Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University Estd. u/s 3 of UGC Act 1956, Category A by MHRD)
Re-accredited with A++ Grade by NAAC. CGPA 3.65/4, Category I by UGC
Coimbatore - 641 043, Tamil Nadu, India

School of Engineering

B.E Computer Science and Engineering

Programme Specific Outcomes:

The graduates in Computer Science and Engineering will be able to

PSO1: Analyse and develop computer programs in the areas related to algorithms, database, web design, data mining, information security, cloud computing and networking for efficient design of computer-based systems of varying complexity.

PSO2: Gain knowledge in diverse areas of Computer Science and experience an environment conducive in cultivating skills for successful career, entrepreneurship and higher studies.

Scheme of Instruction & Examination

(For students admitted from the academic year **2024-2025** and onwards)

Part	*Course Code*	*Name of Course/component*	*Hours of Instruction/week*		*Scheme of Examination*				
			Theory	*Tutorial/ Practical*	*Duration of exam*	*CIA*	*CE*	*Total*	*Credit*
First Semester									
Induction Program including Universal Human Values (Introduction)									
I		**Humanities and Social Sciences (HS)**							
	24BEHS01	English for Technical Writing	2	0/2	3	50	50	100	3
II		**Basic Sciences (BS)**							
	24BESM01	Mathematics - I (Algebra and Calculus)	3	1/0	3	50	50	100	4
	24BESP01	Physics for Computer Technology	3	0/2	3	50	50	100	4
III		**Core Courses Engineering Sciences (ES)**							
	24BEES01	Basic Electrical and Electronics Engineering (ECE)	3	0/2	3	50	50	100	4
	24BEES02	Programming for Problem Solving using C	3	-	3	50	50	100	3
	24BEES05	Programming for Problem Solving using C Laboratory	-	0/2	3	50	50	100	1
	24BEES06	Engineering Practices Laboratory	-	0/4	3	50	50	100	2
IV		**Non-Credit Mandatory Courses (NCMC)**							
	24BEMC01	Environmental Science	3	-	2	100	-	100	Remark
	24EVBNS1/ 24EVBNC1/ 24EVBSP1	Value Based Elective -I NSS-I/NCC-I/ Sports -I	-	-	2	100	-	100	Remark
Second Semester									
I		**Humanities and Social Sciences (HS)**							
	24BEHS02	Universal Human Values -II (Understanding Harmony and Human Conduct)	2	1/0	3	50	50	100	3
II		**Basic Sciences (BS)**							
	24BESM03	Mathematics – II (Probability and Statistics)	3	1/0	3	50	50	100	4
III		**Core Courses Engineering Sciences (ES)**							
	24BEES03	Essentials of Computer Science and Engineering	3	-	3	50	50	100	3
	24BEES04	Digital Principles and Computer Architecture	3	1/0	3	50	50	100	4
	24BEES09	Programming for Problem Solving using Python	3	-	3	50	50	100	3
	24BEES13	Programming for Problem Solving using Python Laboratory	-	0/2	3	50	50	100	1
		Core Courses Professional Core (PC)							
	24BEOC01	Data Structures and Algorithms - I	3	-	3	50	50	100	3
	24BEOC02	Data Structures and Algorithms - I Laboratory	-	0/2	3	50	50	100	1
IV		**Non-Credit Mandatory Courses (NCMC)**							
	24BEMC02	Constitution of India	2	-	2	100	-	100	Remark
	24EVBNS2/ 24EVBNC2/ 24EVBSP2	Value Based Elective -I NSS-II/NCC-II/Sports -II	-	-	2	100	-	100	Remark

Part	*Course Code*	*Name of Course/ component*	*Hours of Instruction / week*		*Scheme of Examination*				
			Theory	*Tutorial/ Practical*	*Duration of exam*	*CIA*	*CE*	*Total*	*Credits*
Third Semester									
II		**Basic Sciences (BS)**							
	24BESM06	Mathematics – III (Discrete Mathematical Structures)	3	1/0	3	50	50	100	4
III		**Core Courses Engineering Sciences (ES)**							
	24BEES21	Object Oriented Programming using Java	3	0/2	3	50	50	100	4
III		**Core Courses Professional Core (PC)**							
	24BEOC03	Foundations of Data Science	3	-	3	50	50	100	3
	24BEOC04	Data Structures and Algorithms -II	3	-	3	50	50	100	3
	24BEOC05	Database Management Systems	3	-	3	50	50	100	3
	24BEOC06	Software Engineering	3	-	3	50	50	100	3
	24BEOC07	Data Structures and Algorithms - II Laboratory	-	0/3	3	50	50	100	1
	24BEOC08	Database Management Systems Laboratory	-	0/3	3	50	50	100	1
IV		**Non-Credit Mandatory Courses (NCMC)**							
	24BEMC03	Consumer Affairs	3	-	2	100	-	100	Remark
	24BEOV01	Value Added Course - Computer Animation	2	-	-	100	-	100	Remark
Fourth Semester									
II		**Basic Sciences (BS)**							
	24BESM09	Mathematics –IV (Linear Algebra and Queueing Theory)	3	1/0	3	50	50	100	4
III		**Core Courses Professional Core (PC)**							
	24BEOC09	Operating Systems	3	-	3	50	50	100	3
	24BEOC10	Artificial Intelligence	3	-	3	50	50	100	3
	24BEOC11	Computer Networks	3	0/2	3	50	50	100	4
	24BEOC12	Design and Analysis of Algorithms	3	-	3	50	50	100	3
	24BEOC13	Distributed Computing	3	-	3	50	50	100	3
	24BEOC14	Operating Systems Laboratory	-	0/3	3	50	50	100	1
	24BEOC15	Artificial Intelligence Laboratory	-	0/3	3	50	50	100	1
IV		**Non-Credit Mandatory Courses (NCMC)**							
	24BEMC04	Essence of Indian Knowledge Tradition	3	-	2	100	-	100	Remark
	24BECS01	Communication Skills	2	-	2	100	-	100	Remark
# 6 to 8 weeks Industrial Internship during summer vacation									

Part	Course Code	Name of Course/ component	Hours of Instruction/week		Scheme of Examination				
			Theory	Tutorial/ Practical	Duration of exam	CIA	CE	Total	Credits
Fifth Semester									
III		**Core Courses** **Professional Core (PC)**							
	24BEOC16	Data Mining and Warehousing	3	-	3	50	50	100	3
	24BEOC17	Cloud Computing and Virtualization	3	-	3	50	50	100	3
	24BEOC18	Big Data Analytics	3	-	3	50	50	100	3
	24BEOC19	Theory of Computation	3	-	3	50	50	100	3
	24BEOC20	Linux Programming	3	-	3	50	50	100	3
	24BEOC21	Data Mining and Big Data Analytics Laboratory	-	0/3	3	50	50	100	1
	24BEOC22	Cloud Computing Laboratory	-	0/3	3	50	50	100	1
III		**Professional Elective (PE)**							
	`	Professional Elective – I (PE1 or PE2)	3	-	3	50	50	100	3
IV		**Non-Credit Mandatory Courses (NCMC)**							
	24BEMC05	Design Thinking	1	0/2	2	100	-	100	Remark
	24BESS01	Soft Skills	2	-	2	100	-	100	Remark

Professional Elective – I (Select one course either from PE1 or PE2)

PE1:	**PE2:**
24BEOE01 Exploratory Data Analysis/ 24BEOE02 Social Media Analytics/ 24BEOE03 Computer Vision/ 24BEOE04 Predictive Analytics	24BEOE21 Quantum Computing/ 24BEOE22 High Performance Computing/ 24BEOE23 Internet of Things and Applications/ 24BEOE24 Software Testing

Sixth Semester									
III		**Core Courses** **Professional Core (PC)**							
	24BEOC23	Internet and Web Technology	3	-	3	50	50	100	3
	24BEOC24	Machine Learning	3	-	3	50	50	100	3
	24BEOC25	Cryptography and Cyber Security	3	-	3	50	50	100	3
	24BEOC26	Compiler Design	3	-	3	50	50	100	3
	24BEOC27	Internet and Web Technology Laboratory	-	0/3	3	50	50	100	1
	24BEOC28	Machine Learning Laboratory	-	0/3	3	50	50	100	1
	24BEOC29	Mini Project	-	0/4	-	100	-	100	2
III		**Professional Electives (PE)**							
		Professional Elective – II (PE1/PE2)	3	-	3	50	50	100	3
	24BEOE40 - 24BEOE59	Professional Elective – III Title of MOOC (SWAYAM-NPTEL) ##	3	-	-	-	-	100	3
IV		**Non-Credit Mandatory Courses (NCMC)**							
	24BEMC06	Professional Ethics	3	-	2	100	-	100	Remark
	24EVBAP1/ 24EVBGP1/ 24EVBWS1/ 24BSCGA1/ 24BSCQA1	Value Based Elective-II	-	-	2	100	-	100	Remark

 # 6 to 8 weeks Industrial Internship during summer vacation

Professional Elective-II (Select one course from PE1 if the student selected PE1 in 5th semester or select one course from PE2 if the student selected PE2 in 5th semester)

PE1:	**PE2:**
24BEOE05 Data Visualization/ 24BEOE06 Image and Video Analytics/ 24BEOE07 Natural Language Processing/ 24BEOE08 Business Analytics	24BEOE25 Security and Privacy in Cloud/ 24BEOE26 UI and UX Design / 24BEOE27 Security in IoT/ 24BEOE28 Edge Computing

Professional Elective-III

One MOOC (12 weeks duration) through SWAYAM - NPTEL with credit transfer of 3 credits, as an alternative to Professional Elective - III in VI Semester which should be completed between 3rd and 7th semester. Title of the MOOC to be specified after enrolment.

Part	Course Code	Name of Course/ component	Hours of Instruction/week		Scheme of Examination				
			Theory	Tutorial/ Practical	Duration of exam	CIA	CE	Total	Credits
Seventh Semester									
I		**Humanities and Social Sciences (HS)**							
	24BEHS08	Engineering Economics	3	-	3	50	50	100	3
III		**Core Courses Professional Core (PC)**							
	24BEOC30	Deep Learning	3	-	3	50	50	100	3
	24BEOC31	Deep Learning Laboratory	-	0/3	3	50	50	100	1
	24BEOC32	Industrial Internship[#]	-	-	3	100	-	100	2
	24BEOC33	Project Work - Phase I	-	0/4	-	100	-	100	2
III		**Professional Electives (PE)**							
		Professional Elective – IV (PE1 or PE2)	3	-	3	50	50	100	3
	24BEOE60 - 24BEOE79	Professional Elective – V (PE1 or PE2) Title of MOOC (SWAYAM-NPTEL) [##]	3	-	3	-	-	100	3
		Open Electives (OE)							
	24BEBO01/ 24BEVO01/ 24BELO01/ 24BEFO01/ 24BEPO01	Open Elective -I	3	-	3	50	50	100	3
IV	**Non-Credit Mandatory Courses (NCMC)**								
	24BEMC07	Disaster Management	3	-	-	100	-	100	Remark
	24BEMO01	Computer Science and Engineering - Computer Based Test (CBT)	-	-	2	100	-	100	Remark

Professional Elective-IV (Select one course from PE1 if the student selected PE1 in 5th & 6th semesters or select one course from PE2 if the student selected PE2 in 5th & 6th semesters)

PE1:	**PE2:**
24BEOE09 Reinforcement Learning/	24BEOE29 IoT Analytics/
24BEOE10 Text and Speech Analysis/	24BEOE30 Blockchain Technology/
24BEOE11 Cognitive Computing/	24BEOE31 Information Security/
24BEOE12 Generative AI	24BEOE32 Full Stack Software Development

Professional Elective-V

[##] One MOOC (12 weeks duration) through SWAYAM - NPTEL with credit transfer of 3 credits, as an alternative to Professional Elective - V in VII Semester which should be completed between 3rd and 7th semester. Title of the MOOC to be specified after enrollment.

