL] dated 08th Sep 2016 https://nptel.ac.in/courses/106/106/106106144/ [2]. Mythili Vutukuru,Dept of CSE ,IITB "Lectures on Operating Systems" dated 14th Mar 2018 https://www.cse.iitb.ac.in/~mythili/os/ [3]. Prof. P.K. Biswas,Dept of EEC,IITK "Operating Systems" dated 06th Apr 2013 http://www.satishkashyap.com/2013/02/video-lectures-on-operating-systems-by.html

23IT4304– DATA BASE MANAGEMENT SYSTEMS

Course Category:	Professional Core	**Credits:**	3
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	2-1-0
Prerequisites:	23PC2104 - Data Structures	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Develop schemas using data models for a given application requirement.
	CO2	Construct queries using SQL and Relational algebra on a given database
	CO3	Design normalized databases for a given application by incorporating various constraints and normal forms.
	CO4	Analyze different forms of transactions and concurrency control mechanisms to maintain data consistency in a multi user environment.

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	2	1		2	1							1	
CO2		2			2									2
CO3			2								2		2	
CO4												1	2	1

Course Content

UNIT I:

Databases And Database Users: Introduction, characteristics of the database approach, actors on the scene, workers behind the scene, advantages of using the DBMS approach

Database System Concepts And Architecture: Data models, schemas, and instances, three schema architecture and data independence, Database languages and interfaces, The database system environment

Relational Data Model And Relational Database Constraints: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas

UNIT II:

SQL: SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, Insert, Delete and Update Statements in SQL

More SQL : Complex Queries, Views and Schema Modification : More Complex SQL Retrieval Queries, Views (Virtual Tables) in SQL, Schema Change Statements in SQL.

The Relational Algebra: Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION

UNIT III:

Data Modeling Using The Entity-Relationship (ER) Model: Using High-Level Conceptual Data Models for Database Design, Entity Types, Entity Sets, Attributes and Keys, Relationship types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types

Database Design Theory And Methodology: Basics of Functional Dependencies and Normalization for Relational Databases - Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal forms based on Primary keys, First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form, Multi valued dependency and Fourth normal form, Properties of Relational

	Decompositions.
	UNIT IV: **Introduction to Transaction Processing Concepts And Theory :** Introduction to Transaction Processing, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing schedules based on Recoverability, Characterizing schedules based on Serializability. **Concurrency Control Techniques:** Two Phase Locking Techniques for concurrency control – Types of locks and system lock tables, Guaranteeing Serializability by Two-Phase Locking. **NoSQL Databases :** Introduction to NoSQL systems - Emergence of NOSQL Systems, Characteristics of NOSQL Systems, Categories of NOSQL Systems**.** **Graph Database :** Introduction, High level view of graph space, The Power of Graph Databases.
Text books and Reference books	**Text Book(s):** [1]. Elmasri and Navathe. "Fundamentals of Database Systems", Ed 7. Pearson Education, 2016 [2]. Ian Robinson, Jim Webber, Emil Efriem, "Graph Databases", OReilly Media, 2015. **Reference Books** [1].Raghurama Krishnan, Johannes Gehrke, "Database Management Systems", 3rd Edition, TATA McGrawHill, 2008. [2].Silberschatz, Korth and Sudharshan. Data base System Concepts. Ed4. McGrawHill, 2009
E-resources and other digital material	[1]. Prof Richard Holowczak, Professor, Baruch College, The Normalization, Feb 2023 https://www.youtube.com/watch?v=GvxBqzWeGz0 [2]. Prof PP Das,IIIKharagpur, DBMS. Dec 7, 2017 https://www.youtube.com/watch?v=IoL9Ve2SRwQ&list=PLIwC9bZ0rmjSkm1VRJROX4vP2YMIf4Ebh [3]. Jennifer widom,(09,05,2018). Introduction to Databases https://www.youtube.com/watch?v=ShjrtAQmIVg [4]. P. B. Mahanty,(09,05,2015). DBMS and RDBMS. http://nptel.iitm.ac.in/video.php?courseId=1128&v=7952RsbAx2w8

23IT4305 - SOFTWARE ENGINEERING

Course Category:	Professional Core	**Credits:**	3
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	23PC2104 - Data Structures	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes

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

CO1	Understand the basic fundamentals of the software development life cycle.
CO2	Apply process models and testing techniques to real time applications.
CO3	Analyze requirements, specifications to build software design architecture.
CO4	Analyze the processes for identifying, assessing, and mitigating risks associated with software maintenance and evolution.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													3	1
CO2	1			2						2			2	
CO3		2								3	2			1
CO4			3							2	3		2	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.

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.

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

UNIT III:

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.

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..
	UNIT IV: **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.
Text books and Reference books	**Text books:** **[1].** Fundamentals of Software Engineering, Rajib Mall, 5th Edition, PHI,2018. **[2].** Software Engineering A practitioner's Approach, Roger S. Pressman, 9th Edition, Mc-Graw Hill International Edition. **References:** **[1].** Software Engineering, Ian Sommerville,10th Edition, Pearson. **[2].** Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.
E-resources and other digital material	**[1].** Prof. N.L. Sarda, Prof. Umesh Bellur, Prof. R.K. Joshi and Prof. Shashi Kelkar, Department of Computer Science & Engineering, IIT Bombay, Oct 8, 2008. NPTEL, Lecture Series on Software Engineering by **[2].** https://www.nptelvideos.com/lecture.php?id=7041 **[3].** Prof. Umesh Bellur, Computer Science & Engineering, Indian Institute of Technology, Bombay, Software engineering: Requirements Engineering/Specification NPTEL pdf, 2008 . Available by https://drive.google.com/file/d/1DC6FXZfYeQ42PODWTNfB4mkIE5WnTSDM/view **Kenneth W T Leung, Assistant Professor of Engineering Education , The Hong Kong University of Science and Technology, Software Engineering Specialization Coursera 2022. Availble by https://www.coursera.org/specializations/software-engineering** **[4].** Ron Burback, Department of Computer Science, Graduate Studies of Stanford UniversityDecember 1999 on Software Engineering Methodologies by http://infolab.stanford.edu/~burback/watersluice/watersluice.html

23TP3206 : ENGLISH FOR PROFESSIONALS

Course Category:	Soft Skills – 2	Credits:	**1**
Course Type:	Practical	Lecture – Tutorial – Practice:	**0-0-2**
Prerequisites:	Basic understanding of the language skills viz Listening, Speaking, Reading and Writing.	Continuous Evaluation:	**100**
		Semester end Evaluation:	**0**
		Total Marks:	**100**

Course Outcomes		
	Upon successful completion of the course, the student will be able to:	
	CO1	Understand how to listen, reflect, and speak while communicating with others.
	CO2	Recall the fundamentals of language in terms of grammar and vocabulary in communication.
	CO3	Apply English language skills in various speaking contexts to present ideas with clarity and accuracy.
	CO4	Analyze the different parts in Versant Test and answer them.

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
CO1	2									3		3
CO2	2									3		3
CO3	2								2	3		3
CO4	2									3		3

Course Content

1. Conversation Starters

roduction – Seeking Permissions – Asking for Directions – Making Requests – Offering Help – Expressing Thanks – Conveying Apologies – Starting a Conversation with a Stranger – Practice.

2. Functional Conversations

roducing Self – Introducing Others – Starting a Group Introduction – Icebreaker Introduction – Introducing a Formal Setting – Practice Exercises.

3. Grammar

Verbs – Tenses – Sentence Structures – Spotting the Errors.

4. Just A Minute

roduction – Significance – Fluency – Coherence – Avoiding Errors – Communication Skills – Confidence – Practice.

5. Vocabulary

Idioms – Phrases – Significance – Meanings – Usage – Practice.

6. Elocution

finition – Importance – Key Components – Voice Modulation – Articulation – Posture and Gestures – Practice.

7. Extempore

roduction – Significance – Developing Quick Thinking – Communication Skills – Confidence – Practice.

8. Debate

	roduction – Understanding the Structure – Purpose of a Debate – Developing Basic Debating skills – Do's and Don'ts – Practice. **9. Versant Test** verview of the Versant Test – Purpose and Importance – Format of the Test – Types of Questions – Practice. **10. Story Telling** Know Your Audience – Choose a Story – Set the Scene – Introduce the Characters – Build Suspense – Describe the Conflict – Show the Resolution – Share the moral/message – Use Vivid Language – Practice Delivery – Invite Reflection/Discussion – Follow Up.
Text books and Reference books	**Text Book(s):** [1] English for Professionals Lab Manual **Reference Books** [1] Wren & Martin. *English Grammar and Composition.* S.Chand & Company, 2023. [2] Dale Carnegie. *The Quick and Easy way to Effective Speaking.* Rupa Publications, 2016. [3] Richard A. Spears. *McGraw-Hill's Dictionary of American Idioms and Phrasal Verbs*. McGraw Hill, 2005. [4] Kamalesh Sadanand. *A Spoken English*. VOL 1&2, Orient BlackSwan, Second Edition, 2014.
E-resources and other digital material	[1] https://www.pearson.com/languages/hr-professionals/versant.htmlSoftx [2] https://www.ted.com/talks [3] https://shortstoryproject.com/

23MC3107 – ENVIRONMENTAL SCIENCE

Course Category:	Audit Course	**Credits:**	-
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	2-0-0
Prerequisites:	-	**Continuous Evaluation:**	100
		Semester end Evaluation:	-
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Identify various factors causing degradation of natural resource and Control Measures
	CO2	Identify various ecosystem and need for biodiversity
	CO3	Realize and explore the problems related to environmental pollution and its management
	CO4	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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1							1					1	
CO2		1	1							1			1	
CO3				1	1							1	1	
CO4						1	1	1					1	

Course Content

UNIT I:

The 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.

