

**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 9001:2015 Certified 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

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

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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

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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

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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

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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

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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	A. Software Testing Methodologies B. Augmented Reality & Virtual Reality C. DevOps D. Generative AI E. 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
5	23IT6405	Professional Elective-III	A. Software Project Management B. Mobile Adhoc Networks C. Natural Language Processing D. Distributed Operating System E. 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
<i>Mandatory Industry Internship of 08 weeks duration during summer vacation</i>							

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SEMESTER VII

S.No.	Course Code	Category	Title	L	T	P	Credits
1	23IT7301	Professional Core	Internet of Things	3	1	0	4
2	23IT7302	Management Course II	Human Resources & Project Management	2	0	0	2
3	23IT7403	Professional Elective-IV	A. Software Architecture & Design Patterns B. Deep Learning C. Computer Vision D. Blockchain Technology E. 12 week MOOC Swayam / NPTEL course recommended by the BoS	3	0	0	3
4	23IT7404	Professional Elective-V	A. Agile Methodologies B. Big Data Analytics C. Mobile Computing D. Cyber Physical Systems E. 12 week MOOC Swayam/NPTEL course recommended by the BoS	3	0	0	3
5	23IT7205	Open Elective – III	Object Oriented Programming Through Java	3	0	0	3
6	23IT7206	Open Elective – IV	NPTEL	3	0	0	3
7	23IT5651	Skill Enhancement Course	Prompt Engineering / SWAYAM Plus – Certificate program in Prompt Engineering and ChatGPT.	0	1	2	2
8	23MC7108	Audit Course	Constitution of India	2	0	0	-
9	23IT	Internship	Evaluation of Industry Internship / Mini Project	-	-	-	2
Total				19	2	02	22

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S.No.	Course Code	Course Category	Title	L	T	P	Credits
1		Internship & Project Work	Full semester Internship & Project Work	0	0	24	12

SEMESTER VIII

SEMESTER III

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: (11 hours) 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: (10 hours) 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: (11 hours) 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: (10 hours) 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 <i>Industrial Engineering and Production Management</i> Dhanpat Rai Publications, 2nd Edition. [2] Martand Telsang” <i>Industrial & Business Management</i>” 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, “<i>Financial Management</i>” Vikas Publications 11th Edition [4] B.B Mahapatro, “<i>Human Resource Management</i>”,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)			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			2						
		CO2			3												
		CO3						2									
		CO4								3				2			
Course Content		UNIT–I: Course introduction, need, basic guidelines, content and process for value education: (12 hours)															
		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: (12 hours)															
		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: (13 hours) 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: (12 hours) 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, Advaita 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)		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	3												1
	CO2		1											1	3
	CO3	3												1	3
	CO4		1												1
Course Content	UNIT I: (12 hours) 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: (10 hours) 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: (10 hours) 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: (11 hours) 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)		P O 1	PO 2	PO 3	P O 4	P O 5	P O 6	PO 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	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:(12 hours) 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: (11 hours) 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: (12 hours) 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: (12 hours) 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++”, 2 nd edition, University Press. [2] Ellis. Horowitz, Sartaj Sahani, Sanguthevar Rajasekharan, “FUNDAMENTALS OF COMPUTER ALGORITHMS”, 2 nd 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:	23ES1103 Programming 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)		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	2												
	CO2		2	3								2	1	2	
	CO3	1	3	2								3	3	3	
	CO4			2								2	2	3	
Course Content	UNIT I: (12 hours) 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: (12 hours) 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: (12 hours) 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: (11 hours) 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)		P O 1	PO 2	PO 3	P O 4	P O 5	P O 6	PO 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO1						2								
	CO2		2												
	CO3								2						
	CO4									2					
	CO5	2													
	CO6	1													
Course Content	UNIT I: (10 hours) [1].Series Completion, [2].Coding-Decoding, [3].Blood Relation, [4].Puzzles test														
	UNIT II: (8 hours) [1].Direction sense test, [2].Logical Venn diagrams, [3].Number test, ranking test, [4].Mathematical operations														
	UNIT III: (10 hours) [1].Arithmetical Reasoning, [2].Inserting missing character, [3].Syllogism. [4].Binary logic. [5].Data sufficiency														
	UNIT IV: (10 hours) [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 handling 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)			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	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: (12 hours) 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: (12 hours) 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, looping 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: (12 hours) 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: (12 hours) 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)		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										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

Course Category:	Programme Core								Credits:				1.5			
Course Type:	Lab								Lecture-Tutorial-Practice:				0-0-3			
Prerequisites:	23ES1103-Programming for Problem Solving 23IT2104 - 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 solutions to applications using object-oriented approach using Java														
	CO2	Implement java technology to solve runtime errors and test the correctness of programs using exception handling														
	CO3	Develop java applications to make use of collections frameworks and Stream API to solve real world problems														
	CO4	Design graphical user interface applications using Java Swings														
Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3-High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	
	CO1	2										3		2	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: - Create a class Hello which can contains all the primitive datatypes: byte, int,short, long, float, double, char, - print all the default values - set the values to them and print those values - Create a class Vehicle which contains the data members vno, vname, company, typefuel member functions insertDetails() getDetails() - 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 - 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 AccountMember 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 ArrayIndexOutOfBoundsException. 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)		P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	PO 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2
	CO1	3	3			3				3					
	CO2	3	3			3				3					
	CO3	3	3			1				1					
	CO4	3	1							1					
Course Content	UNIT I: (10 hours) 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: (10 hours) 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: (10 hours) Group Theory: Groups- definition of a group, examples and elementary properties, sub groups, group homomorphism.														
	UNIT IV: (10 hours) 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, 2 nd edition, PHI. [2]. N.ChandraShekharan and M.Umaparvathi , Discrete Mathematics ,PHI 2010 Reference Books: [1].Kenneth H Rosen, Discrete Mathematics and Applications, 6 th edition, McGrahill [2]. Ralph P. Grimaldi, Discrete and Combinatorial Mathematics, 4 th 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].Dominik Scheduer, 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
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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: (10 hours) 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: (10 hours) 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: (10 hours) 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: (10 hours) 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	Text Book(s): [1].Probability and Statistics for Engineers Eighth edition by Richard A. Johnson Prentice Hall of India.														

books	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)		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	1											1	1
	CO2	3	2											2	1
	CO3	1	3											2	1
	CO4	2	2											1	1
Course Content		UNIT I: (10 hours) 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 : (12 hours) 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: (12 hours) 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: (10 hours) 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”, 9 th ed, John Wiley & Sons (Asia) Pvt. Ltd, 2018. Reference Books: [1]. Dhananjay M. Dhamdhere, “Operating Systems: A Concept-Based Approach”, 3 rd edition, McGraw-Hill Education India Pvt. Ltd, 2017. [2]. William Stallings, “Operating System: Internals and Design Principles”, 8 th 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 08 th Sep 2016 https://nptel.ac.in/courses/106/106/106106144/ [2]. Mythili Vutukuru, Dept of CSE, IITB “Lectures on Operating Systems” dated 14 th Mar 2018 https://www.cse.iitb.ac.in/~mythili/os/ [3]. Prof. P.K. Biswas, Dept of EEC, IITK "Operating Systems" dated 06 th 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: (12 hours) 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: (12 hours) 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: (12 hours) 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: (12 hours) 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,IIKharagpur, DBMS. Dec 7, 2017 https://www.youtube.com/watch?v=IoL9Ve2SRwQ&list=PLIwC9bZ0rmjSkm1VRJROX4vP2YMI4Ebh [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)		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	1
	CO2	1			2						2			2	
	CO3		2								3	2			1
	CO4			3							2	3		2	2
Course Content	UNIT I: (12 hours) 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: (11 hours) 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: (12 hours) 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: (12 hours) 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, McGraw 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. Available by https://www.coursera.org/specializations/software-engineering [4]. Ron Burbach, Department of Computer Science, Graduate Studies of Stanford University December 1999 on Software Engineering Methodologies by http://infolab.stanford.edu/~burbach/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 efinition – 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 erview 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. <i>English Grammar and Composition</i>. S.Chand & Company, 2023. [2] Dale Carnegie. <i>The Quick and Easy way to Effective Speaking</i>. Rupa Publications, 2016. [3] Richard A. Spears. <i>McGraw-Hill’s Dictionary of American Idioms and Phrasal Verbs</i>. McGraw Hill, 2005. [4] Kamalesh Sadanand. <i>A Spoken English</i>. 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)		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		
	CO2		1	1							1			1		
	CO3				1	1							1	1		
	CO4						1	1	1					1		
Course Content	UNIT I: (8 hours) 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: (6 hours) 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: (7 hours) 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: (6 hours) 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 handling 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)		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	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: (9 hours) 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: (9 hours) 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: (9 hours) 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: (9 hours) 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)			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	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: (9 hours)															
		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: (9 hours) 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: (9 hours) 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 (9 hours) 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”, 9thed, 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]. Rajib Mall, “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)		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	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,IIKharagpur, 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	PS O1	PSO2	
		CO1														1	1
		CO2	2				2									1	
		CO3			3		2									2	
		CO4			3		2									2	
Course Content		UNIT I: (10 hours) 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: (10 hours) 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: (12 hours) 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: (12 hours) 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 Servlet/Spring framework															

Text books and Reference books	Text Book(s): [1].James Keogh, “J2Ee: The Complete Reference”, 1 st 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	PS O1	PSO 2
	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: (12 hours) 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: (12 hours) 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: (10 hours) 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: (10 hours) 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: (10 hours) 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 ϵ -Translations, Formal notation for an ϵ -NFA, Epsilon-Closures, Extended Transitions and Languages for ϵ -NFA's, Eliminating ϵ -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: (10 hours) 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: (10 hours) 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: (10 hours) 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. Chandrashekar, “Theory of computation” , 2nd edition, 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: (12 hours) 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: (10 hours) 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: (12 hours) 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: (12 hours) 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]. Applying 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/ood_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 (12 hours) 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 (12 hours) 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: (10 hours) 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:(12 hours) 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, <i>Introduction to Cybersecurity</i>, 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, <i>Computer and Network Security</i>, Stanford Online / Coursera, 2022, September 15 URL: https://www.coursera.org/learn/computer-network-security [3] Brian Krebs, Investigative Cybersecurity Journalist, <i>Cybersecurity Basics and Best Practices</i>, 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, <i>Introduction to Information Security – NPTEL Course</i>, 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), <i>Best Practices for Cyber Security</i>, 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)		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	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: (12 hours) 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, uninformed search strategies – Breadth first search, depth first search. Searching with Partial Information														
	UNIT II: (10 hours) Informed (Heuristic) Search Strategies: Greedy best first search, A* search, Memory bounded heuristic search, Heuristic functions, Game Playing- Adversarial search, Games, Optimal Decisions in Games, Optimal strategies, mini-max algorithm, optimal decisions in multiplayer games, Alpha-Beta pruning, Evaluation functions.														
	UNIT III: (10 hours) 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: (12 hours) 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”, Second Edition, 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)		PO 1	PO 2	PO 3	P O 4	P O 5	P O 6	PO 7	P O 8	P O 9	P O 10	P O 11		PSO 1	PSO 2
	CO1	2		1	1									1	1
	CO2	1		2										1	1
	CO3	2		2	1									1	
	CO4			2										1	2
Course Content	UNIT I: (12 hours) 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: (12 hours) 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: (12 hours) Microcontroller, Architecture of 8051, Special Function Registers (SFRs), I/O Pins Ports and Circuits, Instruction set, Addressing modes, Assembly language programming.														
	UNIT IV: (10 hours) 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)		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									
	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: (12 hours)														
	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 (12 hours)														
	Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Transformation and Data Discretization.														
Text books and Reference books	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 (12 hours)														
	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 (12 hours)														
	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.														