Open Elective - I

24BEVO01 Vaastu Shastra and Remedial Vaastu/
24BELO01 Sensors /
24BEBO01 IoT for Personal Healthcare/
24BEFO01 Fundamentals of Food Process Engineering/
24BEPO01 3D Printing Techniques

Eighth Semester									
III		**Core Courses Professional Core (PC)**							
	24BEOC34	Project Work - Phase II	-	0/20	-	100	100	200	10
		Open Electives (OE)							
	24BEBO02/ 24BEVO02/ 24BELO02/ 24BEFO02/ 24BEPO02	Open Elective - II	3	-	3	50	50	100	3
	24BEBO03/ 24BEVO03/ 24BELO03/ 24BEFO03/ 24BEPO03	Open Elective - III	3	-	3	50	50	100	3

Open Elective- II	**Open Elective- III**
24BEVO02 Real Estate Practices/	24BEVO03 Green Building Concepts/
24BELO02 Drone Technologies/	24BELO03 IoT in Connected Cars/
24BEBO02 Telehealth Technology/	24BEBO03 Diagnostic Instrumentation/
24BEFO02 Principles of Nutrition//	24BEFO03 Food Preservation Technology/
24BEPO002 Cross Media Publishing Techniques	24BEPO003 Multimedia Development

Total Credits	**165**

Semester	*Course Code*	*Name of the Course/component*	*Hours of Instruction/week/ Course*	*Credit/ Course*
Part – IV Non-Credit Mandatory Courses (NCMC)				
	A. Ability Enhancement Compulsory Courses (AECC)			
1	24BEMC01	Environmental Science	3	Remark
2	24BEMC02	Constitution of India	2	
3	24BEMC03	Consumer Affairs	3	
4	24BEMC04	Essence of Indian Knowledge Tradition	3	
4	24BECS01	Communication Skills	2	
5	24BEMC05	Design Thinking	3	
5	24BESS01	Soft Skills	2	
6	24BEMC06	Professional Ethics	3	
7	24BEMC07	Disaster Management	3	
	B. Skill Enhancement Courses (SEC)			
3	24BEOV01	**Value Added Course** Computer Animation	40 hrs. duration	Remark
	C. Value Based Elective- I			
1-2	24EVBNS 1-2/ 24EVBNC 1-2/ 24EVBSP 1-2	NSS I & II/ NCC I & II/ Sports I & II (Representing the Institute)	-	Remark
	Value Based Elective- II			
6	24EVBAP1/ 24EVBGP1/ 24EVBWS1/ 24BSCGA1/ 24BSCQA1	Principles of Dr.Ambedkar's Philosophy/ Gandhian Philosophy/ Women Empowerment Perspective in the Current Scenario/ General Awareness/ Quantitative Aptitude/	Varied duration	Remark
	D. Computer Based Test (CBT)			
7	24BEMO01	Computer Science and Engineering	-	Remark

Minimum credits required to earn the B.E. degree: 165

Requirements to earn the B.E. Degree:

1. Total credits to be earned in Part I, II & III components: 165
2. Successful completion of Part IV Non–Credit Mandatory Courses (NCMC).
3. Minimum of two 3 credit (12 weeks duration) MOOCs to be completed through SWAYAM–NPTEL as an alternative to two Professional Electives, Elective III & Elective V (## with credit transfer).
4. #6 to 8 weeks Industrial Internship during 4th and /or 6th semester during summer vacation.

List of Professional Electives (PE1) AI, Data Science & ML Domain

Part	*Semester*	*Course Code*	*Name of the Course*
III	**V Semester Professional Elective –I**	24BEOE01	Exploratory Data Analysis
		24BEOE02	Social Media Analytics
		24BEOE03	Computer Vision
		24BEOE04	Predictive Analytics
	VI Semester Professional Elective –II	24BEOE05	Data Visualization
		24BEOE06	Image and Video Analytics
		24BEOE07	Natural Language Processing
		24BEOE08	Business Analytics
	VI Semester Professional Elective -III	24BEOE40/ 24BEOE41/ - 24BEOE49	**MOOC (12 Weeks Course in SWAYAM-NPTEL)**
	VII Semester Professional Elective –IV	24BEOE09	Reinforcement Learning
		24BEOE10	Text and Speech Analysis
		24BEOE11	Cognitive Computing
		24BEOE12	Generative AI
	VII Semester Professional Elective -V	24BEOE60/ 24BEOE61/ - 24BEOE69	**MOOC (12 Weeks Course in SWAYAM-NPTEL)**

List of Professional Electives (PE2) Design, Security and IoT Domain

Part	*Semester*	*Course Code*	*Name of the Course*
III	**V Semester Professional Elective –I**	24BEOE21	Quantum Computing
		24BEOE22	High Performance Computing
		24BEOE23	Internet of Things and Applications
		24BEOE24	Software Testing
	VI Semester Professional Elective –II	24BEOE25	Security and Privacy in Cloud
		24BEOE26	UI and UX Design
		24BEOE27	Security in IoT
		24BEOE28	Edge Computing
	VI Semester Professional Elective -III	24BEOE50/ 24BEOE51/ - 24BEOE59	**MOOC (12 Weeks Course in SWAYAM-NPTEL)**
	VII Semester Professional Elective –IV	24BEOE29	IoT Analytics
		24BEOE30	Blockchain Technology
		24BEOE31	Information Security
		24BEOE32	Full Stack Software Development
	VII Semester Professional Elective -V	24BEOE70/ 24BEOE71/ - 24BEOE79	**MOOC (12 Weeks Course in SWAYAM-NPTEL)**

Open Electives offered by the Department

Part	*Semester*	*Course Code*	*Name of the Course*
III	VII	24BEOO01	Open Source Technologies
	VIII	24BEOO02	Cyber Laws and Security Policies
	VIII	24BEOO03	Introduction to Data Analytics

Remark for NCMC Courses

Range of Marks	*Remark*
90-100	Excellent
75-89	Very Good
60-74	Good
40-59	Fair
Less than 40	Not Completed

B.E. Honours (Data Science) (OPTIONAL)

Part	*Semester*	*Course Code*	*Name of the Course*
III	**V S*emester***	24BEOH01	Recommender Systems
		24BEOH02	Sentiment Analysis
	VI S*emester*	24BEOH03	Virtual and Augmented Reality
		24BEOH04	R for Data Analytics
	To be completed between 5th to 7th semesters	24BEOH51/ 24BEOH52/ - 24BEOH60	**MOOC (12 Weeks Course in SWAYAM – NPTEL)**
		24BEOH61/ 24BEOH62/ - 24BEOH70	**MOOC (12 Weeks Course in SWAYAM – NPTEL**

Minor Specialization (Cloud Technologies) (OPTIONAL)

Part	*Semester*	*Course Code*	*Name of the Course*
III	**V S*emester***	24BEOM01	Principles of Cloud Computing
		24BEOM02	Cloud Architecture
	VI S*emester*	24BEOM03	Cloud Application Development
		24BEOM04	Cloud Security
	To be completed between 5th to 7th semesters	24BEOM51/ 24BEOM52/ - 24BEOM60	**MOOC (12 Weeks Course in SWAYAM – NPTEL)**
		24BEOM61/ 24BEOM62/ - 24BEOM70	**MOOC (12 Weeks Course in SWAYAM – NPTEL)**

English for Technical Writing

(Common to Artificial Intelligence and Data Science/ Biomedical Instrumentation Engineering/Civil Engineering with Computer Application/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/ Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)/Electronics and Communication Engineering/Food Technology)

Semester I **Hours of instruction/week: 2T+2P**
24BEHS01 **No. of credits: 3**

Course Learning Objectives:

CLO1: Comprehension of spoken and written deliberations.
CLO2: Presentation in academic and professional situations.
CLO3: Employability skills needed for job interviews and placement.

Unit I Introduction to Technical writing 6

Technical Vocabulary/ Jargon, Word formation, Impersonal passive voice, Tenses, use of prepositions, 'if clauses', subject verb agreement, Editing, British and American English.

Unit II Internal & External Communications 6

Writing instructions and recommendations, Data interpretation, Paragraph writing, Formal letters-writing to officials (seeking permission for practical training, asking for Certificates, testimonials, calling for quotation, purchase letter, complaint letter) & Resume writing, Report Writing, E-mail writing, Framing Agendas, Minutes of the meeting.

Unit III Creative Writing 6

Designing an Advertisement, Interpreting advertisements, Slogan/caption writing, creating one's own advertisement for a product, writing blog and on social media platforms, apply best practices of technical writing to assessing new communications contexts and describing the ethical and safety issues regarding communication and the Internet.

Unit IV Speaking Skills 6

Group Discussion - GD strategies, initiating a discussion, persuasion skills, body language, ways of interrupting (non–offending), summarizing and concluding. Self-introduction, Interview skills &Mock interview.

Unit V Presentation Skills 6

Business and technical presentation, writing summary after reading articles from journals – Format for journal, articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices, references)

Total Hours: 30

List of Experiments:

1. Vocabulary Enrichment – Word Formation
2. Justifying and Summarizing Skills – GRE, TOEFL &IELTS
3. Composing E-mails
4. Designing an advertisement
5. Self-Introduction
6. Group discussion
7. Mock Interview
8. Technical Presentation
9. Book Review
10. Public Speaking Skills

Total Hours: 30

References:

1. ***Bhushun Kumar Kul (2022)***. ***English for Technical Professionals with lab manual,*** Khanna Books Publishing Co (P) Ltd.
2. ***Hamlin Annemarie & Rubio Chris (2016).*** Central Oregon Community College, **Technical Writing** : Open Oregon Educational Resources: ISBN 13: 9781636350653 (Creative Commons Attribution Non Commercial Share Alike)
3. ***S.Sumant (2017). English for Engineers***. Tata Mcgraw Hill Education Private Limited: ISBN13: 978-8182091399.
4. ***Cindy*** **Leaney** ***(2007). Dictionary Activities***. Cambridge University Press.
5. ***Shreesh Chaudhary (2007) Better Spoken English***. Vikas Publishing House Pvt Ltd.

Course Outcomes:

At the end of the course, students will be able to

CO1: Construct organized academic and professional writing.
CO2: Achieve proficiency in the effective use of language in various authentic career, related situations.
CO3: Communicate effectively in different situations by using specific, technical vocabulary.
CO4: Speak convincingly, express their opinions clearly, initiate a discussion, negotiate and argue using appropriate communicative strategies.
CO5: Employ skills to face interviews and technical presentation skills.

CO-PO MAPPING

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

Mathematics – I (Algebra and Calculus)

(Common to Artificial Intelligence and Data Science/ Biomedical Instrumentation Engineering/Civil Engineering with Computer Application/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)/Electronics and Communication Engineering/Food Technology)

Semester I **Hours of Instruction/week: 3T+1Tu**
24BESM01 **No. of Credits: 4**

Course Learning Objectives:

CLO1: To develop skills in processing matrices and applications of differential calculus
CLO2: To enrich knowledge in solving problems in multiple integrals and ordinary differential equations

Unit I Matrices 12

Rank of a matrix – Consistency of a system of linear equations – Solution of a system of linear equations - Characteristic equation of matrix - Eigenvalues and Eigenvectors of a real matrix - Properties of Eigenvalues and Eigenvectors - Cayley Hamilton theorem

Unit II Orthogonal Matrices 9

Orthogonal matrices – Orthogonal transformation of a symmetric matrix - Reduction of quadratic form to canonical form by orthogonal transformation.

Unit III Functions of Several Variables 12

Total derivative – Taylor's series expansion - Maxima and minima - Constrained maxima and minima by Lagrangian multiplier - Jacobians.