(a)Forest resources: Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forests and tribal people.

(b)Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

(c)Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.

(d)Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

(e)Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.

(f)Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT II:

Ecosystems

Concept of 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. Biogeographically classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.
	UNIT III: **Environmental Pollution** Definition, Causes, 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. **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. **Environmental ethics** Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland 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 environmental legislation. **Public awareness** Human Population and the Environment, Population growth, variation among nations, Population explosion—Family Welfare Programme. **Environment and human health** Human rights, Value education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in environment and human health. **Field Work/ Case Studies** 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, birds. Study of simple ecosystems—pond, river, hill slopes, etc.
Text books and Reference books	**Text Book(s):** [1].ErachBharucha. 2004, Environmental Studies for undergraduate courses, University Grants Commission, New Delhi, Bharati Vidyapeeth Institute of Environment Education and Research. **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 GopalaRao, 2006, Prentice-Hall of India Pvt. Ltd., New Delhi. [5] Ecological and Environmental Studies – Santosh Kumar Garg, Rajeswari Garg (or) RajaniGarg, 2006, Khanna Publishers, New Delhi. [6] Essentials of Environmental Studies, Kurian Joseph & R Nagendran, Pearson Education publishers, 2005. [7] A.K Dee – Environmental Chemistry, New Age India Publications.BharuchaErach- Biodiversity of India, Mapin Publishing Pvt.Ltd..
E-resources and other digital material	[1]. ErachBharucha. 2004, Environmental Studies for undergraduate courses, University Grants Commission, New Delhi, BharatiVidyapeeth 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 AhilyaViswavidyalaya, Indore.

23IT4651– PYTHON WITH DJANGO

Course Category:	Skill Enhancement Course	**Credits:**	2
Course Type:	Learning by doing	**Lecture-Tutorial-Practice:**	0-1-2
Prerequisites:	23IT3651: Python Programming Lab	**Continuous Evaluation:**	-
		Semester end Evaluation:	-
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Develop python programs on control flow statements and strings.
	CO2	Design solutions to a variety of problems using python built-in Data Structures.
	CO3	Apply object-oriented concepts, error handing mechanisms in python.
	CO4	Analyze and visualize using NumPy, Pandas and Matplotlib in python.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2			2	2				1	1	2			
CO2	2	1			2				1	1	2			
CO3	2	2		1	2				1	1	2			
CO4	3	3		3	3				3	2	2	3		

Course Content

UNIT I:

Python libraries for web development :

Collections-Container datatypes, Tkinter-GUI applications, Requests-HTTP requests, BeautifulSoup4-web scraping, Scrapy, Zappa, Dash, CherryPy, Turbo Gears, Flask, Web2Py, Bottle, Falcon, Cubic Web, Quixote, Pyramid.

UNIT II:

Introduction to Django Framework

Understanding Django environment, Features of Django and Django architecture, MVC and MTV, Urls and Views, Mapping the views to URLs, Django Template, Template inheritance Django Models, Creating model for site, Converting the model into a table, Fields in Models, Integrating Bootstrap into Django, Creating tables, Creating grids, Creating carousels.

UNIT III:

Integrating Accounts & Authentication on Django

Introduction to Django Authentication System, Security Problem & Solution with Django Creating Registration Form using Django, Adding Email Field in Forms, Configuring email settings, Sending emails with Django, Adding Grid Layout On Registration Page, Adding Page Restrictions, Login Functionality Test and Logout.

Connecting SQLite with Django

Database Migrations, Fetch Data From Database, Displaying Data On Templates, Adding Condition On Data,Sending data from url to view, Sending data from view to template

UNIT IV:

Saving objects into database, Sorting objects, Filtering objects, Deleting objects, Difference between session and cookie, Creating sessions and cookies in Django.

Deploying Django Web Application on Cloud Creating a functional website in Django, Four Important Pillars to Deploy, registering on Heroku and GitHub, Push

	project from Local System to GitHub, working with Django Heroku,Working with Static Root, Handling WSGI with gunicorn, setting up Database & adding users.
Text books and Reference books	**Text Book(s):** [1]. Martin C.Brown, "Python: The Complete Reference Paper back", 4th Edition 2018, McGraw Hill Education. [2]. Reema Thareja, "Python Programming: Using Problem Solving Approach", 3rd Edition 2017,Oxford. [3]. Daniel Rubio, Apress, "Beginning Django Web Application Development and Deployment with Python", 2nd Edition 2017, Apress. **Reference Books:** [1]. Tom Aratyn, "Building Django 2.0 Web Applications: Create enterprise-grade, scalable Python web applications easily with Django 2.0", 2nd Edition 2018, Packt Publishing. [2]. Harry Percival, "Test-Driven Development with Python: Obey the Testing Goat: Using Django, Selenium and JavaScript",2nd Edition 2019, Kindle Edition.
E-resources and other digital material	[1]. https://www.browserstack.com/guide/top-python-web-development-frameworks [2]. https://developer.mozilla.org/en-us/docs/learn/server-side/django/introduction [3]. https://www.classcentral.com/course/youtube-django-authentication-user-management-full-tutorial-117030 [4]. https://www.youtube.com/watch?v=uipsnre6uwe

23ES4152-DESIGN THINKING & INNOVATION

Course Category:	Engineering Science	**Credits:**	2
Course Type:	Learning by doing	**Lecture-Tutorial-Practice:**	1-0-2
Prerequisites:	-	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Describe the fundamental concepts of Design Thinking and Innovation.
	CO2	Apply the design thinking techniques for solving problems in various sectors.
	CO3	Analyze the concepts of design thinking to work in a multidisciplinary environment.
	CO4	Evaluate the value of creativity with design thinking concepts.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2			2	2				1	1	2			
CO2	2	1			2				1	1	2			
CO3	2	2		1	2				1	1	2			
CO4	3	3		3	3				3	2	2	3		

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.

UNIT II:

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 III:

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 IV: Product Design

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. **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.
Text books and Reference books	**Text Book(s):** 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 material	• https://nptel.ac.in/courses/110/106/110106124/ • https://nptel.ac.in/courses/109/104/109104109/ • https://swayam.gov.in/nd1_noc19_mg60/preview • https://onlinecourses.nptel.ac.in/noc22_de16/preview

23IT4353 - OPERATING SYSTEMS & SOFTWARE ENGINEERING LAB

Course Category:	Professional core	**Credits:**	1.5
Course Type:	Lab	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	Data Structures Programming language	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Practice Unix Commands for creating and operating data in files and directories
	CO2	Illustrate semaphore based solution to Synchronization problems
	CO3	Implement Memory management methods
	CO4	Demonstrate different CPU Scheduling and Page Replacement algorithms for a given reference string
	CO5	Apply Object Oriented Analysis and Design concepts and various UML diagrams to real time applications.
	CO6	Generate UML diagrams illustrating both the static and dynamic components of software, and utilize these diagrams to develop projects.

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	1	1											1	1
CO2	1	3											2	1
CO3	1	3											2	1
CO4	3	2											2	1
CO5														
CO6														

Course Content

OPERATING SYSTEMS

Week 1: Practicing of Basic UNIX Commands. Write programs using the following UNIX operating system calls
fork, exec, getpid, exit, wait, close, stat

Week 2: Simulate UNIX commands like opendir and readdir cp, ls, grep, etc.,

Week 3: Simulate the following CPU scheduling algorithms
a) FCFS b) SJF c) Priority d) Round Robin

.

Week 4: Write a program to solve producer-consumer problem using Semaphores.

Week 5: Implement the following memory allocation methods for fixed partition a) First fit b) Worst fit c) Best fit

Week 6: Simulate the following page replacement algorithms
a) FIFO b) LRU c) LFU

SOFTWARE ENGINEERING

Week 7: Demonstrate fundamentals of DFD and building blocks of UML.

Week 8: Develop Structural diagrams for modeling complex systems.

	Week 9: Develop Behavioural diagrams for modeling complex systems. **Week 10:** Describe SRS and test cases for any real time application. a) Online Library Management System b) Online Banking System, etc… **Week 11:** Implement white box and black box testing methods for real-time applications.
Text books and Reference books	**Text Book(s):** [1]. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, "Operating System Concepts", 9th ed, John Wiley &Sons (Asia) Pvt. Ltd, 2018. [2]. Yashavant Kanetkar, "Unix Shell Programming", 1st ed, BPB Publications, 2003. [3]. I. Somerville "Software Engineering" 6 edition:Pearson Education. [4]. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Language user guide", Tenth Edition, Pearson, 2011. **Reference Books:** [1]. RajibMall,"Fundamentals of Software Engineering",Second Edition PHI.
E-resources and other digital material	[1]. Prof. Chester Rebeiro Department of CSE,IITM "Introduction to Operating Systems" [NPTEL] dated 08th Sep 2016 https://nptel.ac.in/courses/106/106/106106144/ [2]. Software engineering NPTEL. Available: http://nptel.iitm.ac.in/video.php?courseId=1076

23IT4354– DATABASE MANAGEMENT SYSTEMS LAB

Course Category:	**Laboratory**	**Credits:**	1.5
Course Type:	**Program Core**	**Lecture-Tutorial-Practice:**	0-0-3
Prerequisites:	**Data Structures Lab**	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes

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

CO1	Execute advanced queries such as relational constraints, operators, joins, set operations, aggregate functions, views in SQL. Apply SQL commands to create relational databases and extract information to satisfy business reporting requests
CO2	Design, create and implement relational database systems for real time applications
CO3	Use various software's to design and build ER diagrams for related database systems.
CO4	Develop application programs using PL/SQL

Contribution of Course Outcomes towards achievement of Program Outcomes (L-Low, M-Medium, H- High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1		2	1							1	
CO2		2			2									2
CO3			2								2		2	
CO4												1	2	1

Course Content

Week 1:

a. Introduction to SQL, RDBMS.
b. Compare various RDBMS softwares
c. Different data types and its implementation
d. Implement Data Definition language
e. Apply Integrity Constraints , aliasing on relations

Week 2:

a. Implement Data Manipulation Language on Relational Model.
b. Implement queries using : Relational Operators, Logical Operators and Comparison operators

.