	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 DATA STRUCTURES

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, Medium, 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: (12 hours) 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: (10 hours) 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: (12 hours) 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: (12 hours) 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 Algorithms", 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: (12 hours) 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: (12 hours) 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: (10 hours) 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: (10 hours) 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, Vilisualizing 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

Course Category:	Program core							Credits:					1.5		
Course Type:	Lab							Lecture-Tutorial-Practice:					0-0-3		
Prerequisites:	Java Programming 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	Understand the JDBC architecture and perform database operations using interfaces with transaction management.													
	CO2	Apply servlet lifecycle concepts and request-response handling mechanisms, redirection, and session tracking techniques.													
	CO3	Develop modular Spring Boot applications by understanding its architecture, structure, and the use of build tools like Maven.													
	CO4	Demonstrate the use of core Spring Boot annotations and implement RESTful services with proper dependency injection and component management.													
	CO5	Utilize Spring Data JPA to access and manipulate relational databases using both in-memory and MySQL backends													
	CO6	Design and build full-stack transactional web applications by integrating Spring Boot, Spring Data JPA													
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	3	2	2	–	–	–	–	–	–		3	–
	CO2	3	2	3	2	2	–	–	–	1	2	–		2	–
	CO3	3	2	3	2	3	–	–	–	1	2	–		3	2
	CO4	3	2	3	3	3	–	–	–	1	2	–		3	2
	CO5	3	2	3	3	3	–	–	–	–	2	–		3	3
	CO6	3	3	3	3	3	–	–	–	2	2	–		3	3
Course Content	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														

	requests. • Task 2: Pass and display attributes between servlets using <code>setAttribute()</code>. Week 6: Session Management in Servlets • Task 1: Track user session using Cookies and <code>HttpSession</code>. • 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 <code>@SpringBootApplication</code>. 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 <code>application.properties</code> 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 <code>@Component</code>, <code>@Service</code>, <code>@Repository</code>. • Task 2: Use <code>@Autowired</code> and <code>@Qualifier</code> 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].
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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	PS O 1	PS O 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>, <div>, 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 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 a program 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., $1^3 + 5^3 + 3^3 = 153$] 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 <u>xxxxxxx@xxxxxx.xxx</u>)
	Week 12 : Case study Simulate the dynamic web 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, Robert 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)		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									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..
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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)		PO 1	PO 2	PO 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	P O 12	PSO 1	PSO 2	
	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 <code>setState()</code> 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 <code>http</code> package. b) Parse the response and display the data in a structured UI format (e.g., <code>ListView</code> or <code>GridView</code>). 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, <i>Beginning Flutter: A Hands-on Guide to App Development</i>, 1st Edition, Wiley, 2020. [2]. Rap Payne, <i>Beginning App Development with Flutter: Create Cross-Platform Mobile Apps</i>, 1st Edition, Apress, 2019. [3]. Richard Rose, <i>Flutter & Dart Cookbook: Developing Full Stack Applications for the Cloud</i>, 1st Edition, O'Reilly Media, 2021. Reference Book(s): [1]. Alberto Miola, <i>Flutter Complete Reference 2.0</i>, 2nd Edition, Independently Published, 2024. [2]. Ronald C. Sheffield, <i>Mastering Dart for Flutter</i>, 1st Edition, Independently Published, 2024. [3]. Kameron Hussain, Frahaan Hussain, <i>Mastering Flutter and Dart: Elegant Code for Cross-Platform Success</i>, 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)		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	3			
	CO2									2	3			
	CO3									3	3			
	CO4									2	3			
Course Content	UNIT I: (8 hours) 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: (6 hours) 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: (6 hours) Standard Operation Methods and Verbal Ability: Note Making, Note Taking, Minutes Preparation, Email Letter Writing; Synonyms, Antonyms, One Word Substitutes Correction of Sentences-Analogies, Spotting Errors, Sentence Completion, Course of Action -Sentences Assumptions, Sentence Arguments, Reading Comprehension, Practice work. •													
	UNIT IV: (8 hours) 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 books	Text Book(s) & Reference Books: [1] Mitra, B. K., Personality development and soft skills (Vol. 156). Oxford University Press, 2011. [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: (4 hours)													
	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: (5 hours)													
	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: (4 hours)													
	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: (6 hours) 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-technical-report-writing/, Last Accessed on: 02/05/2025. [3].. Mark Morris — professional speechwriter, https://www.udemy.com/course/betterbusinesswriting/, Last Accessed on: 02/05/2025

VI SEMESTER

23IT6301 - CLOUD COMPUTING

Course Category:	Programme Core							Credits:				3			
Course Type:	Theory							Lecture-Tutorial-Practice:				3-0-0			
Prerequisites:	Computer Networks							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 cloud computing fundamentals, service models, and deployment models.													
	CO2	Explore enabling technologies, virtualization methods, and distributed architectures.													
	CO3	Analyse containerization, orchestration platforms, and cloud security challenges.													
	CO4	Explore advanced cloud concepts including serverless computing, IoT integration, Edge computing.													
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	2										2	1
	CO2	2	3	2										1	1
	CO3	1	2	3										1	3
	CO4	1	2	2										3	2
Course Content	UNIT I: Introduction to Cloud Computing Fundamentals (12 hours) Overview and definition of Cloud Computing, Cloud Computing reference model, Types of Services (IaaS, PaaS, SaaS), Cloud Deployment models (public, private, hybrid), Cloud Computing characteristics and benefits, Cloud Service Providers (Amazon Web Services, Microsoft Azure, Google App Engine).														
	UNIT II: Cloud Enabling Technologies (12 hours) Parallel and Distributed computing, Elements of Parallel Computing, hardware architectures for parallel computing (SISD, SIMD, MISD, MIMD), Elements of Distributed computing, Inter-process communication, technologies for distributed computing, remote procedure calls (RPC), service-oriented architecture (SOA), Web services, Virtualization and technologies (XEN, VMware).														
	UNIT III: Containers and Orchestration (12 hours) Building blocks of containers, container platforms (LXC, Docker), container orchestration, Docker Swarm and Kubernetes, Amazon EC2. Cloud Computing Challenges: Cloud interoperability and standards, scalability and fault tolerance, energy efficiency in clouds, cloud computing security, cloud security architecture, cloud shared responsibility model, security in cloud deployment models.														
	UNIT IV: Advanced concepts in cloud computing: (12 hours) Serverless computing, Function-as-a-Service, serverless computing architecture, public cloud (e.g. AWS Lambda) and open-source (e.g. OpenFaaS), Integration of Cloud with IOT, Edge Computing, Quantum Cloud Basics.														
Text books and Reference	Text Book(s): [1].Mastering Cloud Computing, 2nd edition, Rajkumar Buyya, Christian Vecchiola,Thamarai Selvi, Shivananda Poojara, Satish N. Srirama, Mc Graw														

books	Hill, 2024. [2].Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012. Reference Books: [1].Cloud Computing, Theory and Practice, Dan C Marinescu, 2nd edition, MK Elsevier, 2018. [2].Essentials of cloud Computing, K. Chandrasekhran, CRC press, 2014. [3]. Online documentation and tutorials from cloud service providers (e.g., AWS, Azure, GCP)
E-resources and other digital material	[1] John R Williams, Abel Sanchez , MIT Professional Education, “Cloud DevOps”, 2022, https://professional.mit.edu/course-catalog/cloud-devops-continuous-ransformation [2] Coursera, “Cloud Application Security”, 2021, https://www.mooc-list.com/course/cloud-application-security-coursera [3] Suresh S, Udemy, “Server Virtualization”, 2021 https://www.udemy.com/tutorial/cloud-computing-the-technical-essentials/basics-of-virtualization/ [4] Prof.Sowmya Kanti Ghosh, IIT Kharagpur, “Cloud Computing”, 2022 https://nptel.ac.in/courses/106/105/106105167/

23IT6302 - CRYPTOGRAPHY & NETWORK SECURITY

Course Category:	Programme Core							Credits:				3			
Course Type:	Theory							Lecture-Tutorial-Practice:				3-0-0			
Prerequisites:	Computer Networks							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	Summarize fundamental security concepts, cryptographic attacks, and classical encryption techniques.													
	CO2	Apply symmetric and asymmetric cryptographic algorithms to secure data communication.													
	CO3	Analyse cryptographic hash functions, digital signature schemes, and key management protocols for ensuring message integrity and authentication.													
	CO4	Illustrate security mechanisms at various layers of the network and system levels.													
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			1								1	1	
	CO2	2		2	1						1			2	
	CO3	1	3								1		2		
	CO4							1			2	1		1	
Course Content	UNIT I: (12 hours) Information and Network Security Concepts: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Cryptography, a Model for Network Security. Classical Encryption Techniques: Symmetric Cipher Model- Cryptography, Cryptanalysis and Brute-Force Attack, Substitution Techniques, Transposition Techniques														
	UNIT II: (12 hours) Block Ciphers and Data Encryption Standard – Stream Ciphers and Block Ciphers, The Data Encryption Standard, The Strength of DES, Block cipher design principles. Advanced Encryption Standard: AES Structure. Public key cryptography and RSA : Principles of public-key cryptosystems, The RSA Algorithm. Other Public-Key Cryptosystems: Diffie Hellman Key exchange.														
	UNIT III: (10 hours) Data Integrity, Digital Signature Schemes & Key Management: Message Integrity and Message Authentication-message integrity, Message authentication, Cryptographic Hash Functions- SHA-512, Digital Signature- process, services, Key Management-Kerberos.														
	UNIT IV: (12 hours) Transport Level Security: Web Security Considerations, Secure Sockets Layer (SSL), Transport Layer Security (TLS). IP Security: IP Security Overview, IP Security Policy, Encapsulating Security Payload (ESP). Network End Point Security: Malicious Software, Intrusion Detection Techniques, Firewalls, Distributed Denial of Service Attacks														

Text books and Reference books	Text Book(s): [1]. William Stallings, “Cryptography and Network Security Principles and Practices”, 5th Edition, Global Edition Pearson, 2022 [2]. Behrouz A Forouzan, “Cryptography and Network Security”, 3rd Edition, Debdeep Mukhopadhyay, McGraw Hill, 2015 Reference Books: [1]. Bernard Meneses, “Network Security and Cryptography” , 1st Edition, , Cengage Learning, 2018 [2]. Keith M. Martin, “Everyday Cryptography”, 1st Edition, Oxford, 2016
E-resources and other digital material	[1] Prof. Jonathan Katz University of Maryland, “Message Integrity” , 2020, Coursera, https://www.coursera.org/lecture/cryptography/message-integrity-7CqCh [2] Prof. Sourav Mukhopadhyay, Associate Professor, IIT Kharagpur, “Data Encryption Standard”, 2019, https://nptel.ac.in/courses/106105162 [3] Prof. Ronald Rivest, MIT, “Cryptographic Hash Functions”, 2014, https://ocw.mit.edu/courses/6-857-network-and-computer-security-spring-2014/resources/mit6_857s14_lec04/ [4] Tanmayi Nagale, Udemy, “Cryptography and System Security”, 2024, https://www.udemy.com/course/cryptography-and-system-security/?srsltid=AfmBOoo-ADthCvSlXr_BDJKqT00sEVgajRBNMGEmcTttM7-KADQHSTJ3&utm_source=chatgpt.com&couponCode=CP130525

23IT6303 - MACHINE LEARNING

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	Illustrate fundamental concepts, learning paradigms, data types, and stages involved in building machine learning models.												
	CO2	Apply distance-based and tree-based approaches to perform classification and regression tasks.												
	CO3	Analyse linear and nonlinear machine learning models.												
	CO4	Evaluate different clustering approaches for grouping 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	PSO 1	PSO 2
	CO1	2											1	
	CO2	2	2	1									3	1
	CO3	2	2	2									3	1
	CO4	2	3	1									3	2
Course Content	UNIT I: (12 hours) Introduction to Machine Learning: Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets.													
	UNIT II: (12 hours) Nearest Neighbor and Decision Trees Based Models: Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures, Radius Distance Nearest Neighbor Algorithm,, Performance of Classifiers, Performance of Regression Algorithms, Area Under the ROC Curve, Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias–Variance Trade-off, Random Forests for Classification and Regression, AdaBoost Classifier, Gradient Boosting (GB).													
	UNIT III: (12 hours) Representation Introduction to Representation, Principal Component Analysis. Linear Discriminants for Machine Learning: Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Backpropagation for Training an MLP.													

	UNIT IV: (10 hours) Clustering : Introduction to Clustering, Partitioning of Data, Matrix Factorization, Clustering of Patterns, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.
Text books and Reference books	Text Book(s): [1]. “Machine Learning Theory and Practice”, M N Murthy, V S Ananthanarayana, Universities Press (India), 2024 Reference Books: [1]. “Machine Learning”, Tom M. Mitchell, McGraw-Hill Publication, 2017 [2]. “Machine Learning in Action”, Peter Harrington, DreamTech [3]. “Introduction to Data Mining”, Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7 th Edition, 2019.
E-resources and other digital material	[1]. Kevin murphy,—machine learning: a probabilistic perspective , mit press, 2012, https://www.cs.ubc.ca/~murphyk/mlbook/pml-intro-5nov11.pdf [2] Machine learning by andrew ng, stanford university https://www.coursera.org/learn/machine-learning [3] Professor s. sarkar iit kharagpur “introduction to machine learning” , https://www.youtube.com/playlist?list=plyihddlf-cgyuwnl55wg8alkm6u8u7gps , 2025 [4] Professor carl gustafjansson, kth, video course on machine learning https://nptel.ac.in/noc/individual_course.php?id=noc19-cs35 , 2025

23IT6404A - SOFTWARE TESTING METHODOLOGIES

Course Category:	Professional Elective-II							Credits:					3	
Course Type:	Theory							Lecture-Tutorial-Practice:					3-0-0	
Prerequisites:	Software Engineering							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 fundamental concepts of software testing, including software testing principles, metrics, path testing, and state graphs.												
	CO2	Apply transaction flow testing, data flow testing, domain testing, state testing and graph matrix techniques for evaluating the software applications.												
	CO3	Identify path products, path expressions, path sums for test design and defect detection.												
	CO4	Illustrate automated testing tools such as JMeter, Selenium, SoapUI, and Katalon to design, execute, and validate structured test cases for real-time applications.												
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	3	3	2									2	
	CO2	2	1	3										1
	CO3	1	2	2									1	2
	CO4	2	2	3		3							2	2
Course Content	UNIT I: (12 hours) Introduction: Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs Flow graphs. Path testing: Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.													
	UNIT II: (12 hours) Transaction Flow Testing: Transaction flows, transaction flow testing techniques. Data Flow testing: Basics of data flow testing, strategies in data flow testing, application of data flow testing. Domain Testing: domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domains and testability..													
	UNIT III: (12 hours) Paths, Path products and Regular expressions: path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection. Logic Based Testing: overview, decision tables, path expressions, kv charts, specifications. Case Study – Insurance Premium Calculation Module													
	UNIT IV: (10 hours) State, State Graphs and Transition testing: state graphs, good & bad state graphs, state testing, Testability tips. Graph Matrices and Application: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools. (Student should be given an exposure to a tool like Jmeter/selenium/soapUI/Catalon). Case Study – ATM Machine State Transitions													