Unit IV Multiple Integrals 12

Double integration – Cartesian and polar coordinates –Change of order of integration – Area as a double integral - Triple integration in cartesian coordinates and spherical polar coordinates - Volume as a triple integral.

Unit V Ordinary Differential Equations 15

Linear equations of second order with constant coefficients and variable coefficients (Homogeneous equations of Euler type) - Method of variation of parameters - Simultaneous first order linear equations with constant coefficients.

Total hours – 60

References:

1. ***T.Veerarajan (*2016*), Engineering Mathematics (for semester I and II),*** updated 2nd Edition, Tata McGraw Hill Publishing Co. Ltd, New Delhi.
2. ***P.Kandaswamy, K.Thilagavathy and K.Gunavathy(2014), Engineering Mathematics, Volume I***, 10th Revised Edition, S. Chand & Co, New Delhi.
3. ***E.Kreyszig (2014), Advanced Engineering Mathematics***, 8th Edition, John Wiley and Sons (Asia) Ltd, Singapore.
4. ***Dennis G.Zill and MichaelR.Cullen(2012),Advanced Engineering Mathematics,***2nd edition, CBS Publishers.
5. ***Srimanta Pal and Subhodh C Bhunia (2012), Engineering Mathematics,*** 9th Edition, John Wiley and Sons.***Dr.B.S.Grewal(2014),Higher Engineering Mathematics***,43rdEdition,Khanna Publishers, New Delhi.
6. ***G.B.Thomas (2009), Calculus ,*** 11th Edition, Pearson Education.

Course Outcomes:

At the end of the course, students will be able to

CO1: Apply the concepts of matrices to solve problems in engineering

CO2: Apply orthogonal transformation to reduce quadratic form of a matrix to canonical form

CO3: Evaluate maxima and minima of a multivariable function

CO4: Determine area and volume using multiple integrals

CO5: Solve higher order linear ordinary differential equations

CO-PO MAPPING

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

Physics for Computer Technology

(Common to Artificial Intelligence and Data Science) / Computer Science and Engineering / Computer Science and Engineering (Artificial Intelligence and Machine Learning)/ Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology))

Semester I **Hours of Instruction/week: 3T+ 2P**
24BESP01 **No. of credits: 4**

Course Learning Objectives:

CLO1: To impart knowledge in basic concepts of engineering materials and devices.
CLO2: To understand and apply the concepts of physics for computer applications.
CLO3: To impart experimental skills on potentially important experiments needed for Engineering.

Unit I Semi conducting Materials **9**

Intrinsic Semiconductors-Energy band diagram-direct and indirect bandgap semiconductors-Carrier concentration in intrinsic semiconductors-extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors — Hall effect.

Unit II Optoelectronic Materials and Devices **9**

Photoconductive materials–Light Dependent Resistor–Working of LDR–Applications of LDR—Photovoltaic materials—Solar cell—Construction and working of a solar cell— Applications of solar cells–Liquid crystals–Liquid crystal Display(LCD)–Construction and advantages of LCD.

Unit III Photonics **9**

Theory of laser - characteristics - Einstein's coefficients - population inversion - Semiconductor laser - Applications of Lasers: Optical fibre- principle - types -material, mode, refractive index-Expression for acceptance angle and numerical aperture. Application–Fiber Optic Communication.

Unit IV Magnetic Materials and Devices **9**

Origin of magnetic moment-Bohrmagneton-Classification of magnetic materials-diamagnetism - paramagnetism - ferromagnetism - anti ferromagnetism - ferri magnetism -Domain theory - Hysteresis - soft and hard magnetic materials –Magnetic principle in computer data storage-Giant Magneto Resistance sensor.

Unit V Nano technology and Quantum Computing **9**

Introduction-Preparation of Nanomaterials: Top-down process: Ball Milling method-Bottom-up process: Vapour Phase Deposition method. Carbon Nano Tube-structure, properties and preparation -Tunneling-Single electron phenomena- Single electron transistor-Quantum system for information processing

Total Hours: 45

List of Experiments (Any 10)

1. LASER- Wavelength & Particle size determination
2. Ultrasonic interferometer-Determination of compressibility of a liquid
3. Melde's apparatus- Frequency of the vibrator
4. Spectrometer- wavelength determination –Grating (Simulation Experiment).
5. Torsional Pendulum-Rigidity modulus of wire and Moment of inertia of disc.
6. Non Uniform bending – Determination of Young's Modulus.
7. LCR Bridge – Dielectric constant of Solids
8. Four Probe Apparatus-Band gap of a Semiconductor
9. Hysteresis curve tracer - Coercivity and Retentivity
10. Solar cell-V-I characteristics
11. Spectrometer- Determination of dispersive power of the prism.
12. Fiber optics – Numerical aperture **Total Hours: 30**

References:

1. ***M.N.Avadhanulu, P.G.Kshirsagar, T V S Arun Murthy (2022). A Text Book of Engineering Physics***. S Chand Publications, New Delhi.
2. ***H.K.Malik, A.K.Singh (2021). Engineering Physics***. McGraw Hill Education Private Limited, New Delhi.
3. ***D.R.Joshi (2010). Engineering Physics.*** McGraw Hill Education Private Limited, New Delhi.
4. ***S.O.Pillai (2014). A Textbook of Engineering Physics.*** NewAge International(P) Limited, New Delhi.
5. ***B. B. Laud (2015). Lasers and Non-Linear Optics***. NewAge International Publications, New Delhi.
6. ***Palanisamy,P.K.(2012). Physics of Materials.*** Scitech Publications, Chennai.

Course Outcomes:

At the end of the course, the students will be able to

CO1: Acquire knowledge on basics of semiconductor physics.
CO2: Understand the principles of optoelectronic devices for various engineering applications.
CO3: Gain fundamental knowledge in lasers and fiber optics.
CO4: Acquire knowledge on magnetic properties of materials and their applications in data storage.
CO5: Understand the basics of nano technology and quantum computing.

CO-PO Mapping

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

Basic Electrical and Electronics Engineering

(Common to Artificial Intelligence and Data Science/ Biomedical Instrumentation Engineering/Civil Engineering with Computer Application/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)/Electronics and Communication Engineering/Food Technology)

Semester I **Hours of Instruction/week: 3T+2P**
24BEES01 **No. of Credits: 4**

Course Learning Objectives:

CLO1: To impart knowledge in the basics of electrical circuits and working principles of electrical machines.

CLO2: To educate on the fundamental concepts of analog electronics, digital electronics and measuring instruments.

Unit I Electrical Circuits 9

Circuit Components: Surface Mount Device (SMD) Components – Ohm's Law – Kirchhoff's Laws – Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state). Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power, apparent power and power factor.

Unit II Electrical Machines 9

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Synchronous motor and Three Phase Induction Motor.

Unit III Basic Electronics 9

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics- Introduction to BJT and JFET (Construction, working and characteristics).

Unit IV Digital Electronics 9

Review of number systems, binary codes (BCD, ASCII), Logic gates, Representation of logic functions – SOP and POS forms, Introduction to K-map representations – Minimization using K maps (Simple Problems only) – Adder and Subtractor (Half and Full)– Multiplexer, Demultiplexer.

Unit V Measurement and Instrumentation 9

Functional elements of an instrument, Standards and calibration, Operating principle – Moving Coil and Moving Iron meters, Measurement of three-phase power, Instrument transformers – Current and Potentiometer Transformer, DSO- Block diagram.

Total Hours: 45

List of Experiments:

1. Verification of Ohms law.
2. Speed control of DC Motor by armature resistance control (Simulation).
3. Determination of transformer equivalent circuit from open circuit and short circuit test (Simulation).
4. VI characteristics of PN junction diode.
5. Voltage regulation using Zener Diode.
6. Implementation of Boolean Functions.
7. Implementation of Adder and Subtractor.
8. Study of Digital Storage Oscilloscope.

Total Hours: 30

References:

1. ***Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering",*** Second Edition, McGraw Hill Education, 2020.
2. ***S.K.Bhattacharya "Basic Electrical and Electronics Engineering",*** Pearson Education, Second Edition, 2017.
3. ***Sedha R.S., "A Textbook Book of Applied Electronics",*** S. Chand & Co., 2008
4. ***A.K. Sawhney, PuneetSawhney "A Course in Electrical & Electronic Measurements & Instrumentation"***, DhanpatRai and Co, New Delhi, 2021.

Course Outcomes:

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

CO1: Compute the simple electric circuit parameters.
CO2: Explain the working principle and test the electrical machines.
CO3: Analyze the characteristics of analog electronic devices.
CO4: Apply the basic concepts of digital electronics.
CO5: Explain the operating principles of measuring instruments.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	1	1	-	-	1	1	1	1
CO2	2	2	1	2	2	1	-	-	1	1	1	1
CO3	2	2	1	2	2	1	-	-	1	1	1	1
CO4	2	2	1	2	2	1	-	-	1	1	1	1
CO5	2	2	1	1	1	1	-	-	1	1	1	1

Programming for Problem Solving using C

(Common to Artificial Intelligence and Data Science/ Biomedical Instrumentation Engineering/Civil Engineering with Computer Application/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)/Electronics and Communication Engineering/Food Technology)

Semester I **Hours of Instruction /week: 3T**
24BEES02 **No. of Credits: 3**

Course Learning Objectives:

CLO1: To understand the basic programming constructs for problem solving.
CLO2: To apply the basic knowledge in programming concepts and problem solving using C.

Unit I Computational Thinking and Problem Solving 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms- building blocks of algorithms (statements- state - control flow- functions)- notation (pseudo code- flow chart- programming language)- algorithmic problem solving- simple strategies for developing algorithms (iteration- recursion). Illustrative problems: find minimum in a list- insert a card in a list of sorted cards- guess an integer number in a range- Towers of Hanoi.

Unit II Introduction to C, Data types, Expressions and Statements 9

Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements- Assignment statements – Decision making statements - Switch statement - Looping statements – Preprocessor directives - Compilation process- Introduction to Arrays: Declaration- Initialization – One dimensional array –Two dimensional arrays - String operations: length- compare- concatenate- copy – Selection sort- linear and binary search.

Unit III Functions and Pointers 9

Modular programming - Function prototype- function definition- function call- Built-in functions (string functions- math functions) – Recursion- Binary Search using recursive functions –Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value- Pass by reference.

Unit IV Structures and Union 9

Structure - Nested structures – Pointer and Structures – Array of structures – Self referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility.

Unit V File Processing 9

Files – Types of file processing: Sequential access- Random access – Sequential access file - Random access file - Command line arguments.

Total Hours: 45

References:

1. ***Yashwant Kanetkar(2020). Let us C.***17th Edition, BPB Publications.
2. ***Byron S. Gottfried, Jitendar Kumar Chhabra (2018). Programming with C.*** Fourth Edition, Tata McGraw Hill Publishing Company., New Delhi.
3. ***Paul Deitel and Harvey Deitel (*2018).*C How to Program with an Introduction to C+.*** Eighth Edition, Pearson Education.
4. ***ReemaThareja(2016). Programming in C.*** Second Edition, Oxford University Press.
5. ***Kernighan, B.W and Ritchie,D.M (2015). The C Programming language.*** Second Edition, Pearson Education.

Course Outcomes:

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

CO1: Learn the basic algorithmic concepts used to solve simple computational problems.
CO2: Explain the basic constructs of C programming language.
CO3: Identify the importance of functions and pointers.
CO4: Differentiate the applications of structures and union.
CO5: Analyze the working of various file processing techniques.

CO-PO MAPPING

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

Programming for Problem Solving using C Laboratory

(Common to Artificial Intelligence and Data Science/ Biomedical Instrumentation Engineering/Civil Engineering with Computer Application/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)/Electronics and Communication Engineering/Food Technology)

Semester I **Hours of Instruction /week: 2P**

24BEES05 **No. of Credits: 1**

Course Learning Objective:

CLO: To understand and gain knowledge on the basic concepts in C programming language.