Week 3:

Implement queries using SQL functions :

a. Aggregate functions
b. String functions
c. Date/time functions
d. Mathematical functions
e. Sorting

Week 4:

Implement Nested Queries using operators

a. Set comparison operators

	b. Correlated sub queries c. Set operators **Week 5:** Combining tables and execution of queries : a. Implement advanced queries using joins and grouping (Group by, Having) b. Views creation and updation **Week 6:** a. Construct an ER-Diagram for the given information model by using appropriate tool. b. Convert entities and relationships to relation table for a given scenario **Week 7:** Implementation of security by assigning privileges to database users : DCL : Understand the implementation of Grant, Revoke and views TCL : Understand the implementation of Commit, Rollback and Savepoint **Week 8:** PL /SQL programming: Blocks, Operators and Control structures,cursors **Week 9:** PL /SQL programming: Triggers, Functions and Procedures **Week 10:** Case Study on a given application: Refine the schemas up to 4th normal form. (Mini Project). **Week 11:** Installing , Configuring and Execution of MongoDB NoSQL **Week 12:** Design and Develop MongoDB Queries using CRUD operations. (Use CRUD operations, SAVE method, logical operators)
Text books and Reference books	**Text Book(s):** [1]. Elmasri and Navathe. "Fundamentals of Database Systems", Ed 7. Pearson Education, 2016 [2]. Ian Robinson, Jim Webber, Emil Efriem, "Graph Databases", OReilly Media, 2015. **Reference Books** [1].Raghurama Krishnan, Johannes Gehrke, "Database Management Systems", 3rd Edition, TATA McGrawHill, 2008. [2].Silberschatz, Korth and Sudharshan. Data base System Concepts. Ed4. McGrawHill, 2009
E-resources and other digital material	[1]. Prof Richard Holowczak, Professor, Baruch College, The Normalization, Feb 2023 https://www.youtube.com/watch?v=GvxBqzWeGz0 [2]. Prof PP Das,IIIKharagpur, DBMS. Dec 7, 2017 https://www.youtube.com/watch?v=IoL9Ve2SRwQ&list=PLIwC9bZ0rmjSkm1VRJROX4vP2YMIf4Ebh [3]. Jennifer widom,(09,05,2018). Introduction to Databases https://www.youtube.com/watch?v=ShjrtAQmIVg [4]. P. B. Mahanty,(09,05,2015). DBMS and RDBMS. http://nptel.iitm.ac.in/video.php?courseId=1128&v=7952RsbAx2w8

SEMESTER V

23IT5301 - ADVANCED JAVA

Course Category:	Program core	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-1-0
Prerequisites:	Java Programming	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand features of Spring Boot, Spring Framework and process involved to connect to Java Database Connectivity
	CO2	Apply concepts of Servlets to develop server side applications
	CO3	Design web applications connecting to JPA with Spring MVC and Spring Boot
	CO4	Develop Spring Boot Applications using Spring Boot Annotations

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

	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1													1	1
CO2	2				2								1	
CO3			3		2								2	
CO4			3		2								2	

Course Content	**UNIT I:** **JDBC**: The concept of JDBC, JDBC Driver Types, JDBC Packages, A Brief Overview Of The JDBC Process, Database Connection, Associating The JDBC/ODBC bridge with the Database, **Statement objects**-Statement, Prepared Statement and Callable Statement, ResultSet.
	UNIT II: **Java Servlets :** Java Servlets and common gateway interface programming, benefits of using a java servlets, simple java servlet, anatomy of a java servlet, deployment descriptor, reading data from a client, sending data to a client, working the cookies, tracking sessions.
	UNIT III: **Getting started with Spring Boot:** Structure, objectives, introduction, features, advantages of Spring Boot, Breaking the monolithic way of developing software, system requirements, setting up of the environment, the 12-factor app, Spring initializer **Developing Spring Boot Application**: Starting with Spring initializer, Build tools, building an application using Maven, understanding the entry point class and Spring Boot Application annotation.
	UNIT IV: **Spring Boot Annotations**: Java Annotations, existence of spring annotations, Spring and Spring Boot annotations, Stereotype annotations, Spring Boot Annotations **Working with Spring Data JPA**: Accessing relational data using Jdbc Template and Spring data JPA in memory database, Spring data JPA with MySQL, Query methods in Spring data JPA
	Case Study: Deploy Web application into a server using Servelt/Spring framework

Text books and Reference books	**Text Book(s):** [1]. James Keogh, "J2Ee: The Complete Reference", 1st Edition, Mcgraw Hill Education, 2002 [2]. Shagun Bakliwal, Hands-on Application Development using Spring Boot, BPB Publications, First Edition, 2022 **Reference Book(s):** [1]. Craig Walls, Spring in Action, Sixth Edition, MEAP Edition, Manning Early Access Program, Version 4, 2021 [2]. Mark Heckler, Spring Boot: Up and Running, O'Reilly Media,2021
E-resources and other digital material	[1]. Ranga Karanam, Java Servlets and JSP - Build Java EE(JEE) app in 25 Steps, 04-06-2022 Available: https://www.udemy.com/course/learn-java-servlets-and-jsp-web-application-in-25-steps/ [2]. Spring-Official documentation, 04-06-2022 Available: https://spring.io/projects/spring-boot [3]. Advanced Java Programming by Infinite Skills, 04-06-2022 Available: https://www.udemy.com/advanced-java-programming/ [4]. Derek Parsons , Spring MVC, Spring Boot and Rest Controllers, Available: 04-06-2022, LearnQuest, https://www.coursera.org/learn/spring-mvc-rest-controller [5]. Ranga Karanam, Spring Framework Master Class - Java Spring the Modern Way, Available: 04-06-2022 https://www.udemy.com/course/spring-tutorial-for-beginners/

23IT5302-COMPUTER NETWORKS

Course Category:	Programme core	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-0-2
Prerequisites:	---	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Illustrate network architectures, protocols, and OSI/TCP-IP reference models
	CO2	Analyze error control, framing, and flow control mechanisms in data link layer protocols.
	CO3	Apply routing algorithms and addressing schemes in network layer including IPv4/IPv6.
	CO4	Compare transport and application layer protocols and evaluate their performance

Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, Medium-2, 3- High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2
	CO1		2											1
	CO2	2		2	2								2	1
	CO3		3			2							2	
	CO4	2	2	2	2	1				2				1

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:** simplex protocol, Simplex stop and wait, Simplex protocol for Noisy Channel.

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

Internetworking: The network layer in the internet – IP protocols-IP Version 4 protocol-IPV4 Header Format, IP Addresses, Class full Addressing, CIDR, Subnets-IP Version 6

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

Presentation, Session, Application Layer – World Wide Web: HTTP, Electronic mail-Architecture- web based mail- email security- TELENET-local versus remote Logging-

	Domain Name System.
Text books and Reference books	**Text Book(s):** [1]. A. S. Tanenbaum, "Computer Networks", 5th Edition, Pearson Education / PHI, 2013 [2]. Behrouz A. Forouzan, "Data Communications and Networks", Fifth Edition TMH,2013 **Reference Books:** [1]. Data Communications and Networks- Achut S Godbole, AtulKahate [2]. Computer Networks, Mayank Dave, Cengage
E-resources and other digital material	[1] Prof. Hari Balakrishnan, Fujitsu Professor of Electrical Engineering and Computer Science at the Massachusetts Institute of Technology (MIT), Introduction to Networking[MIT- Open Course Ware], Available: http://ocw.mit.edu/ [2] Prof. Robert Morris and Prof. Samuel Madden MIT.2014 https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-033-computer-system-engineering-spring-2009/video-lectures/ [3] Prof.SOUMYA K GHOSH, Prof. SANDIP CHAKRABORTY, Department of Computer Science & Engineering , IIT Kharagpur , NPTEL, "Computer Networks and Internet protocol" , July 2018 https://nptel.ac.in/courses/106105183/ [4] Prof.A. Pal, Department of Computer Science Engineering,IIT Kharagpur. On 2018 NPTEL http://nptel.iitm.ac.in [5] Jason Dion, "An in-depth look at Layer 3 of the OSI Model (Network Layer) and examples" , December 2021 https://www.udemy.com/tutorial/networkplus/layer-3-network-layer/ [6] Keith Winstein Congestion-Control Contest,2017 https://web.stanford.edu/class/cs344g/contest.html

23IT5303 - AUTOMATA THEORY & COMPILER DESIGN

Course Category:	Professional Core	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Construct finite state machines, Context Free Grammars, regular expressions and Push down Automata for modelling and solving computation problems.
	CO2	Convert DFA to NFA. NFA to DFA, regular expressions to finite automata, DFA to regular expressions.
	CO3	Develop parsers for programming languages using different parsing techniques (top-down, bottom-up).
	CO4	Analyze various phases of a compiler and code optimization techniques to improve the space and time complexity of programs

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	PSO1	PSO2
CO1	2		3	2								2	2
CO2	1		3	2								2	1
CO3	2		2	1								1	
CO4	2		2	1								1	1

Course Content

UNIT I:

Finite Automata: Deterministic Finite Automata-Definition of DFA, How a DFA processes strings, Simpler Notations for DFA's, Extending the Transition Function to Strings, The Language of DFA, Nondeterministic Finite Automata – Definition of NFA, Extended Transition Function, Language of NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Finite automata with Epsilon –Transitions – Uses of €-Translations, Formal notation for an €-NFA, Epsilon-Closures, Extended Transitions and Languages for €-NFA's, Eliminating €-Transitions.