Text books and Reference books	Text Book(s): [1] Software Testing techniques - Baris Beizer, Dreamtech, second edition, 1990. [2] Software Testing Tools – Dr. K. V. K. K. Prasad, Dreamtech, 2009. Reference Books: [3]. The craft of software testing - Brian Marick, Pearson Education, 2007 [2]. Software Testing Techniques – SPD(Oreille) [3] Software Testing in the Real World – Edward Kit, Pearson, 2002 [4] Effective methods of Software Testing, Perry, John Wiley, 3rd Edition, 2006.
E-resources and other digital material	[5] Prof. Rajib Mall, IIT Kharagpur, NPTEL Software Testing video. Available: https://onlinecourses.nptel.ac.in/noc26_cs59/ 2025 [2]. Gregory Gay. Associate Professor, Chalmers and the University of Gothenburg. Software Quality and Testing - Spring 2022, https://youtu.be/OLbo92_MgtU [3]. Sanjai Rayadurgam Director, University of Minnesota , Introduction to Software Testing, 2025, https://www.coursera.org/learn/introduction-software-testing?utm_medium=sem&utm_source=gg&utm_campaign=b2c_in

23IT6404B- AUGMENTED REALITY & VIRTUAL REALITY

Course Category:	Professional Elective-II								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	Understand the fundamentals of Augmented Reality and explain AR display technologies, perception principles, and tracking mechanisms used in modern AR systems.												
	CO2	Apply computer vision algorithms, interaction techniques, and AR software architectures to design and evaluate effective AR applications.												
	CO3	Demonstrate the principles of Virtual Reality by interpreting geometric models, optical behavior, and human perception factors that shape immersive VR environments.												
	CO4	Analyze visual perception and rendering techniques to enhance VR realism, and evaluate interaction models including motor remapping, locomotion, and social interaction—to improve system performance.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3-High)		P O 1	PO 2	PO 3	P O 4	P O 5	P O 6	PO 7	P O 8	P O 9	P O 10	P O 11	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: (12 hours) Introduction to Augmented Reality: Augmented Reality - Defining augmented reality, history of augmented reality, Examples Displays: Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model Tracking: Tracking, Calibration, and Registration, Coordinate Systems, Characteristics of Tracking Technology, Mobile Sensors													
	UNIT II: (12 hours) Computer Vision for Augmented Reality: Marker Tracking, Outdoor Tracking. Interaction: Output Modalities, Input Modalities, Virtual User Interfaces on Real Surfaces, Augmented Paper, Multi-view Interfaces Software Architectures: AR Application Requirements, Software Engineering Requirements, Distributed Object Systems, Dataflow													
	UNIT III: (10 hours) Introduction to Virtual Reality: Defining Virtual Reality, History of VR, Human Physiology and Perception The Geometry of Virtual Worlds: Geometric Models, Viewing Transformations Light and Optics: Basic Behavior of Light, Lenses, The Human Eye, Cameras, Displays													
	UNIT IV: (10 hours) Visual Perception: Visual Perception - Perception of Depth, Perception of Motion, Perception of Color Visual Rendering: Visual Rendering- Correcting Optical Distortions, Improving Latency and Frame Rates, Immersive Photos and Videos Interaction: Motor Programs and Remapping, Locomotion, Social Interaction													

Text books and Reference books	Text Book(s): [3].Mark Billingham, Tobias Höllerer, and Dieter Schmalstieg, Augmented Reality: Principles and Practice, Pearson Education India, First Edition, 2016. [4].Steven M. LaValle, Virtual Reality, Cambridge University Press, 2016. Reference Books: [4].William R. Sherman and Alan B. Craig, Understanding Virtual Reality: Interface, Application, and Design, Morgan Kaufmann, San Francisco, 2002. [5].Alan B. Craig, William R. Sherman, and Jeffrey D. Will, Developing Virtual Reality Applications: Foundations of Effective Design, Morgan Kaufmann, 2009
E-resources and other digital material	[1] Dr. P. Malliga National Institute of Technical Teachers Training and Research, Chennai Augmented & Virtual Reality – Foundations and Applications-[NPTEL] Available: https://onlinecourses.swayam2.ac.in/ntr26_ed41/preview [2] Dr. Ramesh C Sharma Dr. B R Ambedkar University Delhi, New Delhi-[NPTEL] Available: https://onlinecourses.swayam2.ac.in/nou25_hs59/preview [3] https://www.coursera.org/learn/ar [4] https://www.coursera.org/specializations/virtual-reality

23IT6404C – DEVOPS

Course Category:		Professional Elective - II						Credits:				3		
Course Type:		Theory						Lecture-Tutorial-Practice:				3-0-0		
Prerequisites:		DevOps						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	Summarize the fundamental concepts, goals, and cultural aspects of DevOps in modern software development.												
	CO2	Apply containerization concepts to build Docker images and Files for application deployment.												
	CO3	Deploy containerized applications using Kubernetes to ensure scalable and automated orchestration.												
	CO4	Analyze Kubernetes monitoring, logging, and namespace configurations to improve cluster observability and management.												
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		1		2				2	2		2	
	CO2	2				1				1	1			1
	CO3			2								1	3	
	CO4			2		3				1				3
Course Content	UNIT I: (12 hours) Introduction to Devops: Software delivery challenges, Waterfall and physical delivery, Agile and electrical delivery, software delivery on the cloud, continuous Integration, Continuous Delivery, Configuration management, Infrastructure as code, Orchestration Trend of Microservices: Modular programming, package management, MVC design pattern, Monolithic application, Remote Procedure call, RESTful design, Microservices.													
	UNIT II: (10 hours) DevOps with Container: understanding container, Resource isolation, Linux container concept, Containerized delivery, getting started container, Installing Docker for Ubuntu, Installing Docker for CentOS, Installing Docker for macOS. Container life cycle: Docker basics, Layer, image, container, and volume, distributing images, connect container Working with Dockerfile: writing your first Dockerfile, Dockerfile syntax, Organizing a Dockerfile.													
	UNIT III: (10 hours) Understanding Kubernetes: Understanding Kubernetes, Kubernetes components, Master components, API server, Controller, Scheduler, Node components, Kubelet, Proxy, Docker, Interaction between kubernetes master and nodes. Getting started with Kubernetes: Preparing the environment, kubectl, kubernetes resources, kubernetes objects, Namespace, Name, Label and selector, Annotation, Pods, ReplicaSet(RS) and Replication Controller (RC), Deployments, Services, volumes, Secrets, Control Map, Using ConfigMap via volume, Using ConfigMap via environment variables													
	UNIT IV: (10 hours) Monitoring and Logging: Inspecting a container, Kubernetes dashboard, Monitoring in													

	Kubernetes, Application, Host, External resources, container, Kubernetes, Getting monitoring essentials for Kubernetes, Cluster Administration: Kubernetes namespaces, Default namespaces, Create a new namespace.
Text books and Reference books	Text Book(s): [1]. DevOps with Kubernetes: Accelerating software delivery with container by Hideto Saito, Hui-Chuan Chloe Lee, Cheng-Yang Wu, O'Reilly publications, 2017. [2]. Alisson Machado de Menezes., Hands-on DevOps with Linux, 1st Edition, BPB Publications, India, 2021. [3]. Joyner, Joseph., Devops for Beginners: Devops Software Development Method Guide for Software Developers and It Professionals, 1st Edition Mihails Konoplows, 2015. Reference Books: [1]. Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley; ISBN-10 [2]. Gene Kim Je Humble, Patrick Debois, John Willis. The DevOps Handbook, 1st Edition, IT Revolution Press, 2016. [3]. Verona, Joakim Practical DevOps, 1st Edition, Packt Publishing, 2016. [4]. Joakim Verona. Practical Devops, Ingram short title; 2nd edition (2018). ISBN10: 1788392574 [5]. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wiley publications. ISBN: 9788126579952
E-resources and other digital material	[1]. Mr. Ilangchezhiyan G, Technical Architect, Encora, Azure DevOps and Micro Services, [NPTEL] (7th January, 2023) Available: https://swayam-plus.swayam2.ac.in/courses/course-details?id=MICROS_12 [2]. Prof. Sudip Misra, Professor, Department of CSE, IIT Kharagpur Wireless Ad Hoc and Sensor Networks, [NPTEL](20, Jul, 2024) Available: https://nptel.ac.in/courses/106105160

23IT6404D – GENERATIVE AI

Course Category:	Professional Elective - II							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	Outline the fundamentals, evolution, and probabilistic principles of Generative AI and its core generative models.													
	CO2	Apply language-model and prompt-engineering techniques to generate, refine, and evaluate text outputs.													
	CO3	Analyze image-generation models such as GANs, VAEs, and diffusion models based on architecture, training, and performance.													
	CO4	Design end-to-end generative-AI applications using open-source LLMs, multimodal models, and deployment frameworks with ethical considerations.													
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	3										1	2
	CO2		2	1		3								2	1
	CO3	1	2	3										1	3
	CO4			3	2	2								3	2
Course Content	UNIT I: (10 hours)														
	Introduction to Generative AI and Fundamentals:														
	Definition and scope of Generative AI – History and Evolution – Discriminative vs Generative Models – Introduction to Unsupervised Learning – Applications of Generative AI in Art, Media, and Science – Overview of Common Generative Models – Tools and Libraries: TensorFlow, PyTorch, Hugging Face.														
	Variational Autoencoders (VAEs):														
	Autoencoders: Basic Architecture – Limitations of Basic Autoencoders – Variational Autoencoders (VAEs). Applications in Image Generation.														
	UNIT II: (10 hours)														
Generative Adversarial Networks (GANs):															
Introduction to GANs – Generator and Discriminator Networks – Adversarial Training – Loss Functions – Issues in GAN Training – DCGAN, Conditional GANs, overview of CycleGAN, StyleGAN .Evaluation Metrics for GANs (FID, IS)															
UNIT III: (10 hours)															
Autoregressive and Diffusion Models:															
Introduction to Transformers in Generative Modeling – Language Models (GPT family) – Attention Mechanism – Training and Sampling – Introduction to Diffusion Models -introduction to Diffusion Probabilistic Models (DDPMs), Comparison with GANs, RAG basics															
UNIT IV: (10 hours)															
Applications and Ethics in Generative AI:															
Applications in Image Synthesis, Text Generation, Audio/Music Creation, Drug															

	Discovery – Ethics of Synthetic Media – Deep fakes and Misinformation – Legal Implications – Bias in Generative Models. Evaluation of text models (BLEU, ROUGE).
Text books and Reference books	Text Book(s): [1] David Foster, <i>Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play</i>, O'Reilly, 2nd Edition, 2022. [2] Ian Goodfellow, Yoshua Bengio, and Aaron Courville, <i>Deep Learning</i>, MIT Press, 2016. [3] Francesco Coreia, <i>An Introduction to Generative AI</i>, Springer, 2023. Reference Books: [1] Ian Goodfellow and Yoshua Bengio and Aaron Courville Deep Learning An MIT Press book [2] Altaf Rehmani, “Generative AI for Everyone”, BlueRose One, 2024.
E-resources and other digital material	[1] Prof. Viraj Kumar IISc Bangalore <i>Programming with Generative AI</i> [NPTEL], Available: https://onlinecourses.nptel.ac.in/noc25_cs137/preview [2] Naveen Kumar Bhansali Indian Institute Of Management Bangalore (IIMB) <i>Generative AI and Large Language Models</i>[NPTEL], Available: https://onlinecourses.swayam2.ac.in/imb24_mg116/preview [3] Sebastian Raschka and Yuxi Liu, <i>Machine Learning with PyTorch and Scikit-Learn</i>, Packt Publishing, 2022. [4] Aurélien Géron, <i>Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow</i>, O'Reilly, 3rd Edition, 2022. [5] Delip Rao and Brian McMahan, <i>Natural Language Processing with PyTorch</i>, O'Reilly Media, 2019

23IT6405A- SOFTWARE PROJECT MANAGEMENT

Course Category:	Programme Elective III							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	Understand conventional software management approaches and apply software economics and cost estimation techniques to improve project performance and transition to iterative models.													
	CO2	Explain software lifecycle phases and classify management and engineering artifacts used in project development.													
	CO3	Apply project organizations, workflows and milestone-based iterative planning to control and monitor software projects.													
	CO4	<i>Apply organizational frameworks, automation tools, project control metrics and risk management strategies to manage software projects effectively.</i>													
Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3-High)		PO 1	PO 2	PO 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11		PSO 1	PSO 2
	CO1	3	2	2	2	1								2	1
	CO2	3	2	3	2	2								3	2
	CO3	3	3	3	2	2								3	2
	CO4	3	2	3	3	3								3	3
Course Content	UNIT I: (10 hours) Conventional Software Management: The waterfall model, conventional software Management performance. Evolution of Software Economics: Software Economics, pragmatic software cost estimation. Improving Software Economics: Reducing Software product size, improving software processes, improving team effectiveness, improving automation, Achieving required quality, peer inspections. The old way and the new: The principles of conventional software Engineering, principles of modern software management, transitioning to an iterative process.														
	UNIT II: (12 hours) Life cycle phases: Engineering and production stages, inception, Elaboration, construction, transition phases. Artifacts of the process: The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts.														
	UNIT III: (10 hours) Model based software architectures: A Management perspective and technical perspective. Work Flows of the process: Software process workflows, Iteration workflows. Checkpoints of the process: Major mile stones, Minor Milestones, Periodic status assessments.														
	Iterative Process Planning: Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning.														
	UNIT IV: (10 hours)														