List of Experiments:

1. Write a C program to implement I/O Statements.
2. Write a C program to implement Operators.
3. Develop and execute a C program using Switch Case Statements.
4. Develop and execute a C program using Conditional Statements.
5. Write a C program to implement Looping Statements.
6. Develop and execute a C program for 1D & 2D-Arrays.
7. Execute a C program to perform Strings operations.
8. Write a C program to implement Functions and Recursive Functions.
9. Write a C program to implement various Parameters passing methods of Functions.
10. Write a C program to implement Structures and Unions.
11. Write a C program to implement Pointers.
12. Write a C program to implement Files.

Total Hours: 30

Software Requirements:

Turbo C

References:

1. ***YashwantKanetkar (2020). Let us C.***17th Edition, BPB Publications.
2. ***Byron S. Gottfried, Jitendar Kumar Chhabra (2018). Programming with C.***fourthedition,Tata McGraw Hill Publishing Company., New Delhi.
3. ***Paul Deitel and Harvey Deitel (*2018*). C How to Program with an Introduction to C+.*** Eighth edition, Pearson Education.
4. ***ReemaThareja (2016). Programming in C.*** Second Edition, Oxford University Press.
5. ***Kernighan, B.W and Ritchie,D.M (2015). The C Programming language.*** Second Edition, Pearson Education.

Course Outcomes:

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

CO1: Experiment the fundamental concepts, control statements and functions in C programming.

CO2: Apply Structures, Union, Pointers and File concepts in C Programming to provide solutions to real world applications.

CO3: Analyze real world problems and use appropriate concepts in C programming to solve it.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	3	2	3	1	1	1	2	2	2	2
CO2	3	3	3	2	3	1	1	1	2	2	2	2
CO3	3	3	3	2	3	1	1	1	2	2	2	2

Engineering Practices Laboratory

(Common to Artificial Intelligence and Data Science/ Biomedical Instrumentation Engineering/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)/Electronics and Communication Engineering)

Semester I **Hours of Instruction/week: 4P**
24BEES06 **No. of Credits: 2**

Course Learning Objectives:

CLO1: To study the hardware and software's and gain knowledge on MATLAB and Linux.

CLO2: To study the domestic wiring, measure the various electrical parameters, verify logic Gates and to develop a circuit using electronic components.

List of Experiments:

Computer

PC Hardware and Software

1. System Assembling, Disassembling of parts/peripherals and Hardware Troubleshooting.

MS office

2. Create a document in MS Word which includes Formatting Fonts- Drop cap-Applying Text Effects - Using Character Spacing - Borders and Colors - Inserting Header and Footer - Using Date and Time option.
3. Create a PPT to present your assignment in MS Power Point which includes Basic power point utilities and tools like PPT Orientation – Slide layouts fa–Inserting Text-Word Art –Formatting Text-bullets and Numbering – Auto Shapes –Lines and Arrows.
4. Prepare students grade sheet in excel using basic functions like Sorting-Conditional Formatting –Embedded Chart- Formulas Setting- Page Layout – Spread the content of one cell over many cells-Merge Cells – split Cells – Filters – Freeze Panels – Interactive Buttons – Data protection.

MATLAB

5. Introduction to MATLAB – To define & use variables – vectors – Matrices & Its functions in MATLAB.
6. To study various arithmetic operators and mathematical functions in MATLAB and to create & use m-files.

Operating System

7. Installation of Windows Operating System and Working with basic Unix/ Linux commands.

Software Requirements: MS office, MATLAB and Red Hat Linux.

Electrical & Electronics

1. Residential house wiring using switches, fuse, indicator and lamps.
2. Staircase wiring.
3. Measurement of AC signal parameters (peak-peak, RMS value, period, frequency) using CRO.
4. (i)Identification and study of electronic components and equipment's – Resistors, capacitors, inductors, colour coding and measurement.
   (ii) Identification and verification of logic gates.
5. Soldering and testing of simple electronic circuits.
6. Assembling and testing of simple electronic components on PCB.

Total Hours: 60

Course Outcomes:

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

CO1: Implement various tasks using MS Word, Power Point, and Excel.

CO2: Apply various commands in MATLAB and Linux.

CO3: Construct various types of domestic wiring, measure the various electrical parameters, verify logic gates and develop a circuit using electronic components.

CO-POMAPPING

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

Environmental Science

(Common to Artificial Intelligence and Data Science/ Biomedical Instrumentation Engineering/Civil Engineering with Computer Application/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)/Electronics and Communication Engineering/Food Technology)

Semester I **Hours of Instruction /week: 3T**
24BEMC01 **No. of credits: NCMC**

Objective:

CLO 1: To study the interrelationship between living organisms and environment and to help students understand the various environment problems that we face and develop possible solutions to them.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 11

Definition, scope and importance of environment – need for public awareness - 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 (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity- definition: genetic, species and ecosystem diversity – biogeographical 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.
Field study of common plants, insects, birds.
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – 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.
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT III ENVIRONMENTAL POLLUTION 9

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 municipal solid wastes – role of an individual in prevention of pollution – pollution case studies–disaster management: floods, earthquake, cyclone and landslides.
Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – 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 – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

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 –Case studies.

TOTAL HOURS: 45

References:

1. ***Raman Sivakumar (2009). Introduction to Environmental science and Engineering.*** McGraw Hill Education, ISBN 13: 9780070672802.
2. ***Gilbert M.Masters (2008). Introduction to Environmental Engineering and Science.*** 3rd edition, Pearson Education, ISBN-13: 9780131481930.
3. ***Benny Joseph(2006). Environmental Science and Engineering.*** Tata McGraw-Hill, New Delhi,**ISBN-13 9789387432352.**
4. ***R.K. Trivedi (2010). Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards.*** Vol. I and II, Enviro Media.ISBN:8186421017.
5. ***Dharmendra S. Sengar (2007). Environmental law.*** Prentice Hall of India Pvt. Ltd., New Delhi, ISBN-13: 978-8120330597.
6. ***Rajagopalan, R (2005). Environmental Studies-From Crisis to Cure.*** Oxford University Press, **ISBN:**9780199459759.

Outcomes:

At the end of the course students will be able to

CO1: Will be familiar with various ecosystems and biodiversity and their importance in maintaining ecological balance.

CO2: Will be able to understand the relevance and importance of natural resources in the sustenance of life on earth.

CO3: Will be able to list different types of pollutions and their impacts on air, water and soil quality and suggest suitable measures to mitigate these impacts.

CO4: Will gain knowledge on the various environmental problems related to social issues and possible solutions to such problems.

CO5: Will be able to correlate human population growth to environmental degradation

CO-PO Mapping

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

Universal Human Values (Understanding Harmony and Ethical Human Conduct)

(Common to Artificial Intelligence and Data Science/ Biomedical Instrumentation Engineering/Civil Engineering with Computer Application/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/ Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)/Electronics and Communication Engineering/Food Technology)

Semester II **Hours of Instruction/Week: 2T+1Tu**
24BEHS02 **No. of Credits: 3**

Course Learning Objectives:

CLO1: To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' in all the core aspirations of all human beings.

CLO2: To facilitate the development of a Holistic perspective among students towards life and profession based on a correct understanding of Human reality and the rest of existence.

CLO3: To highlight conceivable implications of such a Holistic understanding in terms of ethical human conduct and interaction with Nature.

CLO4: To provide a much-needed orientation input in value education to the young enquiring minds.

Unit I Introduction to Value Education 9

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to fulfill the Basic Human Aspirations

Unit II Harmony in the Human Being 9

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

Unit III Harmony in the Family and Society 9

Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to Human Relationship, Understanding Harmony in the Society, Vision or the Universal Human Order.

Unit IV Harmony in the Nature/Existence 9

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence

Unit V Implications of the Holistic Understanding– a Look at Professional Ethics 9

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

Total Hours: 45

References:

1. ***Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria***, Excel Books, New Delhi, 2010.
2. ***JeevanVidya: EkParichaya, A Nagaraj, JeevanVidya Prakashan***, Amarkantak,1999.
3. ***Human Values, A.N. Tripathi***, New Age Intl. Publishers, New Delhi, 2004.
4. ***The Story of Stuff (***Book).
5. ***The Story of My Experiments with Truth*** - by Mohandas Karamchand Gandhi
6. ***Small is Beautiful*** - E. F Schumacher.
7. ***Slow is Beautiful*** - Cecile Andrews
8. ***Economy of Permanence*** - J C Kumarappa
9. ***Bharat Mein Angreji Raj***–Pandit Sunderlal
10. ***Rediscovering India*** - by Dharampal
11. ***Hind Swaraj or Indian Home Rule*** - by Mohandas K. Gandhi
12. ***India Wins Freedom*** - Maulana Abdul Kalam Azad
13. ***Vivekananda*** - Romain Rolland (English)

Course Outcomes:

At the end of the course, students will be able to

CO1: Understand the human reality and the rest of Existence.

CO2: Comprehend towards what they have understood on human values and relationship.

CO3: Apprehend the interconnectedness, the interdependence, the harmony all around the society.

CO4: Develop the holistic perception towards nature.

CO5: Transform from personnel to Value-based Life and Profession.

CO-PO MAPPING

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

Mathematics – II (Probability and Statistics)

(Common to Artificial Intelligence and Data Science)/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/ Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology))

Semester II **Hours of Instruction/week: 3T+1Tu**
24BESM03 **No. of credits:4**

Course Learning Objectives:

CLO1: To gain fundamental knowledge of the basic probability concepts and statistical tools.
CLO2: To investigate the performance of engineering processes through probability and statistical models

Unit I Probability and Random Variables 12

Probability – Axioms of probability– Conditional probability– Baye's theorem – Discrete and continuous random variables – Moments–Moment generating functions

Unit II Standard Distributions 12

Binomial – Poisson - Geometric – Uniform - Exponential and Normal distributions.

Unit III Two – Dimensional Random Variables 12

Joint distributions – Marginal and conditional distributions – Independent random variables, Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

Unit IV Test of Significance – Large Samples 12

Large sample test for single proportion - Difference of proportions - Single mean - Difference of means and difference of standard deviations.

Unit V Test of Significance – Small Samples 12

Student's t distribution – Test for single mean and difference of means - F distribution – Test for difference between population variances - Chi-square distribution – Test of goodness of fit - Test of independence of attributes

Total hours – 60

References:

1. ***T.Veerarajan (2010), Probability, Statistics and Random Processes with queueing theory and queueing networks,*** 3rd Edition, Tata McGraw –Hill,.
2. ***P.Kandasamy, K.Thilagavathy and K.Gunavathy (2006), Probability, Random variables and Random processes,*** S.Chand & Co. Ltd, Delhi.
3. ***Gupta S.C. and Kapoor V.K., Fundamentals of Applied Statistics (2007),*** 4th Edition, Sultan Chand and Sons, New Delhi,.
4. ***Papoulis A. and Unnikrishnapillai S., Probability, Random Variables and Stochastic Processes (2010),*** 4th Edition, McGraw Hill Education India, NewDelhi.
5. ***Ross, S.M., Introduction to Probability and Statistics for Engineers and Scientists (2004)***, 3rd Edition, Elsevier.
6. ***K.S.Trivedi, Probability and Statistics with Reliability, Queueing and Computer Science Applications (2016),*** 2nd Edition, Prentice Hall of India, New Delhi.