Regular Expressions and Languages: Regular expressions – Operators of Regular Expressions, Building Regular Expressions, Finite Automata and Regular Expressions - Converting DFA's to Regular expressions by eliminating states, Converting regular expressions to automata.

UNIT II:

Context Free Grammars and Push Down Automata:

Context Free Grammars (CFG), Derivations using a Grammar, Leftmost and Rightmost Derivations, Language of a Grammar, Parse Trees, Ambiguity in Grammars and Languages.

Push Down Automata (PDA), Definition, The Language of a PDA, Equivalence of PDAs and CFGs.

UNIT III:

Introduction: Structure of a compiler

Lexical Analysis – Role of Lexical Analyzer, Input Buffering, Specification of tokens, Recognition of tokens, The Lexical Analyser Generator –LEX

Syntax Analysis : Introduction - Role of a parser, Context Free Grammars – definition of CFG, Derivations, Parse Trees and Derivations, Ambiguity, Top Down Parsing-

	Recursive-Descent Parsing, FIRST and FOLLOW, LL(1) Grammars, Nonrecursive Predictive Parsing, Bottom Up Parsing – Reductions, Handle Pruning, Shift Reduce Parsing, Introduction to LR Parsing – Why LR Parsers, Items and the LR(0)Automaton, LR-Parsing Algorithm, Construction of SLR-Parsing Tables, More Powerful LR Parsers- Canonical LR(1) Items, Constructing LR(1) Sets of Items, Canonical LR(1) Parsing Tables, Constructing LALR Parsing Tables
	UNIT IV: **Intermediate Code Generation** : Variants of Syntax Trees, Three Address Code, Type Checking- Rules for Type Checking, Type Conversions **Code generation:** Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Simple code Generator, Peephole Optimization
Text books and Reference books	**Text Book(s):** [1] John E..Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, " Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education, 2011 [2] Alfred V.Aho, Monica S. Lam, Ravi Sethi, Jeffrey D.Ullman, "Compilers Principles, Techniques and Tools", Pearson Education, Second Edition, 2016. **Reference Books:** [1]. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing. [2]. Lewis H.P. & Papadimitriou C.H , "Elements of Theory of Computation", Second edition, Pearson /PHI. [3]. K.L.P.Mishra and N. Chandrashekaran, "Theory of computation" , 2ndedition, PHI
E-resources and other digital material	[1]. Prof.Kamala Krithivasan, IIT, Madras, "Theory of Automata, Formal Languages and Computation" , 2021, https://nptel.ac.in/courses/106106049/http://dev.tutorialsPInt.com/automata_theory/index.htm [2]. Neso Academy, "Introduction to Theory of Computation", Dec 2016. https://www.youtube.com/watch?v=58N2N7zJGrQhttp://www.nptelvideos.in/2012/11/theory-of-computation.html [3]. Prof. SouravMukhopadhyay, Department of Mathematics, IIT, Kharagpur, ntroduction to Automata, Languages and Computation, NPTEL, 2021. https://nptel.ac.in/courses/106105196 [4]. Compiler design, learning material https://www.tutorialsPInt.com/compiler_design/compiler_design_useful_resources.htm [5]. Prof. Michael Sipser, Introduction, Finite Automata, Regular Expressions, MIT open courseware, 2021 https://ocw.mit.edu/courses/18-404j-theory-of-computation-fall-2020/resources/introduction-finite-automata-regular-expressions/ **[6]. NPTEL course by Prof. Santanu Chattopadhyay, 2021** https://onlinecourses.nptel.ac.in/noc21_cs07/preview

23IT5404A - OBJECT ORIENTED ANALYSIS AND DESIGN

Course Category:	Professional Elective-I	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Basic Knowledge of Programming & Data Structure	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the structure and inherent complexity of software systems.
	CO2	Apply object-oriented principles and UML modelling to represent software systems.
	CO3	Analyse and model advanced structural elements in software architecture.
	CO4	Develop behavioural and architectural models using UML for real-time and web-based systems.

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	PSO 1	PSO 2
CO1												2	1
CO2	1	2	3	2								1	1
CO3	1	2	3	2								1	3
CO4		3	2									3	2

Course Content

UNIT I:

Introduction: The Structure of Complex systems, The Inherent Complexity of Software, Attributes of Complex System, Organized and Disorganized Complexity, Bringing Order to Chaos, Designing Complex Systems. **Case Study:** System Architecture: Satellite-Based Navigation.

UNIT II:

Introduction to UML: Importance of modeling, principles of modeling, object oriented modeling, conceptual model of the UML, Architecture, and Software Development Life Cycle. **Basic Structural Modeling:** Classes, Relationships, common Mechanisms, and diagrams. **Case Study:** Control System: Traffic Management.

UNIT III:

Class & Object Diagrams: Terms, concepts, modeling techniques for Class & Object Diagrams. **Advanced Structural Modeling:** Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages. **Case Study:** AI: Cryptanalysis.

UNIT IV:

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

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.
Text books and Reference books	**Text Book(s):** [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, 2013, Pearson. [2]. Grady Booch, James Rumbaugh, Ivar Jacobson: The Unified Modeling Language User Guide, Pearson Education, 1999. **Reference Books:** [1]. Meilir Page-Jones: Fundamentals of Object Oriented Design in UML, Pearson Education, 1999. [2]. Pascal Roques: Modeling Software Systems Using UML2, WILEY- Dreamtech India Pvt. Ltd, 2009. [3]. Atul Kahate: Object Oriented Analysis & Design, The McGraw-Hill Companies, 2004. [4]. Appling UML and Patterns: An introduction to Object – Oriented Analysis and Design and Unified Process, Craig Larman, Pearson Education, 2004.
E-resources and other digital material	[1] Object Management Group (OMG): http://www.omg.org/. This is the official Site for UML. [2]. Prof. Rajib Mall, IIT Kharagpur, Object Oriented System Development Using UML, Java, and Patterens. https://onlinecourses.nptel.ac.in/noc25_cs52/unit?unit=166&lesson=167 [3].https://www.tutorialspoint.com/object_oriented_analysis_design/ooad_useful_resources.htm [4]. Object-Oriented Analysis and Design: Foundations & Concepts, University of Colorado Boulder, https://www.coursera.org/learn/object-oriented-analysis-and-design-foundations-and-concepts/home/module/1

23IT5404B – CYBER SECURITY

Course Category:	Professional Elective - I	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Identify and classify various cyber threats, vulnerabilities, and attacks affecting modern digital infrastructures
	CO2	Analyze techniques to prevent data leakage and enforce security policies using appropriate frameworks.
	CO3	Configure, manage, and analyze system and network event logs to detect security incidents
	CO4	Evaluate security assessments on web applications and manage network security incidents

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	PSO 1	PSO 2
CO1		2							1				1
CO2	1					3					1	2	
CO3			1					1				1	
CO4					3					2			3

Course Content

UNIT I: Information Security and Threats

Introduction – Information Security, Information Assets & Threats - Threats to Information Assets, Types of Attacks, Types of Virus, Types of Worms, Types of Trojans, Network Attacks, Common Vulnerabilities and Exposures (CVE).

Fundamentals of Information Security: Elements of information security – Network Security, Application Security, Communications Security. Principles and concepts – data security – Critical Information Characteristics, Information States, Prevention Vs Detection, Types of controls – Access Control Models.

UNIT II: Data Leakage and Prevention

Introduction to Data Leakage, Organisational Data Classification, Location and Pathways, Content Awareness, Content Analysis Techniques, Data Protection

Information Security Policies, Procedures, Standards and Guidelines: Information Security Policies, Key Elements of a Security Policy.

Network Sniffers and Injectors – Tcpdump and Windump, Wireshark, Ettercap, Hping, Kismet

UNIT III:

Event Logs - Concepts, Log Management and its need, Log Management Process, Configuring Windows Event Log, IIS Log Files, Log Analysis and Response.