	Project Organizations and Responsibilities: Line-of-Business Organizations, Project Organizations, evolution of Organizations. Process Automation: Automation Building blocks, The Project Environment. Project Control and Process instrumentation: The seven core Metrics, Management indicators, quality indicators, life cycle expectations, pragmatic Software Metrics, Metrics automation. Risk Management: Concepts of Risks and Risk management, Risk Assessment, Risk Control, Examples
Text books and Reference books	Text Book(s): [1]. Software Project Management, Walker Royce, PEA, 2005. [2]. Pankaj Jalote, —Software project management in practice Addison-Wesley First Edition, 2002 Reference Books: [1]. Software Project Management by Manish Kumar Jha, i.e , Dhanpat Rai and Co. [2]. Software Project Management by Er. Rajiv Chopra , 3th e, Kartson Books. [3]. Software Project Management by R.H. Thayer, IEEE CS Press..
E-resources and other digital material	[1] Prof. Rajib Mall & Prof. Durga Prasad Mohapatra, IIT Kharagpur “Software Project Management”, https://onlinecourses.nptel.ac.in/noc19_cs70/preview [2]. Google Project Management Professional Certificate – Coursera https://www.coursera.org/professional-certificates/google-project-management/?utm_source=chatgpt.com [3] Leading Organizations to Success (MIT xPRO / Global Alumni) https://xpro.mit.edu/courses/course-v1%3AxPRO%2BMCP0%2BR1/ [4] Professional Certificate in Advanced Technical Project Management https://xpro.mit.edu/courses/course-v1%3AxPRO%2BPCTPM

23IT6405B - MOBILE ADHOC NETWORKS

Course Category:	Professional Elective-III							Credits:					3		
Course Type:	Theory							Lecture-Tutorial-Practice:					3-0-0		
Prerequisites:	Computer Networks							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 fundamental characteristics, architecture, applications of Mobile Ad Hoc Networks and Wireless Sensor Networks.													
	CO2	Summarize security challenges and defence mechanisms specific to MANETs and WSNs.													
	CO3	Explore the functioning and effectiveness of MAC and transport layer protocols in MANET and WSN environments													
	CO4	Analyse the behaviour and performance of routing protocols used in MANETs and WSNs.													
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	PSO2
	CO1		1									3			1
	CO2		3									1		2	
	CO3			2			3							2	
	CO4		2				2					1			3
Course Content	UNIT I: (10 hours) Introduction to Ad Hoc Wireless Networks- Cellular and Ad Hoc Wireless Networks, Applications of MANETs, Challenges of MANETs, Ad Hoc Wireless Internet. MAC protocols for Ad hoc Wireless Networks- Issues in designing a MAC Protocol for Adhoc wireless Networks, Design Goals of a MAC Protocol for Adhoc wireless, Classifications of the MAC Protocols.														
	UNIT II: (12 hours) Routing Protocols for Ad Hoc Wireless Networks- Issues in Designing a Routing Protocol, Classifications of Routing Protocols, Topology-based versus Position-based Approaches Transport Layer Protocols for Ad Hoc Wireless Networks - Issues and design goals of a Transport layer protocol, Classification of Transport layer solutions, TCP over Ad hoc Wireless Networks, Solutions for TCP over Ad Hoc Wireless Networks, Other Transport layer protocols.														
	UNIT III: (10 hours) Security protocols for Ad hoc Wireless Networks- Security in Ad hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Secure Routing in Ad hoc Wireless Networks. Basics of Wireless Sensors and Applications- Introduction, Empirical Energy Consumption, Sensing and Communication Range, Design Issues, Clustering of Sensors, Applications.														
	Unit- IV (10 hours) Data Retrieval in Sensor Networks- Classification of WSNs, MAC layer, Routing layer,														

	Transport layer, High-level application layer support. Security in WSNs- Security in Adhoc and Sensor Networks, Key Management: Diffie - Hellman Key Agreement, N- Party Diffie -Hellman Key Agreement, Secure Routing, Problems with Existing Adhoc Routing Protocols, Secure Routing Protocol, Cooperation in MANETs, WSN Security, Key Distribution and Management.
Text books and Reference books	Text Book(s): [1]. Ad Hoc Wireless Networks – Architectures and Protocols, C. Siva Ram Murthy, B. S. Murthy, Pearson Education, 2023 [2] Ad Hoc and Sensor Networks – Theory and Applications, 2nd edition Carlos Corderio Dharma P. Aggarwal, World Scientific Publications / Cambridge University Press, March 2011 Reference Books: [1]. Wireless Sensor Networks: An Information Processing Approach, 1st edition, Feng Zhao, Leonidas Guibas, Elsevier Science imprint, Morgan Kauffman Publishers, 2005, rp2009 [2]. Wireless Ad hoc Mobile Wireless Networks – Principles, Protocols and Applications, 1st edition, Subir Kumar Sarkar, et al., Auerbach Publications, Taylor & Francis Group, 2008 [3]. Wireless Ad hoc Networking, 1st edition, Shih-Lin Wu, Yu-Chee Tseng, Auerbach Publications, Taylor & Francis Group, 2007
E-resources and other digital material	[1]. Prof. Sudip Misra, Professor, Department of CSE, IIT Kharagpur Wireless Ad Hoc and Sensor Networks, [NPTEL](20, Jan, 2023) Available: https://nptel.ac.in/courses/106105160 [2]. Nancy Lynch, Computer Science At The Massachusetts Institute of Technology, Mobile Wireless Adhoc Networks, [MIT- Open Course Ware], (26, May, 2023). Available: https://courses.csail.mit.edu/6.885/spring06/ [3]. https://www.geeksforgeeks.org/computer-networks/introduction-of-mobile-ad-hoc-network-manet/

23IT6405C - NATURAL LANGUAGE PROCESSING

Course Category:	Professional Elective III							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 text pre-processing and normalization techniques to prepare raw text for NLP applications.												
	CO2	Develop and evaluate probabilistic language models for NLP tasks such as classification and sentiment analysis.												
	CO3	Analyze linguistic structure using POS tagging, sequence labeling, CFGs, and parsing algorithms.												
	CO4	Construct and interpret syntactic and semantic representations using logical formalisms, WordNet, and WSD techniques.												
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	2
	CO2	2	2	2		1							1	2
	CO3		3									2	1	2
	CO4	3	1	1		2						2	1	2
Course Content	UNIT I: (12 hours) Regular Expressions, Text Normalization, Edit Distance: Regular Expressions, Words, Corpora, Text Normalization, Word Tokenization, Word Normalization, Lemmatization and Stemming, Minimum Edit Distance, The Minimum Edit Distance Algorithm. Natural Language Toolkit Essentials (NLTK): Introduction to NLP – Diving into NLTK Text Wrangling and Cleansing – What is Text wrangling? Text cleansing, Sentence splitter, Tokenization, Stemming, Lemmatization, Stop word removal, Rare word removal.													
	UNIT II: (10 hours) N-gram Language Models – N Grams, Evaluating Language Models, Perplexity, Sampling sentences from a language model, Smoothing-Laplace smoothing, Add-k Smoothing, Back off and Interpolation, Generalization and Zeros, Kenser-Ney Smoothing. Naive Bayes and Sentiment Classification – Naive Bayes Classifiers, Training the Naïve Bayes Classifier, Worked example, Optimizing for Sentiment Analysis, Naive Bayes for other text classification tasks, Naive Bayes as a Language Model.													
	UNIT III: (10 hours) Sequence Labeling for parts of Speech and Named Entities: English Word Classes, Parts-of-speech-Tagging, Named Entities and Named Entities Tagging, HMM Parts of Speech Tagging, Markov Chains, The Hidden Markov Model, The components of an HMM tagger. Context-Free Grammars and Constituency Parsing: Constituency, Context-Free Grammars, Formal Definition of Context-Free Grammar, Treebanks, Grammar Equivalence and Normal Form, Ambiguity, CKY Parsing: A Dynamic Programming Approach - Conversion to Chomsky Normal Form, CKY Recognition, CKY Parsing, CKY in Practice, Dependency Grammar, Dependency													

	Relations. Case Study: Generation of Tags from a given sentences using Penn Treebank tagset. UNIT IV: (12 hours) Logical Representations of Sentence Meaning: Computational Desiderata for Representations, Model-Theoretic Semantics, First-Order Logic, Variables and Quantifiers, Lambda Notation, The Semantics of First-Order Logic, Inference, Event and State Representations. Word Senses and WordNet: Word Senses, Defining Word Senses, How many senses do words have, Relations Between Senses, WordNet: A Database of Lexical Relations, Sense Relations in WordNet, Word Sense Disambiguation. Case Study: Sentiment analysis of text data using NLTK
Text books and Reference books	Text Book(s): [1].Daniel Jurafsky and James H.Martin,“Speech and Language Processing:An Introduction to Natural Language Processing, Computational Linguistics,andSpeechRecognition”, (availbale at https://web.stanford.edu/~jurafsky/slp3/ed3book.pdf) [2]. Jacob Perkins, Nitin Hardeniya, Deepti Chopra, Iti Mathur, Nisheeth Josh Natural Language Processing: Python and NLTK, Packt Publishing,2016 Reference Books: [1]. Hobson lane, Cole Howard, Hannes Hapke, “Natural language processing in action” MANNING Publications, 2019. [2]. RajeshArumugam,RajalingappaShanmugamani “Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application”. PACKT publisher, 2018. [3]. Delip Rao&Brian McMahan, Natural Language Processing with PyTorch,O’Reilly,2019
E-resources and other digital material	[1]. Dan Jurafsky and Christopher Manning, Natural Language Processig Course,Stanford,26thJun2019, https://web.stanford.edu/~jurafsky/NLPCourseraSlides.html [2]. Dan Jurafsky and Christopher Manning, Natural Language Processig Course,10thJun2018, https://www.youtube.com/watch?v=3Dt_yh1mf_U&list=PLQiyVNMpDLKnZYBTUOlSI9mi9wAErFtFm [3]. Prof. DragomirRadev,Ph.D.,Lecture Series on Natural Language Processing,Department of School of Information,University of Michigan,Mar 2016, https://www.youtube.com/playlist?list=PLLssT5z_DsK8BdawOVCCaTCO99Ya58ryR

23IT6405D – DISTRIBUTED OPERATING SYSTEMS

Course Category:		Professional Elective III						Credits:				3			
Course Type:		Theory						Lecture-Tutorial-Practice:				3-0-0			
Prerequisites:		Operating Systems						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	Summarize the fundamental concepts, architectures, and design issues of distributed operating systems, including message passing and inter-process communication mechanisms.													
	CO2	Analyze the concepts of Remote Procedure Calls (RPC), communication protocols, and client–server models to design efficient distributed applications													
	CO3	Apply synchronization techniques, distributed shared memory models, and clock/event ordering algorithms to solve coordination problems in distributed environments.													
	CO4	Compare various resource management strategies, distributed file systems, fault tolerance mechanisms, and process migration techniques in distributed operating 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	2	2	1									3	1	
	CO3	3	2	2									3	1	
	CO4	2	3	1									2	2	
Course Content	UNIT I: (10 hours) Fundamentals: What is Distributed Computing Systems? Evolution of Distributed Computing System; Distributed Computing System Models; What is Distributed Operating System? Issues in Designing a Distributed Operating System; Introduction to Distributed Computing Environment(DCE). Message Passing: Introduction, Desirable features of a Good Message Passing System, Issues in PC by Message Passing, Synchronization, Buffering, Multi-datagram Messages, Encoding and Decoding of Message Data, Process Addressing, Failure Handling, Group Communication, Case Study: 4.3 BSD UNIX IPC Mechanism.														
	UNIT II: (10 hours) Remote Procedure Calls Introduction, The RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages, Marshaling Arguments and Results, Server Management, Parameter-Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client-Server Binding, Exception Handling, Security, Some Special Types of RPCs, RPC in Heterogeneous Environments, Lightweight RPC, Optimization for Better Performance, Case Studies: Sun RPC														
	UNIT III: (12 hours) Distributed Shared Memory:														