Course Outcomes:

At the end of the course, students will be able to

CO1: Apply the concepts of probability in engineering problems and construct simple probabilitymeasures for discrete and continuous random variables

CO2: Understand the basic concepts of Statistics and have an exposure of various distribution functions

CO3: Acquire skills in handling situations involving more than one random variable

CO4: Gain knowledge in testing of hypothesis for large samples applied to real world problems

CO5: Test the hypothesis for small samples, the goodness of fit and independence of attributes

CO - PO Mapping

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

Essentials of Computer Science and Engineering

(Common to Artificial Intelligence and Data Science/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology))

Semester II **Hours of Instruction /week: 3T**
24BEES03 **No. of Credits: 3**

Course Learning Objectives:

CLO1: To understand the fundamentals of computer.

CLO2: To provide an overview of database management systems, software development, operating systems, computer networks and an outlook of autonomous systems.

Unit I Fundamentals of Computer and I/O devices 9

Organization of computer-History and generation of computer-Types of computer-components of computer (Hardware, software and firmware)-classification of software. Input Units- Keyboard, Terminals and its types. Pointing Devices- Scanners and its types - Voice Recognition Systems- Vision Input System - Touch Screen, Output Units-Monitors and its types - Printers- Impact Printers and its types - Non-Impact Printers and its types - Plotters -types of plotters-Sound cards-Speakers.

Unit II Software Development 9

Waterfall model – Agile - Types of computer languages – Programming, markup, scripting Program Development – steps in program development –flowcharts, algorithms, data structures– definition - types of data structures.

Unit III Operating Systems and Database Management Systems 9

Functions of operating systems - types of operating systems - Device & Resource management - overview of LINUX and UNIX.
Database Management Systems: Data models – RDBMS – SQL - Database Transactions - data centers - cloud services.

Unit IV Computer Networks & Web Designing 9

Advantages of computer networks – LAN – WAN – MAN – internet –WiFi - sensor networks - vehicular networks - 5G communications. World Wide Web – Basics, role of HTML – CSS – XML - Tools for web designing - Social media - Online social networks. Security – information security - cyber security - cyber laws.

Unit V Autonomous System 9

IoT – Robotics – Drones - Artificial Intelligence–Learning - Game Development - Natural Language Processing - Image and Video processing.

Total Hours: 45

References:

1. ***David A. Patterson and John L. Hennessy (2020). Computer Organization and Design: The Hardware/Software Interface,*** Elsevier Science Publisher.
2. ***Robert C. Martin (2008). Clean Code: A Handbook of Agile Software Craftsmanship.*** First edition, Pearson Education.
3. ***Abraham Silberschatz Peter B. Galvin, and Greg Gagne (2019). Operating System Concepts,*** Ninth Edition, Wiley Publications.
4. ***Abraham Silberschat, Henry F. Korth, and S. Sudarshan (2020). Database System Concepts,*** Seventh edition. McGraw-Hill Education.
5. ***Olivier Bonaventure (2014). Computer Networking: Principles, Protocols and Practice,*** First Edition. Textbook Equity Edition.
6. ***Nikolaus Correll, Bradley Hayes (2022). Autonomous Systems: From Control Systems Machine Learning and Robotics***. MIT Press.

Course Outcomes:

At the end of the course, students will be able to

CO1: Infer the fundamentals of computer and I/O devices

CO2: Learn the methods and the steps involved in the software development.

CO3: Explain the fundamental concepts of OS and database management systems.

CO4: Acquire the networking concepts and create web pages using HTML.

CO5: Identify the modern technologies in AI.

CO-PO MAPPING

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

Digital Principles and Computer Architecture

(Common to Artificial Intelligence and Data Science/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology))

Semester II **Hours of Instruction /week: 3T+1Tu**
24BEES04 **No. of Credits: 4**

Course Learning Objectives:

CLO1: To understand the basic structure and operation of a digital computer and design Combinational and sequential circuits.
CLO2: To understand the concept of various memories and I/O interfacing.

Unit I Combinational Logic 12

Combinational Circuits – Karnaugh Map - Analysis and Design Procedures – Binary Adder – Subtractor – Decimal Adder - Magnitude Comparator – Decoder – Encoder – Multiplexers – Demultiplexers.

Unit II Synchronous Sequential Logic 12

Introduction to Sequential Circuits – Flip-Flops – operation and excitation tables- Triggering of FF- Analysis and design of clocked sequential circuits – Design – Moore/Mealy models- state minimization- state assignment- circuit implementation - Registers – Counters.

Unit III Computer Fundamentals 12

Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA): Memory Location- Address and Operation – Instruction and Instruction Sequencing – Addressing Modes- Encoding of Machine Instruction – Interaction between Assembly and High-Level Language.

Unit IV Processor 12

Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control- Microprogrammed Control – Pipelining – Data Hazard – Control Hazards.

Unit V Memory and I/O 12

Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface – Interrupt I/O – Interconnection Standards: USB- SATA.

Total Hours: 60

References:

1. ***David A. Patterson and John L. Hennessy (2020).Computer Organization and Design: The Hardware/Software Interface,***Elsevier Science Publisher.
2. ***M. Morris Mano, Michael D. Ciletti (2018). Digital Design: With an Introduction to the Verilog HDL- VHDL- and System Verilog.*** Sixth Edition, Pearson Education.
3. ***CarlHamacher, ZvonkoVranesic, SafwatZaky, NaraigManjikian (2012).*****Computer Organization and Embedded Systems.** Sixth *Edition*-Tata McGraw-Hill.
4. ***William Stallings (2016). Computer Organization and Architecture – Designing for Performance.*** Tenth Edition, Pearson Education.
5. ***M. Morris Mano (2016). Digital Logic and Computer Design.*** Pearson Education.

Course Outcomes:
At the end of the course, students will be able to:

CO1: Design various combinational digital circuits using logic gates.

CO2: Design sequential circuits and analyze the design procedures.

CO3: State the fundamentals of computer systems and analyze the execution of an instruction.

CO4: Analyze different types of control design and identify hazards.

CO5: Identify the characteristics of various memory systems and I/O communication.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12
CO1	3	3	3	2	3	2	1	1	1	1	2	2
CO2	3	3	3	2	3	2	1	1	1	1	2	2
CO3	3	3	2	2	2	1	1	1	1	1	1	2
CO4	3	3	3	2	3	2	1	1	1	1	2	2
CO5	3	3	2	2	2	1	1	1	1	1	1	2

Programming for Problem Solving using Python

(Common to Artificial Intelligence and Data Science/ Biomedical Instrumentation Engineering/Civil Engineering with Computer Application/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)/Electronics and Communication Engineering/Food Technology)

Semester II **Hours of Instruction /week: 3T**

24BEES09 **No. of Credits: 3**

Course Learning Objectives:

CLO1: To understand the basic knowledge in programming concepts and problem solving using Python.

CLO2: To acquire knowledge on Python data structures, functions, modules and packages.

Unit I Introduction to Python Programming Language 9

Introduction to Python Language and installation- overview on python interpreters- working with python- Numeric Data Types: int- float- Boolean- complex and string and its operations- Standard Data Types: List- tuples- set and Dictionaries- Data Type conversions- commenting in python.

Unit II Variables and Operators 9

Understanding Python variables - Multiple variable declarations - Python basic statements- Python basic operators: Arithmetic operators - Assignment operators - Comparison operators- Logical operators- Identity operators - Membership operators - Bitwise operators - Precedence of operators- Expressions.

Unit III Control Flow and Loops 9

Conditional (if)- alternative (if-else)- chained conditional (if- elif -else)- Loops: For loop using ranges-string- Use of while loops in python- Loop manipulation using pass- continue and break- Regular Expression

Unit IV Functions 9

User Defined Functions- Calling Functions- passing parameters and arguments- Python Function arguments: Keyword Arguments- Default Arguments- Variable-length arguments- Anonymous Functions- Fruitful Functions (Function Returning Values)- Scope of the Variables in a Function - Global and Local Variables- Powerful Lambda functions in python- classes and objects.

Unit V I/O Error Handling- Modules and Packages 9

Introduction- Access Modes- Writing Data to a File- Reading Data from a File- Additional File Methods- Introduction to Errors and Exceptions- Handling IO Exceptions- Run Time Errors- Handling Multiple Exceptions. Modules: Importing Module - Packages - Compositions.

Total Hours: 45

References:

1. ***Paul Deitel and Harvey Deitel (2021). Python for Programmers.*** Pearson Education. First Edition.
2. ***John V Gutta- (2021). Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data.*** Third Edition. MIT Press.
3. ***Eric Matthes (2019). Python Crash Course, A Hands - on Project Based Introduction to Programming.*** Second Edition. No Starch Press.
4. ***Martin C. Brown, "The Complete reference – Python",*** Tata McGraw hill edition 2018.
5. ***Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python",*** Network Theory Ltd., 2011.

Course Outcomes:

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

CO1: Explain the basic constructs of python programming language.

CO2: Learn the various types of variables and operators in Python.

CO3: Acquire the knowledge on control statements.

CO4: Learn the concepts of functions.

CO5: Infer the file operations, exception handling, modules and packages in Python.

CO-PO MAPPING

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

Programming for Problem Solving using Python Laboratory

(Common to Artificial Intelligence and Data Science/ Biomedical Instrumentation Engineering/Civil Engineering with Computer Application/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)/Electronics and Communication Engineering/Food Technology)

Semester II **Hours of Instruction /week: 2P**

24BEES13 **No. of Credits: 1**

Course Learning Objective:

CLO: To understand and gain knowledge on the basic concepts in Python Programming language.

List of Experiments:

1. Implement basic Python programs using various data types and to declare a variable in different possible ways.
2. Create a string and perform various string operations.
3. a. Create a list and perform the operations such as insert, remove, append, len, pop and clear.
   b. Create a tuple and perform the g operations such as add items, len, check for item in tuple.
4. Create a Dictionary and perform the operations such as print the dictionary items, access items, use get(), change values, use len().
5. Write a Python program to perform arithmetic, logical, assignment and comparison operators.
6. Implement a Python program using Conditional Statements.
7. Implement a Python programs using Looping Statements.
8. Implement a Python programs using Functions.
9. Write a Python program to double a given number and add two numbers using lambda().
10. Write a Python program to implement filter() to filter only even numbers from a given list.
11. Write a Python program to implement map () function to double all the items in the list.
12. Implement a real-time applications using Exception handling (divide by zero error, voter's age validity, student mark range validation).

Total Hours: 30

Software Requirements:

Python IDE.

References:

1. ***Paul Deitel and Harvey Deitel (2021).Python for Programmers.*** Pearson Education. First Edition.
2. ***John V Gutta- (2021).Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data.*** Third Edition. MIT Press.
3. ***Eric Matthes (2019). Python Crash Course, A Hands - on Project Based Introduction to Programming.*** Second Edition. No Starch Press.
4. ***Martin C. Brown, "The Complete reference – Python",*** Tata McGraw hill edition 2018.
5. ***Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python",*** Network Theory Ltd., 2011.

Course Outcomes:

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

CO1: Experiment the fundamental concepts, control statements and functions in Python programming.

CO2: Apply sequence data types concepts in Python programming to provide solutions to solve real world applications.

CO3: Analyze the real world problems and use appropriate concepts in python to solve it.

CO-PO MAPPING

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

Data Structures and Algorithms – I

(Common to Artificial Intelligence and Data Science/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology))

Semester II **Hours of Instruction /week: 3T**

24BEAC01/24BEOC01/24BERC01/24BEYC01 **No. of Credits: 3**

Course Learning Objectives:

CLO1: To acquire the basic concepts of problem solving algorithms and applications of linear data structures.

CLO2: To learn and analyze various data searching and sorting techniques.

Unit I **Introduction** **9**

Concept of Problem Solving - Introduction to Algorithms - Characteristics of Algorithms -Pseudo code and Flowchart - Abstract Data Types (ADT) - Introduction to Data Structures - Classification of Data Structures - Time and Space complexity of an Algorithm -Asymptotic notations – Best, Worst and Average case - Linear Data Structures -Array as an ADT - Storage Representation of an Array – Applications.