Data Backup : Data Backup -Overview, Types of Backup, Backup Procedures., Types of Storage

UNIT IV:

Web Application Hacking : Scanning for web vulnerabilities : Nikto, , HTTP utilities - Curl, OpenSSL,Stunnel, Application Inspection – Zed Attack Proxy, Sqlmap

Handling Network Security Incidents : Network Reconnaissance Incidents , Denial of

	Service Incidents, Unauthorized Access Incidents, Inappropriate usage incident, Multiple component incident
Text books and Reference books	**Text Book(s):** [1]. Student Handbook – Security Analyst, NASSCOM [2]. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication Mc Graw Hill **Reference Books:** [1]. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and Sunit Belpure, Publication Wiley [2]. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009. [3]. Robert M Slade," Software Forensics", Tata McGraw - Hill, New Delhi, 2005 [4]. Kevin Mandia, Chris Prosise, Matt Pepe, "Incident Response and Computer Forensics ", Tata McGraw -Hill, New Delhi, 2006. [5]. McClure, Stuart, Saumil Shah, and Shreeraj Shah. Web Hacking:attacks and defense. Addison Wesley. 2003.
E-resources and other digital material	[1] Dr. Eric Cole, Cybersecurity Expert and Founder of Secure Anchor, *Introduction to Cybersecurity*, Cybrary Online Learning Platform, 2023, May 10 URL: https://www.cybrary.it/course/introduction-to-it-and-cybersecurity [2] Prof. Dan Boneh, Professor of Computer Science at Stanford University, *Computer and Network Security*, Stanford Online / Coursera, 2022, September 15 URL: https://www.coursera.org/learn/computer-network-security [3] Brian Krebs, Investigative Cybersecurity Journalist, *Cybersecurity Basics and Best Practices*, Krebs on Security Blog, 2024, March 20 URL: https://krebsonsecurity.com/2024/03/cybersecurity-basics-and-best-practices **[4]** Prof. K. S. Easwarakumar, Professor, Department of Computer Science and Engineering, Anna University, *Introduction to Information Security – NPTEL Course*, NPTEL (National Programme on Technology Enhanced Learning), 2021, August 2 URL: https://nptel.ac.in/courses/106105031 **[5]** Indian Computer Emergency Response Team (CERT-In), *Best Practices for Cyber Security*, CERT-In Web Portal, Ministry of Electronics and Information Technology, Govt. of India, 2023, December 10 URL: https://www.cert-in.org.in

23IT5404C - ARTIFICIAL INTELLIGENCE

Course Category:	Professional Elective - I	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes

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

CO1	Apply uninformed and informed search strategies such as BFS, DFS, and A to solve AI problems, and analyse how different environment types affect intelligent agent design
CO2	Analyze adversarial search strategies and evaluate optimal decisions in games using techniques like Minimax, Alpha-Beta Pruning, and evaluation functions.
CO3	Evaluate problem formulations and select suitable search strategies based on problem characteristics.
CO4	Model a simple expert system; explain how knowledge is acquired and used in real time scenarios

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	2	1	3										2	1
CO2	1	2	3	2									1	1
CO3	1	2	3	2									1	3
CO4		3	2										3	2

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, problem formulation.

Searching: Searching for solutions, uniformed search strategies – Breadth first search, depth first search. Searching with Partial Information

UNIT II:

Informed (Heuristic) Search Strategies: Greedy best first search, A* search, Memory bounded heuristic search, Heuristic functions, Game Playing- Adversial search, Games, Optimal Decisions in Games, Optimal strategies, mini-max algorithm, optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions.

UNIT III:

Knowledge representation: Knowledge representation issues, using Predicate Logic, semantic nets- frames and inheritance, Constraint Propagation, representing knowledge using rules, rules based deduction systems. Reasoning under uncertainty, review of probability, Bayes' probabilistic interferences and Dempster-Shafer theory.

UNIT IV:

Logic concepts: First order logic. Inference in first order logic, propositional vs. first order inference, unification & lifts forward chaining, Backward chaining, Resolution, Learning from observation Inductive learning, Decision trees.

Expert Systems: Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition, Typical expert systems – MYCIN, DART (Case

	Study Examples), XCON: Expert systems shells.
Text books and Reference books	**Text Book(s):** [2]. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", SecondEdition, Pearson Education. [3]. Kevin Knight, Elaine Rich, Shivashankar B. Nair., "ARTIFICIAL INTELLIGENCE Third Edition", Mc Graw Hill **Reference Books:** [3]. David Poole, Alan Mackworth, Randy Goebel,"Computational Intelligence: a logical approach", Oxford University Press. [4]. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problemsolving", Fourth Edition, Pearson Education. [5]. J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers. [6]. Artificial Intelligence, SarojKaushik, CENGAGE Learning.
E-resources and other digital material	[5] https://ai.google/ [6] https://swayam.gov.in/nd1_noc19_me71/preview [7] https://www.youtube.com/watch?v=pKeVMlkFpRc&list=PLwdnzlV3ogoXaceHrrFVZCJKbm_laSHcH [8] https://www.youtube.com/watch?v=TjZBTDzGeGg&list=PLUl4u3cNGP63gFHB6xb-kVBiQHYe_4hSi [9] https://www.youtube.com/watch?v=Yq0QkCxoTHM

23IT5404D - MICROPROCESSORS & MICROCONTROLLERS

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Digital Logic and Computer Organization	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the **main features, pin diagram and architecture** of the 8086 microprocessor
	CO2	Develop assembly language programs using 8086 and 8051 instructions, addressing modes and directives.
	CO3	Design and develop applications using **software and hardware interrupts for interfacing memory, stepper motor, Keyboard, LCD, I/O** with 8086 and 8051
	CO4	Compare the microprocessor, microcontroller, PIC, and ARM processors in terms of architecture, performance, and applications

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	2		1	1									1	1
CO2	1		2										1	1
CO3	2		2	1									1	
CO4			2										1	2

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 configuration..

UNIT II:

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

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:

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

UNIT IV:

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 and Reference books	**Text Book(s):** [1] Douglas V Hall, SSSP Rao, "Microprocessors and Interfacing – Programming and Hardware", 3rd Edition Tata McGraw Hill Education Private Limited,1994. [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 material	[1] Prof. Santanu Chattopadhyay (IIT Kharagpur) [NPTEL], (April 2025) Available: https://nptel.ac.in/courses/108105102 [2] Charles Leiserson, "ASSEMBLY LANGUAGE & COMPUTER ARCHITECTURE" Sep 23, 2019 https://www.youtube.com/watch?v=l1ung0wil9y [3] https://onlinecourses.nptel.ac.in/noc22_ee12/preview

23IT5404E- DATA WAREHOUSING AND DATA MINING

Course Category:	Programme Elective-I	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	Probability & Statistics	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Outline the basic concepts of Warehousing and Mining.
	CO2	Derive interesting patterns and associations in datasets.
	CO3	Design classifier models to predict future trends.
	CO4	Apply unsupervised learning techniques for a given application.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11		PSO1	PSO2
CO1	1			1	2									
CO2	1	2	3	1	3								2	1
CO3	2	3	3	1	3								3	2
CO4	2	2	3	1	3								3	1

Course Content

UNIT I:

Data Warehousing and Online Analytical Processing: Basic concepts, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation.

Data Mining Introduction: Data Mining, Technologies, Applications, Major issues.

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

UNIT II: Data Preprocessing and Association Analysis

Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Transformation and Data Discretization.

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.

UNIT III: 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,

Bayesian Classification Methods: Bayes Theorem, Naïve Bayes Classification, Model Evaluation and Selection.

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, Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses.

Text books and Reference books

Text Book(s):

[1]. Data Mining concepts and Techniques, 3rd edition, Jiawei Han, Michel Kamber, Elsevier, 2011.

[2]. Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Pearson, 2012.

	Reference Books: [1] Data Mining: VikramPudi and P. Radha Krishna, Oxford Publisher. [2] Data Mining Techniques, Arun K Pujari, 3rd edition, Universities Press,2013.
E-resources and other digital material	[1] (NPTEL course by Prof.PabitraMitra) http://onlinecourses.nptel.ac.in/noc17_mg24/preview [2] http://www.saedsayad.com/data_mining_map.htm [3] Jiawei Han, John C. Hart, ChengXiang Zhai, Department of Computer Science, University of Illinois, https://www.coursera.org/specializations/data-mining

23IT5205A – INTRODUCTION TO DATASTRUCTURES

Course Category:	Inter Disciplinary Elective	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:	20ES1103 : Programming for Problem Solving	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes

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

CO1	Apply linear data structures to solve different applications.
CO2	Develop algorithms to solve a given problem using appropriate data structure.
CO3	Implement operations on binary trees, binary search trees and sorting.
CO4	Solve problems using algorithm design methods such as the divide and conquer, greedy method and dynamic programming.

Contribution of Course Outcomes towards achievement of Program Outcomes (L-Low, M-Medium, H-High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	2										2	1
CO 2	1											1	
CO 3		1									1	2	2
CO 4				1					1		1		

Course Content

UNIT I

Introduction: Basic Terminology, Classification of Data Structures, Operations on Data Structures, Abstract Data Type, Algorithms, Different Approaches to Designing an Algorithm, Control Structures Used in Algorithms, Time and Space Complexity.

Searching: Linear Search and Binary Search Techniques

Stacks: Introduction to Stacks, Array Representation of Stacks, Operations on a Stack, Linked Representation of Stacks, Operations on a Linked Stack, Applications of Stacks- Evaluation of Arithmetic Expressions, Recursion.

UNIT II

Queues: Introduction to Queues, Array Representation of Queues, Linked Representation of Queue, Types of Queues-Circular Queues, Deques, Priority Queues, Multiple Queues, Applications of Queues

Linked list: Introduction, Singly linked lists-Traversing, Searching, Inserting, Deleting a Node from a linked list

Doubly linked list: Inserting and deleting a Node from a Doubly linked list.