	Introduction, General Architecture of DSM systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other approaches to DSM, Heterogeneous DSM, Advantages of DSM. Synchronization: Introduction, Clock Synchronization, Event Ordering, Mutual Exclusion, Dead Lock, Election Algorithms UNIT IV: (12 hours) Resource Management: Introduction, Desirable Features of a Good Global Scheduling Algorithm, Task Assignment Approach, Load – Balancing Approach, Load – Sharing Approach Process Management: Introduction, Process Migration, Threads. Distributed File Systems: Introduction, Desirable Features of a Good Distributed File System, File models, File–Accessing Models, File – Sharing Semantics, File – Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions and Design Principles
Text books and Reference books	Text Book(s): [1]. 1. Pradeep. K. Sinha: Distributed Operating Systems: Concepts and Design, PHI, 2007. Reference Books: [1]. “Andrew S. Tanenbaum: Distributed Operating Systems, Pearson Education, 2013. [2]. “Ajay D. Kshemkalyani and MukeshSinghal, Distributed Computing: Principles, Algorithms and Systems, Cambridge University Press, 2008 [3]. “SunitaMahajan, Seema Shan, “ Distributed Computing”, Oxford University Press,2015
E-resources and other digital material	[1]. Prof Rajiv .Mishra, IIT. Patna, “Distriibted Systems” Case Study - Distributed Randomized Algorithmshttps://nptel.ac.in/courses/106106168 [2] Prof. Ananthanarayana V.S , IIT Madras, Distributed Computing Systems, basic concepts, https://nptel.ac.in/courses/106106107 [3] Prof. Ananthanarayana V.S , IIT Madras, Distributed Computing Systems Distributed Process Synchronization, https://nptel.ac.in/courses/106106107

23IT6351 CLOUD COMPUTING LAB

Course Category:	Laboratory					Credits:					1.5			
Course Type:	Professional core					Lecture-Tutorial-Practice:					0-0-3			
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	Demonstrate different cloud service types, delivery models, and core cloud technologies through hands-on experiments in a cloud environment.												
	CO2	Compare and experiment with cloud-based services deployed using virtual machines and containers to understand their architectural and performance differences.												
	CO3	Evaluate the key technical and security challenges encountered during the deployment and execution of cloud-based applications.												
	CO4	Implement and explore advanced cloud computing concepts such as serverless functions and cloud simulation tools to analyze cloud behavior and automation.												
	CO5	Apply appropriate cloud programming paradigms to design and execute solutions for real-world and scientific computing problems using cloud services.												
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	PS O 1	PS O 2
	CO1	3		2									1	
	CO2	3		2		3								2
	CO3	2		2		3							2	
	CO4	3		2		3								1
	CO5	2		2		3							2	
Contents	Week 1 : Implement basic Web Services Develop and test simple REST/SOAP-based web services to understand service-oriented communication in cloud environments.													
	Week 2: Work with Inter-Process Communication (IPC) and Messaging Systems Configure publish/subscribe models and message queues to demonstrate distributed communication.													
	Week 3: Install and Configure Virtual Machines a. Set up VirtualBox/VMware Workstation and deploy multiple Linux/Windows OS instances on a host system. b. Install a C compiler inside a virtual machine and execute basic programs to observe compilation and execution inside a VM.													
	Week 4: Launch and Configure an Amazon EC2 Instance Create an EC2 virtual server, deploy a web server, and configure security groups to allow HTTP access.													

	Week 5: Install and Use Google App Engine Create and deploy simple web applications using Python/Java on Google App Engine. Week 6: Deploy Containerized Applications Using Docker Launch Docker containers and host web applications (Apache2 or Flask) while mapping external directories as storage volumes. Week 7: File Transfer Across Virtual Machines and Containers Demonstrate secure file transfer between VMs (SCP/SFTP) and between Docker containers (Docker cp, volumes). Week 8: Work with OpenFaaS for Serverless Computing Deploy and invoke serverless functions using OpenFaaS, demonstrating event-driven execution. Week 09: Salesforce Cloud Platform – Application Development Create a Salesforce Developer Account, build a simple application using Objects, Apex Classes, Triggers, and Lightning App Builder. Demonstrate cloud-native CRM development and deployment. Week 10: Deploying Applications to the Cloud (AWS / Azure / GCP) Package and deploy a real-time or mini web application to a cloud platform using any of the following: • AWS Elastic Beanstalk • Azure App Services • Google Cloud Run / Cloud Functions Validate deployment, scaling options, logging, and monitoring features.
Text books and Reference books	Text Book(s): [1] Mastering Cloud Computing, 2nd edition, Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, Shivananda Poojara, Satish N. Srirama, McGraw Hill, 2024. [2] Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012. Reference Books: [1] Cloud Computing, Theory and Practice, Dan C Marinescu, 2nd edition, MK Elsevier, 2018. [2] Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011. [3] Online documentation and tutorials from cloud service providers (e.g.AWS, Google App Engine) [4] Docker, Reference documentation, https://docs.docker.com/reference/ [5] OpenFaaS, Serverless Functions Made Simple, https://docs.openfaas.com/

E-resources and other digital material	[1] Suresh S, Udemy, “Server Virtualization”, 2021 https://www.udemy.com/tutorial/cloud-computing-the-technical-essentials/basics-of-virtualization/ [2] Coursera, “Cloud Application Security”, 2021, https://www.mooc-list.com/course/cloud-application-security-coursera [3] Prof.Sowmya Kanti Ghosh, IIT Kharagpur, “Cloud Computing”, 2022 https://nptel.ac.in/courses/106/105/106105167/
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23IT6352 - MACHINE LEARNING LAB

Course Category:		Professional Core						Credits:					1.5		
Course Type:		Lab						Lecture-Tutorial-Practice:					0-0-3		
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 data pre-processing techniques and compute descriptive statistics to prepare datasets for machine learning tasks													
	CO2	Implement supervised learning models for both classification and regression and interpret their predictive performance.													
	CO3	Apply unsupervised learning techniques to group data patterns and evaluate clustering quality using suitable metrics.													
	CO4	Design and develop a complete machine learning solution for a real-world problem through a capstone project.													
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		
	CO2	2	1											2	
	CO3	2												2	
	CO4	3			1			1						1	1
Course Content	Week-1: Compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation. Week-2: Perform the following Exploratory Data Analysis Tasks a. Attribute selection b. Handling Missing Values c. Discretization d. Elimination of Outliers e. Univariate Analysis f. Multivariate Analysis Week-3: Apply KNN algorithm for classification and regression Week-4: a) Demonstrate decision tree algorithm for a classification problem and perform parameter tuning for better results b) Demonstrate - decision tree algorithm for a regression problem Week-5: a) Apply Random Forest algorithm for classification and regression b) Demonstrate Naïve Bayes Classification algorithm. Week-6: Apply Support Vector algorithm for classification Week-7:a) Demonstrate simple linear regression algorithm for a regression problem b) Apply Logistic regression algorithm for a classification problem Week-8: Demonstrate Multi-layer Perceptron algorithm for a classification problem Week-9: Implement the clustering algorithm and apply it to the data you selected. Evaluate performance by measuring the sum of the Euclidean distance of each example from its class center. Test the performance of the algorithm as a function of the parameters K. Week-10: a) Demonstrate the use of Fuzzy C-Means Clustering b) Demonstrate the use of Expectation Maximization based clustering algorithm. Week -11 & 12: Capstone Project on complete Machine Learning Pipe line.														

Text books and Reference books	Text Book(s): [1]. “Machine Learning Theory and Practice”, M N Murthy, V S Ananthanarayana, Universities Press (India), 2024 Reference Books: [1]. “Machine Learning”, Tom M. Mitchell, McGraw-Hill Publication, 2017 [2]. “Machine Learning in Action”, Peter Harrington, DreamTech [3]. “Introduction to Data Mining”, Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7 th Edition, 2019.
E-resources and other digital material	[1]. Kevin murphy,—machine learning: a probabilistic perspective , mit press, 2012, https://www.cs.ubc.ca/~murphyk/mlbook/pml-intro-5nov11.pdf [2] Machine learning by andrew ng, stanford university https://www.coursera.org/learn/machine-learning [3] Professor s. sarkar iit kharagpur “introduction to machine learning” , https://www.youtube.com/playlist?list=plyihddlf-cgyuwnl55wg8alkm6u8u7gps , 2025 [4] Professor carl gustafjansson, kth, video course on machine learning https://nptel.ac.in/noc/individual_course.php?id=noc19-cs35 , 2025

23TP6107 - QUANTITATIVE APTITUDE

Course Category:		Soft skill-4						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	Solve various Basic Mathematics problems by following different methods												
	CO2	Follow strategies in minimizing time consumption in problem solving Apply shortcut methods to solve problems												
	CO3	Confidently solve any mathematical problems and utilize these mathematical skills both in their professional as well as personal life.												
	CO4	Analyze, summarize and present information in quantitative forms including table, graphs and formulas												
Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3- High)		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO2
	CO1	2												
	CO2		2											
	CO3	2												
	CO4				2									
Course Content	UNIT I: (8 hours) Numerical ability I: Number system, HCF & LCM, Average, Ratio & Proportion Numerical ability II: Problems on ages, Partnership, Percentages, Profit & Loss, Allegation													
	UNIT II: (8 hours) Arithmetical ability I Time & Work, Pipes & Cistern, Chain Rule Arithmetical ability II: Time & Distance, Problems on Trains, Boats & Steams													
	UNIT III: (8 hours) Arithmetical ability III: Simple interest and compound interest, Calendar and Clock Logical ability: Permutations and Combination, and Probability, Cubes													
	UNIT IV: (8 hours) Mensuration: Areas, Volumes Data interpretation: Tabulation, Bar graphs, Pie charts, line graphs													
Text books and Reference books	Text Book(s): [1]. R. S. Aggarwal “Quantitative Aptitude”, Revised., S Chand publication, 2017, ISBN:8121924987													

SEMESTER VII

23IT7301 - INTERNET OF THINGS

Course Category:		Professional Core						Credits:				3				
Course Type:		Theory						Lecture-Tutorial-Practice:				3-0-0				
Prerequisites:		Computer Networks						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	Explain the fundamentals, evolution, and architecture of IoT, to identify networking components of an IoT systems													
		CO2	Analyze IoT sensing, actuation mechanisms, and data processing topologies for designing IoT devices.													
		CO3	Evaluate various IoT connectivity and communication technologies, protocols, and standards for different application scenarios.													
		CO4	Apply IoT concepts to real-world applications such as fog computing systems, smart agriculture, and vehicular IoT while addressing challenges and future trends.													
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	2
		CO2	3	3	2	2	1								2	1
		CO3	2	2	3	1	2								1	1
		CO4	2	3	4	2	2								2	2
Course Content		UNIT I: (10 hours) Predecessors of IoT: Introduction, Wireless Sensor Networks, Machine-to-Machine Communications. Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT.														
		UNIT II: (10 hours) IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics. IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies.														
		UNIT III: (10 hours) IoT Connectivity Technologies: Introduction, IEEE 802.15.4, Zigbee, Thread, ISA100.11A, WirelessHART, RFID, NFC,DASH7, Z-Wave, Weightless, Sigfox, LoRa, NB-IT, Wi-Fi, Bluetooth IoT Communication Technologies: Introduction, Infrastructure Protocols, Discovery Protocols, Data Protocols, Identification Protocols, Device Management, Semantic Protocols.														
		UNIT IV: (10 hours) Fog Computing and Its Applications: Introduction, View of Fog Computing Architecture, Fog Computing in IoT, Selected Applications of Fog Computing.														

	Paradigms, Challenges, and the Future: Introduction, Evolution of New IoT Paradigms, Challenges Associated with IoT, Emerging Pillars of IoT IoT Case Studies: Agricultural IoT, Vehicular IoT.
Text books and Reference books	Text Book(s): [1]. Sudip Misra, Anandarup Mukhaerjee, Arjit Roy , “Introduction to IoT”, Cambridge University Press, 2021 [2]. Raj Kamal, “ Internet of Things, Architecture and Design Principles ” 1 st Edition, McGraw Hill Education Private Limited, 2017. Reference Books: [1] Fog and Edge Computing: Principles and Paradigms, Rajkumar Buyya (Editor), Satish Narayana Srirama (Editor) , ISBN: 978-1-119-52498-4, January 2019 [2] CunoPfister , “Getting Started with the Internet of Things, , Oreilly [3] Francis daCosta, “ Rethinking the Internet of Things: A Scalable Approach to Connecting Everything ”, 1 st Edition, Apress Publications,2013
E-resources and other digital material	[1] Prof. Sudip Misra, IIT Kharagpur, “Introduction To Internet Of Things” January 2024, NPTEL. Introduction To Internet Of Things - Course. [2] Prof. Sudip Misra, IIT Kharagpur “Introduction to Industry 4.0 and Industrial Internet of Things”, 2019, NPTEL. Introduction to Industry 4.0 and Industrial Internet of Things - Course [3] Ian Harris, “An Introduction to Programming the Internet of Things (IOT) Specialization”, Coursera https://dev.to/thevediwho/my-top-5-resources-to-learn-internet-of-things-555n

23IT7302 – HUMAN RESOURCES & PROJECT MANAGEMENT

Course Category:	Management Course II							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	Explain fundamental concepts of Human Resource Management, including Models, HR planning, recruitment, selection, training, and performance appraisal.												
	CO2	Analyze HRD practices such as training methods, career development, group dynamics, and HR accounting in organizational contexts.												
	CO3	Apply project management principles including project life cycle, scheduling, resource allocation, and monitoring techniques.												
	CO4	Evaluate different types of projects and implement appropriate management strategies, including leadership, conflict resolution, and project performance evaluation												
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	3	2									1	1	
	CO2	2	3	2	2					1	2	2	2	1
	CO3	3	2	3	2					1	2	3	1	2
	CO4	3	3	4	3					1	3	2	2	1
Course Content	UNIT I: (10 hours) HRM: Nature, Scope, Concept of HRM, Functions of HRM, Role of HR manager, emerging trends in HRM (E-HRM), HR audit models, ethical aspects of HRM. HR Planning, Demand and Supply forecasting of HR, Job Design, Recruitment, Sources of recruitment, Selection-Selection Procedure. HRD, Models, Concept of Training and Development, Methods of Training, Career Development and Counselling, group dynamics. HR accounting. Performance Appraisal: Importance, Methods of performance appraisal.													
	UNIT II: (8 hours) Basics of Project Management, Concept, Project environment, Types of Projects, Project life cycle, Project proposals, project networks-DPR, Project appraisal and Project selection, resource management, Monitoring project progress, 80-20 rules, production technology, communication matrix													
	UNIT III: (9 hours) Identification of various project types: Infrastructure projects, Industrial projects, Service projects, Social projects and their unique management challenges. Management strategies tailored to specific project types. Project scheduling and resource allocation strategies													
	UNIT IV: (8 hours) Project Implementation and Review: Forms of project organization, prerequisites for successful project implementation, project planning, project control, human aspects of project management, conflict resolution and leadership in projects, project review, performance evaluation, abandonment analysis.													