Unit II **Linked List** **9**

Concept of Linked List - Comparison of Sequential and Linked Organizations - Linked List using Dynamic Memory Management - Linked List as an ADT - Introduction to types of Linked List - Linked List operations - Time complexity analysis of Linked List operations - Application: Polynomial as ADT using Linked List.

Unit III **Stack** **9**

Stack as an ADT - Representation and implementation of Stack using Sequential and Linked Organization - Applications of Stack - Simulating Recursion using Stack – Arithmetic Expression Conversion and Evaluation - Time complexity analysis of Stack operations.

Unit IV **Queue** **9**

Queue as an ADT - Representation and Implementation of Linear Queue - Circular Queue - Priority Queue - Double Ended Queue - Applications: Job scheduling - Queue simulation - Time complexity analysis of Queue operations - Comparison of Linear Data Structures.

Unit V **Sorting and Searching Techniques** **9**

Need of Sorting and Searching - Sorting Order and Stability in Sorting - Concept of Internal and External Sorting - Bubble Sort - Insertion Sort - Selection Sort - Quick Sort - Merge Sort - Radix Sort - Shell Sort - Time complexity analysis of Sorting Algorithms - Linear Search -Binary Search -Time complexity analysis of Searching Algorithms.

Total Hours: 45

References:

1. ***Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rives, Clifford Stein (2022). Introduction to Algorithms.*** Fourth Edition, Mcgraw Hill/ MIT Press.
2. ***M.A Weiss (2014). Data Structures and Algorithm Analysis in C.*** Fourth Edition. Pearson Education.
3. ***ReemaThareja(2014). Data Structures Using C.*** Second Edition. Oxford UniversityPress.
4. ***Rance D. Necaise (2011). Data Structures and Algorithms Using Python.*** John Wiley & Sons Inc.
5. ***Sanjay Pahujia (2010). A Practical approach to Data Structures and Algorithms.*** First Edition. A New Age International.

Course Outcomes:

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

CO1: Learn the basic types of data structure, its application and analyze algorithms using time and space complexity.

CO2: Distinguish between linear data structures based on their representations and apply the concept of Linked list to solve the problems.

CO3: Implement stack ADT and describe specific tasks to which stacks are suited.

CO4: Use appropriate queue operations for solving a given problem.

CO5: Select the appropriate searching or sorting algorithm based on the algorithm's behaviour.

CO-PO MAPPING

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

Data Structures and Algorithms - I Laboratory

(Common to Artificial Intelligence and Data Science/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology))

Semester II **Hours of Instruction /week: 2P**

24BEAC02/24BEOC02/24BERC02/24BEYC02 **No. of Credits: 1**

Course Learning Objective:

CLO: To implement appropriate linear data structure for a given problem and demonstrate sorting and searching algorithms.

List of Experiments:

1. Array implementation of Stack and queue
2. Implementation of Singly Linked List
3. Implementation of Doubly Linked List
4. Linked list implementation of Stack and queue
5. Implementation of Stack to check whether given expression is well formed parenthesized.
6. Implementation of Stack to convert infix to postfix expression and evaluate the postfix expression.
7. Implementation of Polynomial Manipulation using Linked List
8. Implementation of Heaps using Priority Queues
9. Implementation of Linear Search and Binary Search
10. Implementation of Insertion Sort and Selection Sort
11. Implementation of Merge Sort
12. Implementation of Quick Sort

Total Hours: 30

Software Requirements:

Turbo C and Python

References:

1. ***Thomas H. Cormen, Charles E. Leiserson, Ronald Rivest, Clifford Stein (2022). Introduction to Algorithms.*** Fourth Edition- Mcgraw Hill/ MIT Press.
2. ***ReemaThareja (2014)***. ***Data Structures Using C***. Second Edition. Oxford University Press.
3. ***M.A Weiss (2014). Data Structures and Algorithm Analysis in C.*** Fourth Edition. Pearson Education.
4. ***Sanjay Pahujia (2010)***. ***A Practical approach to Data Structures and Algorithms.*** First Edition. A New Age International.
5. ***Rance D. Necaise (2011). Data Structures and Algorithms Using Python.*** John Wiley & Sons.

Course Outcomes:

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

CO1: Implement Linear data structure algorithms.
CO2: Implement the applications of Stack, Queue and Linked list.
CO3: Implement various sorting and searching algorithms in data structures.

CO-PO MAPPING

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

Constitution of India

(Common to Artificial Intelligence and Data Science/ Biomedical Instrumentation Engineering/Civil Engineering with Computer Application/ Computer Science and Engineering/ Computer Science and Engineering (Artificial Intelligence and Machine Learning)/ Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology)/Electronics and Communication Engineering/Food Technology)

Semester II **Hours of Instruction/week: 2T**
24BEMC02 **No. of Credits: NCMC**

Course Learning Objectives:

CLO1: To know about historical background of the constitution making and its importance for building a democratic India.
CLO2: Elucidate the functioning of three wings of the government i.e., executive, legislative and judiciary.
CLO3: Expound the value of the fundamental rights and duties for becoming good citizen of India.
CLO4: Analyse the decentralization of power between central, state and local self-government.

Unit I History of Making of the Indian Constitution 6

History, Drafting Committee,(Composition & Working), Philosophy of the Indian Constitution-Preamble, Salient Features

Unit II Contours of Constitutional Rights & Duties 6

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

Unit III Organs of Governance 6

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UnitIV Local Administration 6

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, Panchayatraj: Introduction, PRI:Zila Pachayat. Elected officials and their roles

UnitV Election Commission6

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Total Hours:30

References:

1.***The Constitution of India, 1950 (Bare Act),*** Government Publication.
2. **M.V.Pylee, "*Introduction to the Constitution of India*",**4th Edition, Vikas publication,2005.
3***. Durga Das Basu, "Introduction to the constitution of India",(***Student Edition),19th edition,

Prentice-Hall EEE, 2008.

Course Outcomes:

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

CO1: Comprehend the history of Indian Constitution and the various schedules under it.

CO2: Exercise the fundamental rights in proper sense at the same time identifies his/her responsibilities in national building.

CO3: Appreciate and discuss the basic components of Indian constitution, Constitutional rights and duties and various Organs of Governance

CO4: Analyse the Indian political system, the powers and functions of the Union, State and Local Governments in detail

CO5: Understand Electoral Process, Emergency provisions and Amendment procedure.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	-	-	-	1	-	2	2	2	-	1
CO2	-	1	-	-	-	2	-	2	2	2	-	1
CO3	-	1	-	-	-	2	-	2	2	2	-	1
CO4	-	1	-	-	-	1	-	2	2	2	-	1
CO5	-	1	-	-	-	1	-	2	2	2	-	1

Mathematics – III (Discrete Mathematical Structures)

(Common to Artificial Intelligence and Data Science/Computer Science and Engineering/Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology))

Semester: III **Hours of Instruction/ week: 3T+1Tu**
Course Code: 24BESM06 **No. of credits: 4**

Course Learning Objectives (CLOs):

CLO1: To impart the knowledge of the mathematical logic

CLO2: To acquire the knowledge of algebraic structures lattices, Boolean algebra and graph theory

UNIT - I Logic **12**

Statements - Truth Tables - connectives - Normal forms - predicates and Quantifiers - Inference theory for statement calculus and Predicate Calculus

UNIT - II Combinatorics **12**

Permutation and combination - Mathematical Induction - Pigeon hole principle - Principle of inclusion and exclusion - Recurrence relations - generating function

UNIT - III Algebraic Systems **12**

Semi groups - monoids - groups - Subgroups - Group homomorphism - Cosets - Lagrange's theorem - Normal subgroup - Rings and Fields (definition and Examples only)

UNIT - IV Lattices and Boolean Algebra **12**

Partial ordering - Posets - Hasse diagram - Lattices - properties of Lattices - Sub Lattices - Special Lattices - Boolean Algebra

UNIT – V Graphs **12**

Introduction to Graphs - Graph terminology - Directed and Undirected Graphs - Matrix Representation of graphs - Graph Isomorphism - connectivity - Euler and Hamilton Paths

Total Hours: **60**

References:

1 Kenneth H. Rosen & Kamala Krithivasan. (2012). *Discrete Mathematics and its Applications (with Combinatorics and Graph Theory)*. Tata McGraw – Hill Publishing Company Ltd., New Delhi.

2 Tremblay. J.P. & Manohar. R. (2017). *Discrete Mathematical Structure and its Application to Computer Science*. Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1st Edition.

3 Ralph P. Grimaldi & Ramana. B.V. (2019). *Discrete and Combinatorial Mathematics: An Applied Introduction*, Pearson Education. 5th Edition.

4 Veerarajan. T. (2017). *Discrete Mathematics with Graph Theory and Combinatorics*. McGraw Hill Education

5 Swapan Kumar Sarkar. (2019). *A Textbook of Discrete Mathematics.* S Chand Publishing. 9th Edition.

6 Sastry. C.V. & Rakesh Nayak (2020). *A Textbook of Discrete Mathematics*, Wiley India Pvt Ltd.

7 Herstein. I. N. (1996). *Abstract Algebra*, Wiley, 3rd Edition.

Course Outcomes:

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

CO1: Understand basic concepts of mathematical logic and inference theory

CO2: Apply counting principles and recurrence relation to solve enumeration problems

CO3: Analyse various algebraic structures

CO4: Examine the properties of lattices and Boolean algebra

CO5: Apply graph theory to solve practical problems that arise in engineering.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	-	1	-	-	-	-	-	2
CO2	3	3	2	1	-	1	-	-	-	-	-	2
CO3	3	3	2	1	-	1	-	-	-	-	-	2
CO4	3	3	2	1	-	1	-	-	-	-	-	2
CO5	3	3	2	1	-	1	-	-	-	-	-	2

Object Oriented Programming using Java

Semester: III **Hours of Instruction/week: 3T+2P**
Course Code: 24BEES21 **No. of credits: 4**

Course Learning Objectives (CLOs):

CLO1: To understand Object Oriented Programming concepts and basics of Java programming language.
CLO2: To know the principles of packages, inheritance and interfaces and develop a java application with Graphical User Interface Application using JavaFX.

UNIT - I Introduction to OOP and Java 9

Object Oriented Programming (OOP): Overview of OOP – Object oriented programming paradigms – Features of Object-Oriented Programming.

Java: Overview of Java – Characteristics of Java - Java development Kit - Java Virtual Machine - Java Runtime Environment Data Types, Variables and Arrays –Operators – Control Statements – Programming Structures in Java – Defining classes in Java –Constructors-Methods -Access specifiers - Static members- Java Doc comments.

UNIT - II Inheritance, Polymorphism and Abstraction 9

Inheritance – Inheritance types, super keyword, preventing inheritance: final classes and methods - Polymorphism – method overloading and method overriding - Abstraction - abstract classes and methods.

UNIT - III Interfaces, Packages and Strings 9

Interfaces: Defining and implementing interface - extending interfaces -Packages:package structure - Member access - Importing Packages – Strings: Basic String class, methods and String Buffer Class.

UNIT - IV Exception Handling and I/O programming 9

Exception Types - Try Catch Block - Throw - Throws - Finally - User Defined Exceptions -Java Input and output - Streams - Reading/writing console I/O - Reading and Writing Files.

UNIT - V JavaFX Event Handling, Controls and Components 9

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, Toggle Button – Radio Buttons – ListView – ComboBox – ChoiceBox – Text Controls - ScrollPane. Layouts – FlowPane – HBox and VBox – BorderPane – StackPane – GridPane. Menus– Basics – Menu – Menu bars – MenuItem.