UNIT III:

Trees–Introduction, Binary trees, Creating a Binary Tree from a General Tree, Traversing a Binary Tree

Efficient Binary Trees – Binary search tree, Operations on Binary Search Trees-Searching, Inserting and Deleting a node

Sorting: Bubble sort, Insertion sort, Selection sort, Merge sort and Quick sort

UNIT IV:

Divide and Conquer: General Method, Binary Search, Finding Minimum and Maximum

Greedy Algorithm: General Method, Knapsack Problem, Single-Source Shortest

	Paths **Dynamic Programming:** General Method, Multistage Graph, All Pairs Shortest Paths, The Traveling sales Person Problem
Text books and Reference books	**Text Book(s):** [1]. Reema Thareja ”Data structures using C” 2nd edition Oxford University press,2014 [2]. Ellis Horowitz, Sartaj Sahni,Sanguthevar Rajasekharan” Computer Algoithms”, Computer Science Press **Reference Books:** [1]. Thomas H Corman, E Leiserson, Ron Rivest, ”Introduction to Algorithms” , MIT Press, 2nd Edition, Jan 2001. [2]. Alfred V Aho, J D Ullman, J E Hopcroft, ”Data Structures and Algorithms” , Addison Wesley Longman, 1983. [3]. Mark Allen Weiss, ”Data Structures in C++”, Addison Wesley Longman, 2nd Edition, 1998. [4]. Horowitz E and Sahni S, “ Fundamentals of Computer Algorithms”, Computer Science Press, 1984.
E-resources and other digital material	[1]. SudarshanIyengar: IIT Ropar (12, August, 2018). Data Structures and Algorithms[NPTEL]. Available: http://nptel.ac.in/ [2]. Erik Demaine, (12, may, 2018). Advanced Data Structures [MIT-OpenCourseWare]. Available: http://ocw.mit.edu/ [3]. https://www.coursera.org/learn/data-structures [4]. https://www.coursera.org/specializations/data-structures-algorithms

23IT5205D - DATA VISUALIZATION

Course Category:	Open Elective	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Prerequisites:		**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Illustrate visualizations that represent the relationships contained in complex data sets and their interpretation.
	CO2	Analyze data to create visualization for a particular research application.
	CO3	Identify appropriate visualization chart to present and represent design solutions.
	CO4	Choose leading open source software packages to create and publish visualizations that enable clear interpretations of big, complex and real world data.

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	PSO1	PSO2
CO1	2	1	3								2	1	1
CO2	3	1	1								1	2	1
CO3		2										1	2
CO4	2		1		2							2	1

Course Content

UNIT I:

The Context of Data Visualization: Visualization as a discovery tool, The bedrock of visualization knowledge, Defining data visualization, Visualization skills for the masses, the data visualization methodology. Setting the Purpose and **Identifying Key Factors:** Establishing intent – the visualization's function, Establishing intent – the visualization's tone, Key factors surrounding a visualization project, The " eight hats" of data visualization design

UNIT II:

Conceiving and Reasoning Visualization Design Options: Data visualization design is all about choices, The visualization anatomy – data representation, The visualization anatomy – data presentation Taxonomy of Data Visualization Methods: Data visualization methods, Choosing the appropriate chart type, Assessing hierarchies and part-to-whole relationships

UNIT III:

Constructing and Evaluating Your Design Solution: For constructing visualizations, technology matters, The construction process, Approaching the finishing line, Post-launch evaluation. Case Studies on real-time applications.

UNIT IV:

An Introduction to Connecting to Data: An Introduction to Connecting to Data in Tableau, Shaping Data for Use with Tableau, Getting a Lay of the Land: Tableau Terminology, View the Underlying Data, View the Number of Records, Dimension Versus Measure, What Is a Measure? What Is a Dimension? Discrete Versus Continuous

Five Ways to Make a Bar Chart/An Introduction to Aggregation: Five Ways to Create a Bar Chart in Tableau An Introduction to Aggregation in Tableau, Line Graphs,

	Independent Axes, and Date Hierarchies, How to Make a Line Graph in Tableau, Independent Axes in Tableau, Date Hierarchies in Tableau, Marks Cards, Encoding, and Level of Detail, An Explanation of Level of Detail, An Introduction to Encoding, Label and Tooltip Marks Cards.
Text books and Reference books	**Text Book(s):** [1] Andy Kirk, ‖Data Visualization: a successful design process‖, Packt Publishing (26 December 2012) [2] Ryan Sleeper, Practical Tableau, O'Reilly Media, Inc. April 2018. **Reference Books:** [1].Chakrabarti, S,‖Mining the web: Discovering knowledge from hypertext data —,Morgan Kaufman Publishers, 2003. [2].Fry, Vi‖isualizing data, Sebastopo,O_Reily, 2007.
E-resources and other digital material	[1].Dr. GauravDixit,Department of Management Studies, Indian Institute of Technology, Roorkee: https://nptel.ac.in/courses/110107092/7,2017 [2].P Adam Marcus, and Eugene Wu. RES.6-009 How to Process, Analyze and Visualize Data. January IAP 2012. Massachusetts Institute of Technology: MIT Open Courseware, https://ocw.mit.edu.,2012 [3] Prof.ShankarNarasimhan,Ragunathan, Rengasamy,IIT Madras Data Visualization in R Basic graphics, https://nptel.ac.in/courses/106106179/11,2016 [4] Statistics and Visualization for Data Analysis and Inference, Dr. Ed Vul, Dr. Mike Frank, Massachusetts Institute of Technology, https://ocw.mit.edu/resources/res-9-0002-statistics-and-visualization-fordata- analysis-and-inference-january-iap-2009/, 2009.

23IT5351- ADVANCED JAVA LAB

<table>
<tr><td>Course Category:</td><td colspan="2">Program core</td><td colspan="2">Credits:</td><td>1.5</td></tr>
<tr><td>Course Type:</td><td colspan="2">Lab</td><td colspan="2">Lecture-Tutorial-Practice:</td><td>0-0-3</td></tr>
<tr><td rowspan="3">Prerequisites:</td><td colspan="2" rowspan="3">Java Programming Lab</td><td colspan="2">Continuous Evaluation:</td><td>30</td></tr>
<tr><td colspan="2">Semester end Evaluation:</td><td>70</td></tr>
<tr><td colspan="2">Total Marks:</td><td>100</td></tr>
<tr><td rowspan="7">Course Outcomes</td><td colspan="5">Upon successful completion of the course, the student will be able to:</td></tr>
<tr><td>CO1</td><td colspan="4">Understand the JDBC architecture and perform database operations using interfaces with transaction management.</td></tr>
<tr><td>CO2</td><td colspan="4">Apply servlet lifecycle concepts and request-response handling mechanisms, redirection, and session tracking techniques.</td></tr>
<tr><td>CO3</td><td colspan="4">Develop modular Spring Boot applications by understanding its architecture, structure, and the use of build tools like Maven.</td></tr>
<tr><td>CO4</td><td colspan="4">Demonstrate the use of core Spring Boot annotations and implement RESTful services with proper dependency injection and component management.</td></tr>
<tr><td>CO5</td><td colspan="4">Utilize Spring Data JPA to access and manipulate relational databases using both in-memory and MySQL backends</td></tr>
<tr><td>CO6</td><td colspan="4">Design and build full-stack transactional web applications by integrating Spring Boot, Spring Data JPA</td></tr>
<tr><td rowspan="8">Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3-High)</td><td></td><td>PO 1</td><td>PO 2</td><td>PO 3</td><td>PO 4</td><td>PO 5</td><td>PO 6</td><td>PO 7</td><td>PO 8</td><td>PO 9</td><td>PO 10</td><td>PO 11</td><td></td><td>PSO 1</td><td>PSO 2</td></tr>
<tr><td>CO1</td><td>3</td><td>2</td><td>3</td><td>2</td><td>2</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td></td><td>3</td><td>–</td></tr>
<tr><td>CO2</td><td>3</td><td>2</td><td>3</td><td>2</td><td>2</td><td>–</td><td>–</td><td>–</td><td>1</td><td>2</td><td>–</td><td></td><td>2</td><td>–</td></tr>
<tr><td>CO3</td><td>3</td><td>2</td><td>3</td><td>2</td><td>3</td><td>–</td><td>–</td><td>–</td><td>1</td><td>2</td><td>–</td><td></td><td>3</td><td>2</td></tr>
<tr><td>CO4</td><td>3</td><td>2</td><td>3</td><td>3</td><td>3</td><td>–</td><td>–</td><td>–</td><td>1</td><td>2</td><td>–</td><td></td><td>3</td><td>2</td></tr>
<tr><td>CO5</td><td>3</td><td>2</td><td>3</td><td>3</td><td>3</td><td>–</td><td>–</td><td>–</td><td>–</td><td>2</td><td>–</td><td></td><td>3</td><td>3</td></tr>
<tr><td>CO6</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>–</td><td>–</td><td>–</td><td>2</td><td>2</td><td>–</td><td></td><td>3</td><td>3</td></tr>
<tr><td>Course Content</td><td colspan="14">Week 1: Basic JDBC Programming
• Task 1: Install JDBC and create a basic connection to a MySQL database.
• Task 2: Write a simple JDBC program to insert and retrieve data using Statement interface.
Week 2: Prepared Statements and ResultSet Operations
• Task 1: Perform insert, update, delete operations using PreparedStatement.
• Task 2: Explore ResultSet navigation methods and retrieve data in tabular format.
Week 3: Advanced JDBC Concepts
• Task 1: Implement batch update using JDBC.
• Task 2: Create a CRUD application using JDBC with transaction management and RowSet.
Week 4: Servlet Basics and Configuration
• Task 1: Create a basic servlet and deploy using web.xml.
• Task 2: Demonstrate ServletContext and ServletConfig usage.
Week 5: Servlet Communication and Redirection
• Task 1: Use RequestDispatcher and sendRedirect() to forward/redirect</td></tr>
</table>