Text books and Reference books	Text Book(s): [1] Robert L. Mathis, John H. Jackson, Manas Ranjan Tripathy, Human Resource Management, Cengage Learning 2016. [2] Sharon Pande and Swapnalekha Basak, Human Resource Management, Text and Cases, Vikas Publishing, 2e, 2016. [3]. Stewart R. Clegg, Torgeir Skyttermoen, Anne Live Vaagaasar, Project Management, Sage Publications, 1e, 2021 [4]. K. Nagarajan, Project Management, New Age International Publishers, 8e, 2017. Reference Books: [1] Subba Rao P, “Personnel and Human Resource Management-Text and Cases”, Himalaya Publications, Mumbai, 2013. [2] K Aswathappa, “Human Resource and Personnel Management”, Tata McGraw Hill, New Delhi, 2013. [3]. Prasanna Chandra, “Projects, Planning, Analysis, Selection, Financing, Implementation and Review”, Tata McGraw Hill, New Delhi, 1998. [4]. Vasanth Desai, “Project Management”, 4th edition, Himalaya Publications, 2018. [5] Lalitha Balakrishnan, Gowri, “Project Management”, Himalaya Publishing house, New Delhi, 2022
E-resources and other digital material	[1] Prof. Aradhna Malik, IIT Kharagpur, “Principles Of Human Resource Management”, NPTEL, 2021, https://onlinecourses.nptel.ac.in/noc21_mg21/preview [2] Prof.A.Ramesh, IIT Roorkee, “Project Management”, NPTEL, 2026 https://nptel.ac.in/courses/110107430 [3] Gabriella Parente, HR and Leadership Speaker, “Strategic HRM: Talent, Performance, Compensation Design”, Coursera, 2026 https://www.coursera.org/learn/strategic-hrm-talent-performance-compensation-design

23IT7403A - SOFTWARE ARCHITECTURE & DESIGN PATTERN

Course Category:	Professional Elective-IV								Credits:				3	
Course Type:	Theory								Lecture-Tutorial-Practice:				3-0-0	
Prerequisites:	Software Engineering								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	Summarize the basic concepts to identify state behaviour of real world objects												
	CO2	Apply Object Oriented Analysis and Design concepts to solve complex problems												
	CO3	Design models to show the importance of systems analysis and design in solving complex problems using case studies												
	CO4	Analyze Pattern Oriented approach for real world problems												
Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3- High)		PO 1	PO 2	PO 3	P O 4	P O 5	P O 6	PO 7	P O 8	P O 9	P O 10	P O 11	PSO1	PSO2
	CO1	3	3	2									2	
	CO2	2	1	3										1
	CO3	1	2	2									1	2
	CO4	2	2	3		3							2	2
Course Content	UNIT I: (10 hours) Introduction: design pattern, Describing design patterns, the catalog of design pattern, organizing the catalog, how design patterns solve design problems, how to select a design pattern, how to use a design pattern What is object oriented development, key concepts of object oriented design other related concepts, benefits and drawbacks of the paradigm													
	UNIT II: (10 hours) Analysis a System: Overview of the analysis phase, stage 1 gathering the requirements functional requirements specification, defining conceptual classes and relationships, using the knowledge of the domain Design and Implementation, discussions and further reading Design Pattern Catalog: Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, proxy.													
	UNIT III: (10 hours) Interactive systems and the MVC architecture: Introduction The MVC architectural pattern, analyzing a simple drawing program designing the system, designing of the subsystems, getting into implementation, implementing undo operation drawing incomplete items, adding a new feature pattern based solutions													
	UNIT IV: (10 hours) Designing with Distributed Objects: Client server system, java remote method invocation, implementing an object oriented system on the web, Web services (SOAP, Restful), Enterprise Service Bus													
Text books and Reference	Text Book(s): [1] Object Oriented Analysis, Design and Implementation, Brahma Dathan, Sarnath Rammath . Universities Press, 2013													

books	[2] Design Patterns, Erich Gamma, Richard Helan, Ralph Johman, John Vlissides, Pearson Publication, 2013 Reference Books: [1] Frank Bachmann, Regine Meunier, Hans Rohnert “Pattern Oriented Software Architecture”, Volume 1, 1996. [2] William J Brown et al., "Anti Patterns: Refactoring Software, Architectures and Projects in Crisis", John Wiley, 1998
E-resources and other digital material	[1] Prof. Rajib Mall, IIT Kharagpur, “Object Oriented System Development Using UML, Java And Patterns”, 2026. https://onlinecourses.nptel.ac.in/noc26_cs46/preview?user_email [2] Holczer Balazs, software engineer, “Software Architectures (SOLID) & Design Patterns in Java”,2025. https://www.udemy.com/course/basics-of-software-architecture-design-in-java/ [3]https://learn.microsoft.com/en-us/azure/architecture/ai-ml/guide/ai-agent-design-patterns, Microsoft build, 2026

23IT7403B - DEEP LEARNING

Course Category:		Program Elective							Credits:				3			
Course Type:		Theory							Lecture-Tutorial-Practice:				2-0-2			
Prerequisites:		23IT6303-Machine Learning							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	Summarize the fundamentals of deep learning, GAN, Deep generative models													
		CO2	Implement deep learning models using different open source DL libraries like tensorflow, keras,theano and CNTK													
		CO3	Apply Artificial Neural networks ,Convolution neural network models to suitable real world problems													
		CO4	Build a sequence model for time series and sequence-to sequence applications													
Contribution of Course Outcomes towards achievement of Program Outcomes 1-Low, 2-Medium, 3-High)			P O 1	PO 2	PO 3	PO 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	PO 11	PSO 1	PSO 2	
		CO1	1	1	1		1						1	1	1	
		CO2	2	2	1		1						1	1	1	
		CO3	2	2	2	1	2						2	2	2	
		CO4	3	3	2	1	2						3	3	3	
Course Content		UNIT I: Fundamentals of Deep Learning: Fundamentals of Deep Learning: Artificial Intelligence, History of Machine learning: Probabilistic Modeling, Early Neural Networks, Kernel Methods, Decision Trees, Random forests and Gradient Boosting Machines , Evaluating Machine learning Models, Overfitting and Underfitting. [Text Book 2] Introducing Deep Learning: Biological and Machine Vision, Human and Machine Language, Artificial Neural Networks, Training Deep Networks, Improving Deep Networks. [Text Book3]														
		UNIT II: Neural Networks: Anatomy of Neural Network, Introduction to Keras: Keras, TensorFlow, Theano and CNTK, Setting up Deep Learning Workstation, Classifying Movie Reviews: Binary Classification, Classifying newswires: Multiclass Classification. [Text Book 2]														
		UNIT III: Convolutional Neural Networks: Nerual Network and Representation Learing, Convolutional Layers, Multichannel Convolution Operation Recurrent Neural Networks: Introduction to RNN, RNN Code, PyTorch Tensors: Deep Learning with PyTorch, CNN in PyTorch. [Text Book 3]														
		UNIT IV: Interactive Applications of Deep Learning: Machine Vision, Natural Language processing, Generative Adversial Networks, Deep Reinforcement Learning. [Text Book 1] Deep Learning Research: Autoencoders, Deep Generative Models: Boltzmann Machines,Restricted Boltzmann Machines, Deep Belief Networks. [Text Book 1]														
Text books and Reference		Text Book(s): [1] Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016														

books	[2] Deep Learning with Python, Francois Chollet, December 2017, Manning Publications, ISBN: 9781617294433 [3] Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence, Jon Krohn, Grant Beyleveld, Aglaé Bassens, September 2019, Addison-Wesley Professional, ISBN: 9780135116821 [4] Deep Learning from Scratch, Seth Weidman, September 2019, O'Reilly Media, Inc., ISBN: 9781492041412 Reference (Book)s: [1]. Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009. [2]. Matrix Computations, Golub, G., H., Van Loan, C., F, JHU Press, 2013. [3]. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004.
E-resources and other digital material	[1]. Mitesh Khapra, "Deep Learning", Sep 20, 2018, https://www.youtube.com/watch?v=4TC5s_xNKSs&list=PLH-xYrxjfO2VsvyQXfBvsQsufAzvldg9 [2]. Afshine Amidi and Shervine Amidi, "Deep Learning cheat sheets for Stanford's CS 230", 2018, https://github.com/afshinea/stanford-cs-230-deep-learning [3]. Yoshua Bengio, Deep learning: "Theoretical Motivations, Canadian Institute for Advanced Research", 2015 http://videlectures.net/deeplearning2015_bengio_theoretical_motivations [4]. Prof. Prabir Kumar Biswas, IIT Kharagpur Swayam NPTEL: https://onlinecourses.nptel.ac.in/noc22_cs22/preview

23IT7403C – COMPUTER VISION

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	Explain camera models, radiometry, color and apply these concepts to analyze real-world imaging systems.												
	CO2	Apply filtering, edge detection, and texture methods to process images and analyze spatial-frequency characteristics for feature extraction.												
	CO3	Analyze multi-view geometry and segmentation techniques, and evaluate different clustering and graph-based methods for accurate image segmentation.												
	CO4	Design tracking models using probabilistic methods such as Hough Transform, EM algorithm, and Kalman filtering for dynamic vision applications.												
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	2
	CO2		2										2	1
	CO3	2		1		2				1			1	
	CO4		2	2		2				1			1	1
Course Content	UNIT I: (10 hours) Geometric Camera Models: Image Formation, Radiometry-Measuring Light: Light in Space, Light Surfaces, Important Special Cases Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Interreflections: Global Shading Models Color: The Physics of Color, Human Color Perception, Representing Color, A Model for Image Color, Surface Color from Image Color.													
	UNIT II: (10 hours) Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Edge Detection: Noise, Estimating Derivatives, Detecting Edges Texture0: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.													
	UNIT III: (10 hours) The Geometry of Multiple Views: Two Views Stereopsis: Reconstruction, Human Stereopsis, Binocular Fusion, Using More Cameras Segmentation by Clustering: Segmentation, Human Vision: Grouping and Gestalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering,													
	UNIT IV: (12 hours) Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in Practice, Tracking With Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data													

	Association, Applications and Examples
Text books and Reference books	Text Book(s): [3] David A. Forsyth, Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2015. Reference Books: [4]. E. R. Davies: Computer and Machine Vision – Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013. [5]. R. C. Gonzalez and R. E. Woods “Digital Image Processing” Addison Wesley 2008. [6]. Richard Szeliski “Computer Vision: Algorithms and Applications” Springer-Verlag London Limited 2011.
E-resources and other digital material	[1] Prof. P. K. Biswas, IIT Kharagpur, “Computer Vision”, 2019, https://nptel.ac.in/courses/106105216 [2] Prof. Subhasis Chaudhuri, IIT Bombay, “Digital Image Processing”, 2018, https://nptel.ac.in/courses/117104069 [3] University at Buffalo, Coursera, “Computer Vision Basics”, 2020, https://www.coursera.org/learn/computer-vision-basics [4] Andrew Ng, DeepLearning.AI, “Convolutional Neural Networks (Deep Learning Specialization)”, 2021. https://www.coursera.org/learn/convolutional-neural-networks [5] MIT OpenCourseWare, “Advanced Computer Vision”, 2018, https://ocw.mit.edu/courses/6-869-advances-in-computer-vision-fall-2018/

23IT7403D – BLOCKCHAIN TECHNOLOGY

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	Understand blockchain fundamentals, types and consensus mechanisms.												
		CO2	Analyze public, private and consortium blockchain systems and smart contracts.												
		CO3	Evaluate security, privacy challenges and real-world applications												
		CO4	Explore modern blockchain platforms, tools and emerging trends												
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	2
		CO2		2										2	1
		CO3	2		1									1	
		CO4		2	2						1			1	1
Course Content		UNIT I: (10 hours) Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future. Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol. Cryptocurrency: Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.													
		UNIT II: (10 hours) Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain. Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.													
		UNIT III: (10 hours) Private Blockchain System: Introduction, Key Characteristics of Private Blockchain, Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E- commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain. Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda.													