Total Hours: **45**

List of Experiments:

1. Write a program to get n numbers in an array. Display the elements in ascending and descending order.
2. Write a program for student management system. Initialize the register number of the student through constructors.
3. Develop a java application with an Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club funds. Generate pay slips for the employees with their gross and net salary.
4. Write a program for the following using inheritances:
   a) Finding area of sphere using single inheritance.
   b) Calculating performance of the students using multi-level inheritance.
   c) Students' information manipulation using hierarchical inheritance.
5. Write a program for calculating area of rectangle and triangle using interface.
6. Write a program for employee management using packages.
7. Write a program to implement exception handling and creation of user defined exceptions.
8. Write a program for manipulating strings.
9. Develop applications to demonstrate the features of generics classes.
10. Develop applications using JavaFX controls, layouts and menus.

Total Hours: **30**

References:

1 Herbert Schild.t (2019). *Java: The Complete Reference.* McGraw Hill Education. 11th Edition.
2 Herbert Schildt (2015). *Introducing JavaFX 8 Programming*. McGraw Hill Education. 1st Edition.
3 Doug Lowe, Joel Murach& Andrea Steelman. (2005). *Murach's Beginning Java 2, JDK 5.* Mike Murach & Associates Inc.
4 Horstmann & Cornel.l (2007). *Core Java Volume-I Fundamentals.* Pearson Education. 8th Edition.
5 Cay S. Horstmann. (2018). *Core Java Fundamentals*. Prentice Hall. Volume 1. 11th Edition.
6 D. S. Malik. (2009). *Java Programming.* Cengage Learning.

Course Outcomes:

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

CO1: Interpret the basic concepts of object-oriented programming to solve simple problems.

CO2: Develop programs using inheritance, polymorphism and abstraction.

CO3: Build Java applications with interfaces, packages, string class and methods.

CO4: Make use of exception handling mechanisms and I/O programming to solve real world problems.

CO5: Integrate the concepts of event handling and JavaFX components and controls for developing GUI based applications.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	1	3	1	-	1	2	1	1	2
CO2	2	2	3	2	3	1	-	1	2	1	1	2
CO3	3	3	1	2	3	1	-	1	2	1	1	2
CO4	3	1	2	2	3	1	-	1	2	1	1	2
CO5	1	1	2	3	3	1	-	1	2	1	1	2

Foundations of Data Science

Semester: III **Hours of Instruction/week: 3T**

Course Code: 24BEOC03 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To understand the basic concepts of data science and pre-processing techniques.
CLO2: To explore the various tools used in data science.

UNIT - I Introduction 9

Overview of Data Science and Big Data - Datafication: Current landscape of Perspectives - Skill Sets needed – Matrices - Matrices to Represent Relations Between Data and Linear Algebraic Operations on Matrices - Approximately Representing Matrices by Decompositions - SVD and PCA – Statistics: Descriptive Statistics - Distributions and Probability - Statistical Inference: Populations and Samples - Statistical Modeling - Fitting a Model - Hypothesis Testing.

UNIT - II Data Preprocessing 9

Types of Data and Representations - Acquiring Data – Crawling - Parsing Data - Data Manipulation - Data Wrangling - Data Cleaning - Data Integration - Data Reduction - Data Transformation - Data Discretization - Distance Metrics - Evaluation of Classification Methods: Confusion Matrix - Student's T-tests and ROC Curves - Exploratory Data Analysis.

UNIT - III Python Libraries for Data Wrangling 9

Basics of Numpy arrays – aggregations - computations on arrays – comparisons – masks -Boolean logic - fancy indexing - structured arrays - data manipulation with pandas - data indexing and selection - operating on data - missing data - Hierarchical indexing - combining datasets - aggregation and grouping - pivot tables.

UNIT - IV Data Visualization 9

Importing Matplotlib – Line plots – scatter plots - visualizing errors - density and contour plots - Histograms – legends – colors – subplots-text and annotation – customization-3D plotting -Geographic data with Basemap-Visualization with seaborn.

UNIT - V Text Analysis 9

Data Flattening – Filtering– Chunking - Feature Scaling - Dimensionality Reduction - Nonlinear Futurization - Shingling of Documents – Locality-Sensitive Hashing for Documents - Distance Measures - LSH Families for Other Distance Measures - Collaborative Filtering - Sampling Data in a Stream - Filtering Streams - Counting Distinct Elements in a Stream – Moments – Windows - Clustering for Streams.

Total Hours: **45**

References:

1 Joel Grus. (2019). *Data science from scratch*. O'Reilly Media. 2nd Edition.
2 Avrim Blum, John Hopcroft & Ravindran Kannan. (2020). *Foundations of Data Science*, Cambridge University Press.
3 Robert S.Witte & John S.Witte. (2017). *Statistics*. Wiley Publications. 11th Edition.
4 Jake Vanderplas. (2016). *Python Data Science Handbook*. O`Reilly Publishing House.
5 Peter Bruce & Andrew Bruce. (2020). *Practical Statistics for Data Scientists: 50*. O'Reilly Media.

Course Outcomes:

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

CO1: Explain the principles and purposes of data science, and articulate the different dimensions of the area.
CO2: Explore the various data pre-processing and manipulation techniques including various distributed analysis paradigms.
CO3: Use the Python libraries for Data Wrangling.
CO4: Apply tools and techniques to visualize large-scale data.
CO5: Analyse the and filtering and clustering techniques on text data.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	1	-	-	-	1	1	1	2
CO2	2	3	3	2	2	-	-	-	2	2	1	2
CO3	2	2	1	2	2	-	-	-	1	1	1	2
CO4	3	2	2	2	2	-	-	-	1	1	1	2
CO5	3	2	2	2	2	-	-	-	2	1	1	2

Data Structures and Algorithms – II

Semester: III **Hours of Instruction/week: 3T**

Course Code: 24BEOC04 **No. of credits: 3**

Prerequisite: Data Structures and Algorithms – I

Course Learning Objectives (CLOs):

CLO1: To understand representation, implementation and applications of trees, search trees, graphs, multiway trees data structures.
CLO2: To apply the concepts of hashing and choose data structures for developing solutions in various domains.

UNIT - I Trees 9

Introduction to Non-Linear Data Structure - Binary Trees - Types of Binary Trees – Properties of Binary Trees - Binary Tree as Abstract Data Type - Representation using Sequential and Linked Organization - Binary Tree creation - Recursive and Non-Recursive Tree Traversals - Threaded Binary Tree and operations - Applications of Binary Trees.

UNIT - II Search trees 9

Representation of Symbol Tables - Static Tree Table and Dynamic Tree Table - Binary Search Tree and its operations - Binary Search Trees as Abstract Data Type - Height Balanced Tree: AVL Tree and operations - Red Black Tree.

UNIT - III Graphs 9

Basic Terminologies - Storage Representation- Graph Traversals - Graph as Abstract Data Type - Spanning Trees - Minimum Spanning Trees - Kruskal’s Algorithm - Prim’s Algorithm - Dijkstra's Single Source Shortest Path Algorithm - Topological Sorting.

UNIT - IV Multiway trees and Heap 9

Multiway search tree - B Tree and operations - B+ Tree- Applications of B-trees - Heap basic concepts - Realization of Heap - Heap as an Abstract Data Type - Heap implementation - Heap Sort - Heap as a Priority Queue.

UNIT - V Hashing and File Organization 9

General idea of Hashing - Hash Table - Hash function – Rehashing - Issues in Hashing - Collision Resolution Strategies: Linear Probing - Quadratic Probing - Double Hashing - Open addressing and Chaining - File Organization - Sequential File - Direct Access File and its Primitive operations.

Total Hours: **45**

References:

1 Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest & Clifford Stein. (2022). *Introduction to Algorithms.* Tata McGraw Hill. 4th Edition.

2 M.A Weiss. (2014). *Data Structures and Algorithm Analysis in C*. Pearson Education. 4th Edition.

3 Sanjay Pahujia. (2010). *A Practical approach to Data Structures and Algorithms*. A New Age International. 1st Edition.

4 Rance D. Necaise. (2011). *Data Structures and Algorithms Using Python*. John Wiley & Sons Inc.

5 R. Sartaj Sahani. (2007). *Data Structures, Algorithms and Applications in JAVA*. Universities Press. 2nd Edition.

6 ReemaThareja. (2014). *Data Structures Using C*. Oxford University Press. 2nd Edition.

7 www.nptel.ac.in

Course Outcomes:

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

CO1: Interpret the concepts of trees to solve the problems using efficient algorithms.

CO2: Distinguish between various search trees based on their representations and applications.

CO3: Apply various operations on graphs.

CO4: Identify different types of Multi-way trees and heap structures and apply them to problem solutions.

CO5: Apply Hashing techniques and File handling for solving a problem.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	1	1	-	1	2	1	3
CO2	3	3	3	2	3	-	-	-	1	1	1	2
CO3	3	3	3	2	3	-	-	-	1	1	1	2
CO4	2	3	3	2	3	-	-	-	2	1	1	2
CO5	2	3	3	2	3	1	1	-	2	2	1	3

Database Management Systems

Semester: III **Hours of Instruction/week: 3T**

Course Code: 24BEOC05 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To learn the concepts of basic query language.
CLO2: To analyze the fundamental concepts of transaction processing, concurrency control techniques, recovery procedures and NoSQL database.

UNIT - I Relational Databases **9**

Purpose of Database System–Views of data–Data Models–Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL.

UNIT - II Relational Data Model

9

Entity – Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First– Second–Third Normal Forms– Dependency Preservation – Boyce Code Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT - III Transactions **9**

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery– Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UNIT - IV Implementation Techniques **9**

RAID – File Organization – Organization of Records in Files – Indexing and Hashing – Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.

UNIT - V NoSQL Database **9**

Overview and History of NoSQL Databases –Introduction to NoSQL, -Definition of the Four Types of NoSQL Database - The Value of Relational Databases - Getting at Persistent Data – Concurrency – Integration - Impedance Mismatch - Application and Integration Databases - Attack of the Clusters - The Emergence of NoSQL - Sorting and Accessing data, Sorting data in and Accessing Data from Mongo DB, Querying Mongo DB.

Total Hours: **45**

References:

1 Abraham Silberschatz, Henry F.Korth & S. Sudharshan. (2011). *Database System Concepts.* Tata McGraw-Hill International Edition. 6th Edition.

2 Ramez Elamsri. Durvasul VLN. Somayazul, Shamkant B. Navathe, Shyam K. Gupta. (2013). *Fundamentals of Database Systems.* Pearson Education. 7th Edition.

3 Raghu Ramakrishnan & Johannes Gehrke. (2013). *Database Management Systems*. Tata McGraw-Hill. 3rd Edition.

4 Sadalage, P. & Fowler. (2019). *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*. Wiley Publications. 1st Edition.

5 www.nptel.ac.in

Course Outcomes:

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

CO1: Explain the fundamental concepts of Relational databases and construct queries using SQL.

CO2: Analyse the Relational model for conceptual design of the database and apply normalization techniques to improve database design.

CO3: Explore the various transaction techniques.

CO4: Compare and contrast various indexing strategies in different database systems.

CO5: Analyze the different the NoSQL Databases, interface and interact with NoSQL.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	-	-	-	2	2	2	2
CO2	2	3	2	3	2	-	-	-	2	1	2	2
CO3	3	2	2	2	2	-	-	-	2	2	2	2
CO4	2	2	2	2	2	-	-	-	1	2	2	2
CO5	3	3	2	3	3	-	-	-	1	2	2	2

Software Engineering

Semester: III **Hours of Instruction/week: 3T**

Course Code: 24BEOC06 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To understand various processes and methodology required in software projects and testing methods.

CLO2: To model, plan, execute and test software projects.

UNIT - I Software Process and Agile Development 9

Introduction to Software Engineering-Software Process-Perspective and Specialized Process Models-Agile introduction and background-Agile Manifesto and Principles-Overview of Scrum -Agile process-Extreme programming-Introduction to Scrum-Feature Driven Development- Lean Software Development.