	requests. • **Task 2:** Pass and display attributes between servlets using setAttribute(). **Week 6: Session Management in Servlets** • **Task 1:** Track user session using Cookies and HttpSession. • **Task 2:** Demonstrate session tracking using Hidden Form Fields and URL rewriting. **Week 7: Spring Boot Fundamentals** • **Task 1:** Create a basic Spring Boot application using Spring Initializr. • **Task 2:** Understand and demonstrate the use of the main class with @SpringBootApplication. **Week 8: Project Structure and Build Tools** • **Task 1:** Create and manage a Spring Boot project using Maven. • **Task 2:** Add dependencies and explore the application.properties file. **Week 9: REST API with Spring Boot** • **Task 1:** Build a simple REST API with GET and POST endpoints. • **Task 2:** Test the API using Postman and handle basic request parameters. **Week 10: Annotations and Stereotypes** • **Task 1:** Demonstrate the use of stereotype annotations like @Component, @Service, @Repository. • **Task 2:** Use @Autowired and @Qualifier to inject dependencies. **Week 11: Spring Data JPA with In-Memory Database** • **Task 1:** Set up H2 in-memory DB with Spring Data JPA and create an entity. • **Task 2:** Create Repository interface and demonstrate basic CRUD using Spring Data JPA. **Week 12: Spring Data JPA with MySQL and Custom Queries** • **Task 1:** Integrate MySQL with Spring Boot and perform database operations. • **Task 2:** Write custom query methods using Spring Data JPA method naming conventions.
Text books and Reference books	Text Book(s): [1] H. Schildt, Java: The Complete Reference, 11th ed., McGraw-Hill Education, 2018. [2] M. Hall and L. Brown, Core Servlets and JavaServer Pages (Vol 1), 2nd ed., Prentice Hall, 2007. [3] C. Walls, Spring in Action, 5th ed., Manning Publications, 2018. [4] C. Bauer and G. King, Java Persistence with Hibernate, 2nd ed., Manning Publications, 2015. [5] Reference Books: [6] B. Basham, K. Sierra, and B. Bates, Head First Servlets and JSP, 2nd ed., O'Reilly Media, 2008. [7] S. K. Srivastava, Java Server Pages (JSP) for Beginners, 1st ed., BPB Publications, 2010. [8] M. Heckler, Spring Boot: Up and Running, 1st ed., O'Reilly Media, 2020. [9] W. Savitch, Java Programming and Problem Solving with Data Structures, 9th ed., Pearson, 2019.
E-resources and other digital material	[1] Udemy, Spring Framework for Beginners [Online]. Available: https://www.udemy.com/course/spring-framework-tutorial-for-beginners/. [Accessed: May 6, 2025]. [2] Udemy, JDBC and MySQL for Java Developers [Online]. Available: https://www.udemy.com/course/jdbc-and-mysql-for-java-developers/. [Accessed: May 6, 2025]. [3] Coursera, Java Programming and Software Engineering Fundamentals

[Online]. Available: https://www.coursera.org/specializations/java-programming. [Accessed: May 6, 2025].
[4] EdX, Java Web Development [Online]. Available: https://www.edx.org/learn/java-web-development. [Accessed: May 6, 2025].

23IT5352 - COMPUTER NETWORKS LAB

Course Category:	Laboratory	**Credits:**	1
Course Type:	Professional core	**Lecture-Tutorial-Practice:**	0-0-2
Prerequisites:		**Continuous Evaluation:**	30
		Semester End Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Simulate various network topologies and communication models using network simulation tools such as Cisco Packet Tracer and NS2.
	CO2	Implement data link layer mechanisms including framing, error detection, and flow control protocols.
	CO3	Develop and simulate network layer functionalities including routing algorithms, IP addressing, and packet forwarding in static and dynamic network environments.
	CO4	Analyze transport and application layer protocols using socket programming and traffic analysis tools like Wireshark.
	CO5	Apply troubleshooting techniques for diagnosing network issues and ensure secure data communication.

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	PSO 1	PSO 2
CO1	3		2									1	
CO2	3	3	2										2
CO3		2		2	2							2	
CO4	3	2	2	1					2				1
CO5	2			2								2	

Contents

Week 1 :
Simulate different network topologies (Star, Ring, Bus, Mesh) using simulation tools like Cisco Packet Tracer.

Implement data link layer framing techniques

Week 2:
Simulate error detection methods (CRC, checksum, parity bits).

Week 3:
Implement flow control mechanisms like Stop-and-Wait and Sliding Window Protocols.
Measure performance under different traffic conditions and buffer sizes

Week 4:
Implement and compare routing algorithms: Dijkstra's and Distance Vector
Use NS2 trace files to analyze convergence time, route selection, and packet loss.

Week 5:
Write a tcl script for simulating a LAN using NS2. (nodes : n1,n2,n3…, the delay, Bandwidth, Link layer type (LL), Interfacing queue (Queue-Drop Tail), MAC type, channel type etc

	Create subnet-based scenarios in NS2. Simulate packet forwarding using IP addressing **Week 6:** Simulate both TCP and UDP traffic in the same scenario Compare performance based on metrics like delay, packet loss, and throughput **Week 7 :** Simulate a simple client-server model (FTP/CBR) over TCP/UDP Write client-server applications using UDP and TCP sockets (e.g., chat or file transfer **Week 8:** Wireshark i. Packet Capture Using Wire shark ii. Starting Wire shark iii. Viewing Captured Traffic iv. Analysis and Statistics & Filters. **Week 9:** Simulate MANET using AODV or DSR protocols. **Week 10:** Real time projects, case studies
Text books and Reference books	**Text Book(s):** [1] A. S. Tanenbaum and D. J. Wetherall, Computer Networks, 5th Edition, Pearson Education, 2014. [2] Teerawat Issariyakul Ekram Hossain,"Introduction to Network Simulator NS2" Springer.2012 **Reference Books:** [1] Eitan Altman, Tania Jimenez, Jean Walrand, "NS Simulator for Beginners", Series Editor
E-resources and other digital material	[1]. Marc Greis, NS2 Tutorial, ISI.edu. [Online]. Available: https://www.isi.edu/nsnam/ns/tutorial/ [2]. Prof. A. Pal, Computer Networks, NPTEL, IIT Kharagpur. [Online]. Available: http://nptel.iitm.ac.in [3]. Jason Dion, Layer 3 of the OSI Model, Udemy, 2021. [Online]. Available: https://www.udemy.com/tutorial/networkplus/layer-3-network-layer/

23IT5653–FULL STACK DEVELOPMENT-1

Course Category:	Skill Enhancement course	**Credits:**	1
Course Type:	**Laboratory**	**Lecture-Tutorial-Practice:**	0-0-2
Prerequisites:	**C programming**	**Continuous Evaluation:**	
		Semester end Evaluation:	
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	**Understand** the structure and purpose of HTML5 elements to build well-formed web pages.
	CO2	**Apply** semantic HTML5 to create accessible and organized web page layouts.
	CO3	**Apply** CSS3 properties and selectors to style web pages for visual appeal and consistency.
	CO4	**Evaluate** and implement responsive design techniques using Flexbox, Grid, and media queries.
	CO5	**Develop** dynamic behavior on web pages using JavaScript functions and DOM manipulation.
	CO6	**Analyze** and debug JavaScript code to ensure interactivity and performance.

Contribution of Course Outcomes towards achievement of Program Outcomes (L-Low, M-Medium, H- High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1					1				1		2	1	1
CO2					1				1		2	1	1
CO3					1				1		2	1	1
Co4					1				1		2	1	1
Co5					1				1		2	1	1
CO6					1				1		2	1	1

Course Content

Week 1:Lists, Links and Images

1. Write a HTML55 program, to explain the working of lists.
2. Write a HTML55 program, to explain the working of hyperlinks using <a> tag and href, target Attributes.
3. Create a HTML55 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.
4. Write a HTML55 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

Week 2 :HTML55 Tables, Forms and Frames

1. Write a HTML55 program, to explain the working of tables. (use tags: <table>, <tr>, <th>, <td> and attributes: border, rowspan, colspan)
2. Write a HTML55 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.).
3. Write a HTML55 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). 4. Write a HTML5 5program, 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).
	Week 3: HTML5 5 1. Write a HTML5 program, that makes use of <article>, <aside>, <figure>, <figcaption>, <footer>, <header>, <main>, <nav>, <section>, , tags. 2. Write a HTML5 program, to embed audio and video into HTML5 web page. 3. Write a program to apply different types (or levels of styles or style specification formats) - inline, internal, external styles to HTML5 elements. (identify selector, property and value).
	Week 4:Selector forms 1. 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
	Week 5:CSS3 with Color, Background, Font, Text and CSS3 Box Model 1. Write a program to demonstrate the various ways you can reference a color in CSS3. 2. Write a CSS3 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. 3. Write a program using the following terms related to CSS3 font and text: i. font-size ii. font-weight iii. font-style 4. iv. text-decoration v. text-transformation vi. text-alignment 5. Write a program, to explain the importance of CSS3 Box model using Content ii. Border iii. Margin iv. padding
	Week 6 :Applying JavaScript - internal and external, I/O, Type Conversion 1. Write a program to embed internal and external JavaScript in a web page. 2. Write a program to explain the different ways for displaying output. 3. Write a program to explain the different ways for taking input. 4. 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
	Week 7: JavaScript Pre-defined 1. Write a program using document object properties and methods. 2. Write a program using window object properties and methods. 3. Write a program using array object properties and methods. 4. Write a program using math object properties and methods. 5. Write a program using string object properties and methods. 6. Write a program using regex object properties and methods. 7. Write a program using date object properties and methods.
	Week 8:JavaScript User-defined Objects 1. Write a program to explain user-defined object by using properties, methods, accessors, constructors and display.