	Initial Coin Offering: Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms, UNIT IV: (12 hours) Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric. Applications of Blockchain: Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain in Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain Case Studies: Retail, banking, healthcare, energy
Text books and Reference books	Text Book(s): [1]. “Blockchain Technology”, Chandramouli Subramanian, Asha A.George, Abhilasj K A, Meena Karthikeyan , Universities Press Reference Books: [1]. Blockchain Blue print for Economy, Melanie Swan, SPD Oreilly. [2]. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gauar, Pearson Addition Wesley [3]. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder. [4]. Bitcoin: A Peer-to-Peer Electronic Cash System. Satoshi Nakamoto
E-resources and other digital material	[1]. Blockchain Demo https://tools.superdatascience.com/blockchain/hash/ [2]. Bitcons Monetary Policy https://www.blockchain.com/explorer [3]. Blockchain & Web3.0 Why the Web 3.0 Matters and you should know about it [4]. Ethereum Virtual Machine & Gas Calculating Costs in Ethereum Contracts [5]. Bina Ramamurthy, University at Buffalo, State University of New York, Blockchain Basics and Smart Contracts [6]. Prof. Sandeep Shukla, IIT Kanpur, Introduction to Blockchain Technology and Applications, 2020, https://nptel.ac.in/courses/106105184/

23IT7404A - AGILE METHODOLOGIES

Course Category:	Professional Elective							Credits:				3			
Course Type:	Theory							Lecture-Tutorial-Practice:				3-0-0			
Prerequisites:	23IT4305 : Software Engineering							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	Summarize the core concepts, values, and principles of Agile methodologies, including Scrum, XP, and Kanban, and differentiate them from traditional software development approaches.													
	CO2	Apply Agile estimation, planning, and time-management techniques to effectively manage software development tasks and project iterations.													
	CO3	Demonstrate effective teamwork and collaboration within Agile environments, including understanding roles, customer/user interactions, trust-building, and ethics in Agile teams.													
	CO4	Evaluate Agile quality assurance practices—such as Test-Driven Development, continuous measurement, and retrospectives—to ensure high-quality software delivery and adaptability to change.													
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										3		
	CO2	2	3						1			3	2	1	
	CO3					1			3		3	3	1	1	
	CO4					3			1		3	2	1		
Course Content	UNIT I: (9 hours) Agile and Scrum Principles: Three Perspectives on Software Engineering, Agile Manifesto, Scrum and Self-Organizing Teams, The Rules of Scrum, Scrum Values, Sprints, Planning, and Retrospectives, How to Plan and Run an Effective Scrum Sprint Customers and Users: Objectives, The Customer, The User Teamwork: Objectives, A Role Scheme in Agile Teams, Dilemmas in Teamwork														
	UNIT II: (9 hours) Agile estimation techniques: T-Shirt Sizing, Sprint Poker, Three-Point Method, Affinity Estimation, Relative Mass Evaluation, Dot voting, Maximum allowable size (MAS), Big, Uncertain, Small. Case Study: Which Agile Estimation Technique Should Your Team Use? Time: Objectives, Time-Related Problems in Software Projects, Tightness of Software Development Methods, Sustainable Pace, Time Management of Agile Projects														
	UNIT III: (10 hours) Measures: Importance of Measures, Case Study- Monitoring a Large-Scale Project by Measures Quality: Overview, The Agile Approach to Quality Assurance, Test-Driven Development, Measured TDD XP And Embracing Change: Going into Overtime, The Primary Practices of XP, The Game Plan Changed, but We're Still Losing, The XP Values Help the Team Change Their Mindset, An Effective														

	Mindset Starts with the XP Values, The Momentum Shifts, Understanding the XP Principles Helps You Embrace Change UNIT IV: (10 hours) Learning: How Does Agile Software Development Support Learning Processes Abstraction: Abstraction Levels in Agile Software Development Trust: Software Intangibility and Process Transparency, Game Theory Perspective in Software Development, Ethics in Agile Teams, Diversity
Text books and Reference books	Text Book(s): [1] Hazza and Dubinsky, —Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009. [2] Andrew Stellman, Jill Alison Hart, Learning Agile, O'Reilly, 2015 Reference Books: [1] Andrew Stellman, Jennifer Green, Head First Agile, O'reilly, 2017. [2] Rubin K , Essential Scrum : A Practical Guide To The Most Popular Agile Process, Addison-Wesley, 2013
E-resources and other digital material	[1] Praveen Mittal, Adjunct Professor, University of Minnesota https://www.coursera.org/learn/agile-software-development [2] Prof. Rajib Mall, CSE IIT Kharagpur, Course name: Agile model https://archive.nptel.ac.in/courses/106/105/106105182/ [3] Nate Dinot, Author & Co-founder of Conquer Life & Enterprise Agile Coach, Course name: An overview of agile methodologies https://www.udemy.com/course/agile-methodologies-overview/ [4] Bertrand Meyer : Agile methods are one of the most important developments https://learning.edx.org/course/course-v1:ETHx+ASD.1x+2T2020/home

23IT7404B – BIG DATA ANALYTICS

Course Category:	Professional Core							Credits:				3			
Course Type:	Theory							Lecture-Tutorial-Practice:				3-0-0			
Prerequisites:	Database Management Systems							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 the fundamentals and importance of Big Data, including key trends, unstructured data, and real world applications in domains such as healthcare, marketing, finance, and risk management.													
	CO2	Apply NoSQL data models and database concepts, including key value, document, and graph databases, and demonstrate operations such as data storage, retrieval, and processing.													
	CO3	Illustrate the architecture and working of Hadoop and implement basic data processing tasks using MapReduce and Hive for large scale data analysis.													
	CO4	Utilize Apache Spark for distributed data processing, including RDDs, DataFrames, and transformations, and perform basic stream processing using Structured Streaming.													
Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3- High)		PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2
	CO1	2	2			1							1	2	1
	CO2	3	2		1	3							1	3	2
	CO3	3	2	1	2	3							1	3	2
	CO4	3	2	1	2	3							2	3	3
Course Content	UNIT I: Importance of Big Data: Big data, convergence of key trends, unstructured data. Industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.														
	UNIT II: NOSQL: Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharding, master-slave replication, peer- peer replication, combining sharding and replication, consistency, relaxing consistency, version stamps.														
	UNIT III: Hadoop Distributed File System: The Design of HDFS, HDFS Concepts, The Command-Line Interface. MapReduce: Data formats, analyzing data with Hadoop, scaling out, Java interface, data flow. Hive: Hive Services, The Metastore, Comparison with Traditional Databases, HiveQL, data types, Tables, Partitions and Buckets, Joins, Subqueries and Views.														
	UNIT IV:														

	Introduction to Data Analysis with Spark- Apache Spark, A Unified Stack, A brief History of Spark. Programming with RDDs- RDD Basics, Creating RDDs, RDD Operations. Working with Key/value Pairs- Creating Pair RDDs, Transformations on Pair RDDs.
Text books and Reference books	Text Book(s): [4] Big Data, Big Analytics: Emerging, Michael Minnelli, Michelle Chambers, and Ambiga Dhiraj, 1st edition, 2013. [5] Learning Spark: Lightning-Fast Data Analysis, Holden Karau, Andy Konwinski, Patrick Wendell & Matei Zaharia. [6] Business Intelligence and Analytic Trends for Today's Businesses", Wiley, First edition-2013. [7] P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World Polyglot Persistence", Addison-Wesley Professional, 2012 [8] Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012. Reference Books: [7]. "Hadoop Operations", O'Reilley, Eric Sammer, First Edition -2012. [8]. "Programming Hive", O'Reilley, E. Capriolo, D. Wampler, and J. Rutherglen, 2012. [9]. "HBase: The Definitive Guide", O'Reilley, Lars George, September 2011: First Edition.
E-resources and other digital material	[7]. Statistical Foundation for Big Data Analysis, Prof. Arindam Banerjee, IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc26_cs09/preview [8]. Introduction to NoSQL Databases, Rav Ahuja, https://www.coursera.org/learn/introduction-to-nosql-databases

23IT7404C - MOBILE COMPUTING

Course Category:	Professional Elective							Credits:					3	
Course Type:	Theory							Lecture-Tutorial-Practice:					3-0-0	
Prerequisites :	23IT5302 - Computer Networks							Continuous Evaluation:					30	
								Semester end Evaluation:					70	
								Total Marks:					100	
Course Outcomes	Upon successful completion of the course, the student will be able to:													
	CO 1	Outline the architecture of mobile computing systems and the functionalities of various mobile network models..												
	CO 2	Apply knowledge of various mobile generations to select suitable technologies for real-world use cases.												
	CO 3	Analyze MANET architectures and protocols to enable seamless communication in dynamic networks.												
	CO 4	Analyze WLAN operations for reliable mobile internet communication.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3-High)		PO 1	PO 2	PO 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	P O 11	PSO 1	PSO 2
	CO 1	1										2	1	
	CO 2		2			1	1				1			2
	CO 3		3				2				2		2	
	CO 4						1					1	1	
Course Content	UNIT I: (12 hours) Mobile Communications: An Overview- Mobile Communication-guided transmission, unguided transmission- signal propagation frequencies, antennae, modulation, modulation methods and standards for voice-oriented data communication standards, modulation methods and standards for data and voice communication, mobile computing- novel applications and limitations, mobile computing architecture, mobile system networks. Mobile devices and systems: Cellular networks and frequency reuse, Mobile smart phones, Smart mobiles and systems, handheld pocket computers, Handheld devices, Smart systems, Limitations of mobile devices.													
	UNIT II: (10 hours) GSM and other 2G Architectures: GSM-services and system architecture, Radio interfaces of GSM, Protocols of GSM, Localization, Call handling, GPRS system architecture. Wireless medium access control, CDMA, 3G, 4G , 5G and 6G. Communication: Modulation, Multiplexing, Controlling the medium access, Spread spectrum, Coding methods, IMT-2000 3G wireless communication standards, WCDMA 3G communication standards, CDMA 3G communication standards, Broadband wireless access, 4G networks.													

	UNIT III: (10 hours) Mobile IP Network layer: IP and Mobile IP network layers: OSI layer functions, TCP/IP and Internet protocol, Mobile internet protocol; Packet delivery and Handover Management; Location Management: Agent Discovery; Mobile TCP Introduction to Mobile Adhoc network: fixed infrastructure architecture, MANET infrastructure architecture; MANET: properties, spectrum, applications; Security in Ad-hoc network; Wireless sensor networks; sensor network applications. Unit- IV: (10 hours) Synchronization: Synchronization in mobile computing systems, Usage models for Synchronization in mobile application, Domain-dependant specific rules for data synchronization, Personal information manager, synchronization and conflict resolution strategies, synchronizer; Mobile agent: mobile agent design, aglets; Application Server. Mobile Wireless Short Range Networks and Mobile Internet: Wireless networking and wireless LAN, Wireless LAN (WLAN) architecture, IEEE 802.11 protocol layers, Wireless application protocol (WAP)-WAP1.1 architecture, wireless datagram protocol (WDP), Wireless Transport Layer Security (WTLS), wireless transaction and session layers, wireless application environment.
Text books and Reference books	Text Book(s): [1]. Mobile Computing, Raj Kamal, second edition, Oxford , 2015 [2]. Mobile Computing, Technology Applications and Service Creation, Asoke K Talukder, Hasanahmed, Roopa R Yavagal , Second Edition, Mc Graw Hill, 2020 Reference Books: [1]. Principles of Mobile Computing UWE Hansmann, Lothar Merk, Martin S. Nocklous, Thomas Stober Second Edition, Springer, 2017. [2]. Mobile Communication, 1st edition, Jochen Schiller, Addison Wesley, second Edition, Pearson Education, 2007
E-resources and other digital material	[1]. Prof. Sudip Misra, Professor, Department of CSE, IIT Kharagpur Wireless Ad Hoc and Sensor Networks, [NPTEL](20, Jan, 2023) Available: https://nptel.ac.in/courses/106105160 [2]. Nancy Lynch, Computer Science At The Massachusetts Institute of Technology, Mobile Wireless Adhoc Networks, [MIT- Open Course Ware], (26, May, 2023). Available: https://courses.csail.mit.edu/6.885/spring06/ https://www.geeksforgeeks.org/computer-networks/introduction-of-mobile-ad-hoc-network-manet/

23IT7404D - CYBER PHYSICAL SYSTEMS

Course Category:	Professional Elective							Credits:			3			
Course Type:	Theory							Lecture-Tutorial-Practice:			3-0-0			
Prerequisites:	23IT4303 - Operating Systems, 23IT5302 - Computer Networks							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 fundamental principles, architecture, and symbolic modelling techniques of Cyber Physical Systems.												
	CO2	Analyze security requirements, attack models, and countermeasures to protect Cyber Physical Systems from cyber threats.												
	CO3	Apply synchronization, real-time scheduling, and distributed consensus techniques to design reliable Cyber Physical Systems.												
	CO4	Evaluate modern CPS applications including Industry 4.0, Smart Grid, Healthcare CPS, Digital Twins and AI-driven CPS solutions.												
Contribution of Course Outcomes towards achievement of Program Outcomes (1-Low, 2-Medium, 3-High)		P O 1	PO 2	PO 3	PO 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PSO 1	PSO 2
	CO1	2	1										2	
	CO2	2	3	2	2								2	1
	CO3	2	2	3		2							2	2
	CO4	1	2	3	2	3							2	3
Course Content	UNIT I: Introduction and Symbolic Synthesis for Cyber-Physical Systems (10 hours) Introduction to Cyber Physical Systems: Definition, Key Features of CPS, Application Domains, Basic Principles of Design and Validation of CPS, Challenges in CPS, CPS Hardware Platforms, Processors, Sensors and Actuators, CPS Networks (Wireless, CAN, Automotive Ethernet). Symbolic Synthesis for Cyber-Physical Systems: Introduction and Motivation, Basic Techniques – Preliminaries, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Continuous-Time Controllers, Software Tools.													
	UNIT II: Security of Cyber-Physical Systems (10 hours) Introduction and Motivation, Basic Techniques – Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques – System Theoretic Approaches. CPS Security Case Studies: Stuxnet, Smart Grid Attacks, Automotive CPS Threats, Intrusion Detection and Anomaly Detection in CPS, Secure Communication Protocols, Blockchain-based CPS Security													
	UNIT III: Synchronization and Real-Time Scheduling in Distributed CPS (10 hours) Synchronization in Distributed Cyber-Physical Systems: Challenges in Cyber-Physical Systems, A Complexity-Reducing Technique for Synchronization, Formal Software Engineering, Distributed Consensus Algorithms, Synchronous Lockstep Executions, Time-Triggered Architecture. Real-Time Scheduling for Cyber-Physical													

	Systems: Introduction and Motivation, Basic Techniques, Scheduling with Fixed Timing Parameters, Memory Effects, Multiprocessor/Multicore Scheduling, Accommodating Variability and Uncertainty. UNIT IV: Model Integration and Modern CPS Applications (10 hours) Model Integration in Cyber-Physical Systems: Introduction and Motivation, Causality, Semantic Domains for Time, Interaction Models for Computational Processes, Semantics of CPS DSMLs, Formalization of Semantics. Modern CPS Applications: Industry 4.0 and Industrial IoT, Digital Twins and their role in CPS, Smart Grid and Energy CPS, Healthcare and Medical Cyber-Physical Systems, Smart Cities and Connected Autonomous Vehicles, Role of AI and Machine Learning in CPS, Edge Computing for CPS.
Text books and Reference books	Text Book(s): [1]. Raj Rajkumar, Dionisio De Niz, Mark Klein, “Cyber-Physical Systems”, Addison-Wesley Professional, 2024 Reprint. [2]. Rajeev Alur, “Principles of Cyber-Physical Systems”, Paperback Edition, MIT Press, 2024 Reprint (ISBN: 9780262548922). [3]. Fei Hu, “Cyber-Physical Systems: Integrated Computing and Engineering Design”, CRC Press, Taylor & Francis, 2024 Reprint. Reference (Book)s: [1]. Keshav Kaushik, Susheela Dahiya, Rajkumar Buyya, Chung-Nan Lee (Eds.), “Cyber-Physical Systems Security: A Multi-disciplinary Approach”, Studies in Big Data Vol. 154, Springer, 2025 (ISBN: 978-981-97-5734-3). [2]. Ramesh Chandra Poonia, Sugam Sharma, Ibrahim A. Hameed, Kamal Upreti (Eds.), “Smart Cyber Physical Systems: Proceedings of ICSCPS 2024”, Smart Innovation, Systems and Technologies, Springer, 2025. [3]. Gunasekaran Manogaran, Nour Eldeen M. Khalifa, Mohamed Loey, Mohamed Hamed N. Taha (Eds.), “Cyber-Physical Systems for Industrial Transformation: Fundamentals, Standards and Protocols”, CRC Press, Taylor & Francis, 2024. [4]. Siddhartha Bhattacharyya, Jyoti Sekhar Banerjee, Ahmed J. Obaid, Wei-Chang Yeh (Eds.), “Intelligent Cyber-Physical Systems Security for Industry 4.0”, Chapman & Hall / CRC Press, 2024 Reprint. [5]. May El Barachi, Sujith Samuel Mathew, Farhad Oroumchian (Eds.), “Transforming Industry using Digital Twin Technology”, Springer, 2024 (Softcover 2025).
E-resources and other digital material	[1] Prof. Soumyajit Dey, Department of Computer Science and Engineering, IIT Kharagpur, “Introduction to Cyber Physical Systems”, NPTEL, 2024. URL: https://nptel.ac.in/courses/106105195 [2] Prof. Edward A. Lee and Prof. Sanjit A. Seshia, University of California, Berkeley, “Introduction to Embedded Systems – A Cyber-Physical Systems Approach”, UC Berkeley EECS Open Course, 2023. URL: https://ptolemy.berkeley.edu/books/leeseshia/ [3] Prof. Andre Platzer, Carnegie Mellon University, “Foundations of Cyber-Physical Systems”, CMU Open Courseware, 2023. URL: https://symbolaris.com/course/fcps.html [4] Prof. Raj Rajkumar, Carnegie Mellon University, “Cyber Physical Systems”, Coursera, 2024. URL: https://www.coursera.org/learn/cyber-physical-systems-1 [5] NIST Cyber-Physical Systems Public Working Group, “CPS Framework”, National Institute of Standards and Technology, 2024. URL: https://www.nist.gov/el/cyber-physical-systems [6] IEEE Cyber Physical Systems Technical Committee, “CPS Resources and

	Publications”, IEEE Portal, 2025. URL: https://www.ieee-ies.org/technical-committees/cyber-physical-systems
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23IT7205A- OBJECT ORIENTED PROGRAMMING THROUGH JAVA

Course Category:	Open Elective-III		Credits:					3						
Course Type:	Theory		Lecture-Tutorial-Practice:					3-0-0						
Prerequisites:	Basics of 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	Apply conditional and looping statements for decision-making.												
	CO2	Describe object-oriented programming principles to build classes and objects												
	CO3	Implement exception handling techniques for handling run time errors												
	CO4	Apply packages to organize and structure the Java code effectively, ensuring												
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	PS O1	PSO 2
	CO1	1	1											
	CO2	1	1											
	CO3		2	3									1	
	CO4			1								1	1	1
Course Content	UNIT I: (10 hours) Object Oriented Programming: Basic concepts, Principles. Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style. Data Types, Variables, and Operators: Data Types in Java, Declaration of Variables, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, printf() Method, Static Variables and Methods, Final keyword, Arithmetic, Relational, Logical, Bitwise Operators. Control Statements: if, nested if, if-else, switch, while, do-while, for, for-each, break, continue.													
	UNIT II: (10 hours) Classes and Objects: Class Declaration and Modifiers, Class Members, Object Declaration, Access Control, Constructors, Overloaded Constructors, Nested Classes, Final Class and Methods, this keyword. Methods: Defining Methods, Overloaded Methods, Recursive Methods, Overriding Methods, final and static methods.													
	UNIT III: (10 hours) Arrays: Declaration and Initialization, Accessing Elements, Operations on Arrays, Dynamic Array Size, Sorting and Searching, Multidimensional Arrays. String Handling in Java: String Class, Character Extraction, Comparison, Modification, Searching, StringBuffer. Inheritance: Types of Inheritance, Object Class, final keyword, super keyword, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces. Interfaces: Declaration, Implementation, Multiple Interfaces, Nested Interfaces, Functional Interfaces, Annotations.													
	UNIT IV: (10 hours) Packages and Java Library: Defining Packages, Importing Packages, Access Control, java.lang Package, Math Class, Wrapper Classes, Random Class, Date/Time Formatting. Exception Handling: Exception Hierarchy, throw, throws, try, catch, finally, Checked and Unchecked Exceptions. Multithreaded Programming: Thread Class, Thread States, Synchronization, Deadlock, Race Conditions, Inter-thread Communication. Case Study: Reservation system													

Text books and Reference books	Text Book(s): [3].Anitha Seth, B.L. Juneja , “JAVA one step ahead” , Oxford University Press, 2017 [4].Debasis Samanta, Monalisa Sarma , “Joy with JAVA “, Cambridge University Press,,2018 [5].Paul Deitel, Harvey Deitel “ JAVA 9 for Programmers” , Pearson Education,2018 Reference Book(s): [3].Herbert Schildt, “Java The Complete Reference”, 11 th Edition, McGraw-Hill Education, New Delhi, 2019. [4].Kathy Sierra & Bert Bates, Head First Java, Second edition, Shroff/O’Reilly, 2009
E-resources and other digital material	[1]Prof. Debasis Samanta, IIT Kharagpur, NPTEL course, https://onlinecourses.nptel.ac.in/noc22_cs47/preview [2] Cay Horstmann, Cheng-Han Lee, Sara Tansey, San Jose State University, (19-05-2021) Intro to Java Programming https://www.youtube.com/watch?v=Wsp5Rrenoq4 [3] 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

23IT5651– PROMPT ENGINEERING

Course Category:	Skill Enhancement									Credits:			2	
Course Type:										Lecture-Tutorial-Practice:			0-1-2	
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	Summarize the foundational concepts of prompt engineering, including prompt design principles, anatomy, and iterative prompting lifecycle.												
	CO2	Apply advanced prompt patterns and techniques such as few-shot prompting, role-based prompting, and constraint specification to design effective prompts.												
	CO3	Construct structured outputs and reasoning-based prompts using formats like JSON, YAML, and task decomposition strategies.												
	CO4	Develop retrieval-augmented generation (RAG) pipelines using LangChain, embeddings, and vector stores for real-world LLM applications.												
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	3	2								2		1	2
	CO2	2	3	2	1	2					2		2	3
	CO3	2	3	3	2	2					2		2	3
	CO4													
		2	3	3	3	3					2		3	3
Course Content	UNIT I: (6 hours) Foundations of Prompt Engineering: Definition of prompt engineering, Distinction between prompt engineering and model fine-tuning, Motivation and benefits of prompt engineering, Core principles of effective prompt design, Anatomy of a prompt, Setting up the Python environment for LLM interaction, Iterative prompting lifecycle, Common prompt pitfalls and remediation.													
	UNIT II: (6 hours) Advanced Prompt Patterns & Techniques: Enhanced prompt anatomy: contextual detail and explicit output specifications, Few-shot in-context prompting, Prompt structuring and template design, Role-based prompting to establish personas or system behaviour, Negative prompting to filter or suppress undesired content, Constraint specification and instruction enforcement (e.g., length, format), Iterative prompt refinement and optimization.													
	UNIT III: (6 hours) Structured Output & Reasoning Techniques: Importance of structured outputs for real-world applications, Prompting for specific formats (lists, tables, Markdown), Generating valid JSON and YAML via explicit instructions, Eliciting chain-of-thought reasoning in zero-shot prompts, Decomposing complex tasks into manageable sub-tasks.													
	UNIT IV: (6 hours) Retrieval-Augmented Generation & LangChain Workflows: Limitations of LLM internal knowledge, Need for external data sources, Introduction to Retrieval Augmented Generation (RAG), Overview of RAG architecture (indexing vs. retrieval + generation), Getting started with LangChain for LLM applications, Basics of LangChain Expression Language (LCEL), Simplified indexing pipeline: document													

	loading & text splitting, Fundamentals of embedding's and vector stores, Building a basic retrieval generation pipeline with an LCEL chain.
Text books and Reference books	Text Books: [1] James Phoenix, Mike Taylor: Prompt Engineering for Generative AI, O'Reilly Media, 2024. [2] Valentina Alto: Building LLM Applications with LangChain, Packt Publishing, 2023. Reference Books: [1] Ben Auffarth: Generative AI with Python and LangChain, Packt Publishing, 2024. [2] Mehul Gupta: LangChain in Your Pocket, Packt Publishing, 2024. [3] Adrian Thompson: ChatGPT for Conversational AI and Chatbots, Packt Publishing, 2024. [4] Chip Huyen: AI Engineering: Building Applications with Foundation Models, O'Reilly Media, 2025.
E-resources and other digital material	[1] DeepLearning.AI, "ChatGPT Prompt Engineering for Developers", 2023, https://www.deeplearning.ai/short-courses/chatgpt-prompt-engineering-for-developers/ [2] OpenAI, "OpenAI Documentation & Prompt Engineering Guide", https://platform.openai.com/docs [3] LangChain, "LangChain Official Documentation", https://python.langchain.com [4] Hugging Face, "Transformers and Prompt Engineering Course", https://huggingface.co/learn [5] DAIR.AI, "Prompt Engineering Guide", https://www.promptingguide.ai

SEMESTER VIII

23IT8 - MAJOR PROJECT

Course Category:		Internship & Project Work					Credits:					12			
Course Type:		Practical					Lecture-Tutorial-Practice:					0-0-24			
Prerequisites:		Major Project					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, develop and test the developed model using advanced techniques												
		CO2	Compare and analyse the proposed framework results with state-of-the-art techniques.												
		CO3	Derive and justify the conclusions from the work done and make recommendations for future improvement.												
		CO4	Work as an individual or in a team in the development of technical projects.												
		CO5	Create a logically coherent project report and project the work in an effective manner.												
Contribution of Course Outcomes towards achievement of Program Outcomes 1-Low, 2-Medium, 3-High)			PO 1	P O 2	P O 3	P O 4	P O 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
		CO1	2	2	3	3	2				2		2	2	2
		CO2	1	2	3	2	3				2		2	2	2
		CO3	1	1	2	3	3				2		1	2	2
		CO4			1	1					3	2	2	1	1
		CO5						1	1	2	3	3	2	1	1