	Week 9: JavaScript Conditional Statements and Loops 1. Write a program which asks the user to enter three integers, obtains the numbers from the user and outputs HTML5 text that displays the larger number followed by the words "LARGER NUMBER" in an information message dialog. If the numbers are equal, output HTML5 text as "EQUAL NUMBERS". 2. Write a program to display week days using switch case. 3. Write a program to print 1 to 10 numbers using for, while and do-while loops. 4. Write aprogram to print data in object using for-in, for-each and for-of loops 5. Develop a program to determine whether a given number is an 'ARMSTRONG NUMBER' or not. [Eg: 153 is an Armstrong number, since sum of the cube of the digits is equal to the number i.e.,13 + 53+ 33 = 153] 6. 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)
	Week 10 :Javascript Functions 1. 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
	Week 11:Javascript Events 1. Design a HTML5 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 2. 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 xxxxxxx@xxxxxx.xxx)
	Week 12 : Case study Simulate the dynamic wed applications using HTML5, CSS3 and Java Script such as BankApplication ,Library application, Movie ticket Booking , Train ticket booking applications etc.,
Text books and Reference books	**Text Book(s):** [1]Programming the World Wide Web, 8th Edition, Robet W Sebesta, Pearson, 2014. [2]Web Programming with HTML5, CSS3 and JavaScript, John Dean, Jones & Bartlett Learning, 2019 (Chapters 1-11).
E-resources and other digital material	[1] https://www.coursera.org/specializations/web-design **"Web Design for Everybody: Basics of Web Development & Coding Specialization"** [2] https://www.coursera.org/learn/introduction-HTML5-CSS3-javascript**Introduction to HTML5, CSS3, & JavaScript** [3] https://www.w3schools.com/ **on HTML5,CSS3,JAVA SCRIPT**

23HS5155 - ADVANCED COMMUNICATION SKILLS LAB

Course Category:	HSS	**Credits:**	1
Course Type:	Laboratory	**Lecture-Tutorial-Practice:**	0-0-2
Prerequisites:	20TP4106 English for Professionals	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes

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

CO1	Execute rational pronunciation of speech sounds including accentuation
CO2	Apply elements of listening comprehension in professional environments
CO3	Develop the abilities of rational argumentation and skills of public speaking
CO4	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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1									3			
CO2					2					3		2	1
CO3					2					3		3	2
CO4					1					3		3	1

Course Content

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
- R´esum´e 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 oSf Syllogisms(Descriptive And Pictorial)

Text books and

Text Book(s):

[1]. M. Cutts, Oxford Guide to Plain English, 7th impression, Oxford, UK: Oxford

Reference books	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:** [3] S. R. Covey, The 7 Habits of Highly Effective People, 2nd edition, London, UK: Simon & Schuster UK Ltd (Pocket Books), 2004. [4] 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:	Engineering Science	**Credits:**	1
Course Type:	Laboratory	**Lecture-Tutorial-Practice:**	0-0-2
Prerequisites:	Basic Programming Knowledge	**Continuous Evaluation:**	30
		Semester end Evaluation:	70
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	**Demonstrate** understanding of Dart programming fundamentals and Flutter architecture to build basic mobile UI components.
	CO2	**Develop** responsive and interactive user interfaces using Flutter widgets and layout structures (Row, Column, Stack) adapting to multiple screen sizes.
	CO3	**Implement** effective navigation, state management, and user input handling to enable dynamic user interaction and multi-screen app flow.
	CO4	**Integrate** external APIs and apply animations, custom themes, and testing methodologies to deliver well-rounded and professional mobile applications.

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2		3							1	3	
CO2	3		3		3				1			2	3	
CO3	2	2	3		3				2	2		2	3	
CO4	2	2	3	2	3		1		2	2	1	3	3	2

Course Content

1. Introduction to Dart and Flutter Setup

a) Install Flutter SDK and Dart SDK on your system.
b) Write a simple Dart program to understand basic syntax, data types, and control structures.

2. Exploring Basic Flutter Widgets and Layouts

a) Explore commonly used Flutter widgets such as Text, Image, and Container.
b) Implement various layout structures using Row, Column, and Stack widgets.

3. Building Responsive User Interfaces

a) Design a UI that adapts to different screen sizes and device orientations.
b) Use MediaQuery and layout breakpoints to implement responsiveness.

4.Navigation Between Screens

a) Set up navigation between multiple screens using Navigator.
b) Implement navigation using **named routes** for structured app flow.

5. Understanding State Management

a) Differentiate between **stateless** and **stateful** widgets with examples.

	b) Implement state management using setState() and Provider package. **6.Creating and Styling Custom Widgets** a) Create reusable custom widgets for common UI components. b) Apply app-wide styling using themes and custom styles. **7. Designing Forms and Validating Inputs** a) Design a form with input fields such as text fields, dropdowns, and checkboxes. b) Implement form validation and display appropriate error messages. **8. Adding Animations to Enhance UX** a) Add animations to UI elements using Flutter's built-in animation classes. b) Experiment with different animation types like **fade**, **slide**, and **scale**. **9. Working with REST APIs** a) Fetch data from a public REST API using http package. b) Parse the response and display the data in a structured UI format (e.g., ListView or GridView). **10. Testing and Debugging Flutter Apps** a) Write unit tests and widget tests for UI components. b) Use Flutter's debugging tools (e.g., DevTools, Hot Reload, Logs) to find and fix issues.
Text books and Reference books	**Text Book(s):** [1].**Marco L. Napoli**, *Beginning Flutter: A Hands-on Guide to App Development*, 1st Edition, Wiley, 2020. [2].**Rap Payne**, *Beginning App Development with Flutter: Create Cross-Platform Mobile Apps*, 1st Edition, Apress, 2019. [3].**Richard Rose**, *Flutter & Dart Cookbook: Developing Full Stack Applications for the Cloud*, 1st Edition, O'Reilly Media, 2021. **Reference Book(s):** [1]. ***Alberto Miola**, Flutter Complete Reference 2.0, 2nd Edition, Independently Published, 2024.* *[2]. **Ronald C. Sheffield**, Mastering Dart for Flutter,1st Edition, Independently Published, 2024.* *[3]. **Kameron Hussain, Frahaan Hussain**, Mastering Flutter and Dart: Elegant Code for Cross-Platform Success,1st Edition, Independently Published, 2023.*
E-resources and other digital material	**[1]. Flutter Documentation (Official)** https://docs.flutter.dev/ **[2]. Dart Programming Language Documentation (Official)** https://dart.dev/guides **[3]. Flutter YouTube Channel (Official)** https://www.youtube.com/c/FlutterDev

23TP5106 - PERSONALITY DEVELOPMENT

Course Category:	Soft Skills	**Credits:**	1
Course Type:	Learning by Doing	**Lecture-Tutorial-Practice:**	0-0-2
Prerequisites:	20TP4106 English for Professionals	**Continuous Evaluation:**	100
		Semester end Evaluation:	0
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the corporate etiquette
	CO2	Make presentations effectively with appropriate body language
	CO3	Be composed with positive attitude
	CO4	. 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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1									2	3			
CO2									2	3			
CO3									3	3			
CO4									2	3			

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.

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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

Text books and Reference

Text Book(s) & Reference Books:

[1] Mitra, B. K., Personality development and soft skills (Vol. 156). Oxford University Press, 2011.

books	[2] 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 **Reference Books:** [5] S. R. Covey, The 7 Habits of Highly Effective People, 2nd edition, London, UK: Simon & Schuster UK Ltd (Pocket Books), 2004. [6] J. S. Brubacher, Eclectic Philosophy of Education: A Book of Readings, Englewood Cliffs, NJ, USA: Prentice-Hall, 1951.
E-resources and other digital material	[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:	Audit Course	**Credits:**	0
Course Type:	Theory	**Lecture-Tutorial-Practice:**	2-0-0
Prerequisites:		**Continuous Evaluation:**	100
		Semester end Evaluation:	0
		Total Marks:	100

Course Outcomes	Upon successful completion of the course, the student will be able to:	
	CO1	Understand the basics of writing technical reports, technical sentence formation, using transitions, and appropriate tenses for technical writing.
	CO2	Understand the use of drafts, illustrations, grammar, spelling, readability, and writing in plain English for effective technical documentation
	CO3	Apply the use of word processor tools such as Table of Contents, citations, footnotes, comments, macros, and document protection
	CO4	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)

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

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 and Reference books	**Text Book(s) & Reference 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 material	[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-tec hnical-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