UNIT - II Requirements Analysis and System Modeling 9

Functional and non-functional requirements -The software requirements document- Requirements specification, elicitation, validation, management - Developing Use Cases - Object modeling using UML–Use case Model–Class diagrams–Interaction diagrams–Activity diagrams – State chart diagrams–Data modeling–Class-based modeling.

UNIT - III Software Design 9

Design process and concepts - Design model- Software architecture– Architectural styles–Architectural design -Transform and transaction mapping– Component level design-Designing class-based components-User interface design– Golden rules–Interface analysis-Design patterns-Pattern based software design.

UNIT - IV Software Testing and Maintenance 9

Strategic approach and issues- Software testing strategies– Unit testing– Integration testing - Validation testing– System testing and debugging-White box testing- Basis path testing - Black box testing - Control structure testing- Re-Engineering - Reverse engineering - Restructuring - Forward engineering.

UNIT - V Project Management 9

Software Configuration Management-Software Project Management- Spectrum-Process and Project metrics – Estimation- COCOMO-Function Point-Project Scheduling- Dev/Ops: From development to deployment – Three Tier– Responsiveness, Service level objectives and Apdex – Releases and feature flags – Monitoring and finding bottlenecks – Improving rendering and database performance with caching.

Total Hours: **45**

References:

1 Roger S.Pressman. (2014). *Software Engineering: A practitioner's Approach*. Tata McGraw-Hill International Edition. 7th Edition.

2 Ian Sommerville. (2012). *Software Engineering*. Pearson Education Asia. 9th Edition**.**

3 Bernd Bruegge & Allen H. Dutoit. (2009). *Object-Oriented Software Engineering: Using UML, Patterns and Java.* Pearson Education. 3rd Edition.

Course Outcomes:

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

CO1: Acquire knowledge on software engineering lifecycle models.

CO2: Identify the software requirements and interpret it with UML.

CO3: Design the software using various design concepts, architectural styles, component and interface design methods.

CO4: Evaluate the software using appropriate testing and maintenance approaches.

CO5: Estimate the project, manage to schedule the project and work on DevOps.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	2	-	-	-	-	-	1	2
CO2	2	3	2	3	2	-	-	-	2	1	3	2
CO3	2	3	2	1	1	-	-	-	2	1	3	2
CO4	2	3	2	2	3	-	-	-	2	1	3	2
CO5	2	3	1	2	3	-	-	-	2	-	3	2

Data Structures and Algorithms - II Laboratory

Semester: III **Hours of Instruction/week: 3P**
Course Code: 24BEOC07 **No. of credits: 1**

Course Learning Objectives (CLOs):

CLO1: To apply suitable nonlinear data structures and different algorithm design techniques.

List of Experiments:

1. Implementation of Binary trees
2. Implementation of Binary search Tree
3. Implementation of Pre-order, In-order and Post-order Tree Traversals
4. Implementation of AVL Tree
5. Implementation of RedBlack Tree
6. Construct a B-Tree of order 3 by inserting numbers of given data
7. Implementation of Breadth First Search and Depth First Search
8. Implementation of Dijkstra's Algorithm
9. Implementation of Prim's and Kruskal's Algorithm
10. Implementation of Hashing techniques
11. Implementation of Heap sort
12. Implement Collision Resolution techniques

Total Hours: **45**

Software Requirements:

Turbo C, Python and Java

References:

1 Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest & Clifford Stein. (2022). *Introduction to Algorithms.* Tata McGraw Hill. 4th Edition.

2 M.A Weiss. (2014). *Data Structures and Algorithm Analysis in C*. Pearson Education. 4th Edition.

3 Sanjay Pahujia. (2010). *A Practical approach to Data Structures and Algorithms*. A New Age International. 1st Edition.

4 Rance D. Necaise. (2011). *Data Structures and Algorithms Using Python*. John Wiley & Sons Inc.

5 R. SartajSahani. (2007). *Data Structures, Algorithms and Applications in JAVA*. Universities Press. 2nd Edition.

6 Reema Thareja. (2014). *Data Structures Using C*. Oxford University Press. 2nd Edition.

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Course Outcomes:

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

CO1: Implement Binary tree, Binary Search tree and balanced tree concepts

CO2: Implement graph algorithms and hashing techniques

CO3: Implement Heap sort and Collision Resolution techniques

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	3	-	-	-	1	1	2	3
CO2	3	2	3	3	3	-	-	-	1	2	3	3
CO3	3	2	2	3	2	-	-	-	1	2	1	1

Database Management Systems Laboratory

Semester: III **Hours of Instruction/week: 3P**

Course Code: 24BEOC08 **No. of credits: 1**

Course Learning Objective (CLO):

CLO1: To understand data definitions and data manipulation commands and familiar in design and implementation of typical database applications.

List of Experiments:

1. Data Definition Commands, Data Manipulation Commands for inserting, deleting,
2. Tables and Transaction Control statements
3. Database Querying – Simple queries, Nested queries, Sub queries and Joins.
4. Views, Sequences, Synonyms
5. Database Programming: Implicit and Explicit Cursors
6. Procedures and Functions
7. Programs for Multiple sub queries and correlative sub queries.
8. Programs to create database triggers
9. Implementation of Database Design using ER modelling.
10. Database Connectivity with Front End Tools
11. Create NoSQL database for a sample application.
12. Mini Project (Application Development using Oracle/ Mysql)

Total Hours: **45**

Software Requirements:

Oracle 11g, MySql workbench

References:

1 Steven Feuerstein & Bill Pribyl. (2014). Oracle PL/SQL Programming. O'Reilly Media. 6th Edition.

2 Ramez Elamsri. Durvasul. VLN., Somayazulu, Shamkant B. Navathe, Shyam K. Gupta. (2013). *Fundamentals of Database Systems*. Pearson Education. 7th Edition.

Course Outcomes:

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

CO1: Use typical data definitions and manipulation commands.

CO2: Design applications to test Nested, views and Join Queries.

CO3: Implement applications that require a Front-end Tool

CO-PO MAPPING

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	-	-	-	1	2	2	3
CO2	2	2	2	2	2	-	-	-	2	2	2	3
CO3	3	2	3	3	3	-	-	-	1	2	3	3

School of Engineering

Consumer Affairs
(Non-Credit Mandatory Courses)

(Applicable for the B.E students admitted from the academic year 2024-2025 & onwards)

Semester: III **Hours of Instruction/week: 3T**

Course Code: 24BEMC03

Course Learning Objectives (CLOs):

CLO1: To familiarize the students with their rights and responsibilities as a consumer.
CLO2: To expound the social framework of consumer rights and legal framework of protecting consumer rights.

UNIT - I Conceptual Framework **9**

Consumer and Markets: Concept of Consumer, Nature of markets: Liberalization and Globalization of markets with special reference to Indian Consumer Markets, E-Commerce with reference to Indian Market. Concept of Price in Retail and Wholesale, Maximum Retail Price (MRP), Fair Price, GST, labelling and packaging along with relevant laws, Legal Metrology.

Experiencing and Voicing Dissatisfaction: Consumer buying process, Consumer Satisfaction/dissatisfaction-Grievances-complaint, Consumer Complaining Behaviour: Alternatives available to Dissatisfied Consumers; Complaint Handling Process: ISO 10000 suite

UNIT - II The Consumer Protection Law in India **9**

Objectives and Basic Concepts: Consumer rights and UN Guidelines on consumer protection, Consumer goods, defect in goods, spurious goods and services, service, deficiency in service, unfair trade practice, restrictive trade practice.

Organizational set-up under the Consumer Protection Act: Advisory Bodies: Consumer Protection Councils at the Central, State and District Levels; Adjudicatory Bodies: District Forums, State Commissions, National Commission: Their Composition, Powers, and Jurisdiction (Pecuniary and Territorial), Role of Supreme Court under the CPA with important case law.

UNIT - III Grievance Re-dressal Mechanism under the Indian Consumer Protection Law **9**

Who can file a complaint? Grounds of filing a complaint; Limitation period; Procedure for filing and hearing of a complaint; Disposal of cases, Relief/Remedy available; Temporary Injunction, Enforcement of order, Appeal, frivolous and vexatious complaints; Offences and penalties.
Leading Cases decided under Consumer Protection law by Supreme Court/National Commission: Medical Negligence; Banking; Insurance; Housing & Real Estate; Electricity and Telecom Services; Education; Defective Products; Unfair Trade Practices.

UNIT - IV Role of Industry Regulators in Consumer Protection **9**

I. Banking: RBI and Banking Ombudsman
II. Insurance: IRDA and Insurance Ombudsman
III. Telecommunication: TRAI
IV. Food Products: FSSAI
V. Electricity Supply: Electricity Regulatory Commission
VI. Real Estate Regulatory Authority

UNIT - V Contemporary Issues in Consumer Affairs 9

Consumer Movement in India: Evolution of Consumer Movement in India. Formation of consumer organizations and their role in consumer protection. Misleading Advertisements and sustainable consumption. National Consumer Helpline, Comparative Product testing, Sustainable consumption and energy ratings.

Quality and Standardization: Voluntary and Mandatory standards; Role of BIS, Indian Standards Mark (1S1), Ag- mark, Hallmarking. Licensing and Surveillance; Role of International Standards: 1SO an Overview

Note: Unit II and III refers to the Consumer Protection Act, 1986. Any change in law would be added appropriately after the new law is notified.

Total Hours: 45

References:

1 Khanna, Sri Ram, Savitap Hanspal, Sheetal Kapoor, and H.K. Awasthi. (2007). *Consumer Affairs*. University Press.

2 Choudharv, Ram Naresh Prasad (2005). *Consumer Protection Law Provisions and Procedure,* Deep and Deep Publications Pvt. Ltd.

3 G. Ganesan and M. Sumathy. (2012). *Globalization and Consumerism*: *Issues and Challenges*, Regal Publications.

4 Suresh Misra and Sapna Chadah (2012). Consumer Protection in India: Issues and concerns, IIPA, New Delhi

5 Rajyalaxrni Rao (2012), *Consumer is King,* Universal Law Publishing Company

6 Empowering Consumers e-book.

7 The Consumer Protection Act, 1986 and its later versions.

Articles:

1. Misra Suresh. (Aug 2017) "Is the Indian Consumer Protected? One India One People.
2. Raman Mittal, Sonkar Sumit and Parineet Kaur (2016) Regulating Unfair Trade Practices: AnAnalysis of the Past and Present Indian Legislative Models, Journal of Consumer Policy.
3. Chakravarthy, S. (2014). MRTP Act metamorphoses into Competition Act. CUTS Institute for Regulation and Competition position paper. Available online at www.cuts-international.org/doc01.doc
4. Kapoor Sheetal (2013) "Banking and the Consumer" Akademos (ISSN 2231-0584)
5. Bhatt K. N., Misra Suresh and Chadah Sapna (2010). Consumer, Consumerism and Consumer Protection, Abhijeet Publications.
6. Kapoor Sheetal (2010) "Advertising-An Essential Part of Consumer's Life-Its Legal and EthicalAspects", Consumer Protection and Trade Practices Journal, October 2010.
7. Verma, D.P.S. (2002). Regulating Misleading Advertisements, Legal Provisions and Institutional Framework.Vikalpa. Vol. 26: No. 2. pp. 51-57.

Periodicals:

1. *Consumer Protection Judgments (CPJ*) (Relevant cases reported in various issues).
2. *Recent issues of magazines: International Journal on consumer law and practice,* National Law School of India University, Bengaluru.
3. *Consumer Voice.* Published by VOICE Society, New Delhi.

Websites:

www.ncdrc.nic.in
www.consumeraffairs.nic.in
www.iso.org.
www.bis.org.in
www.consumereducation.in
www.consumervoice.in
www.fssai.gov.in
www.cercindia.org

Course Outcomes:

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

CO1: Understand the concepts of consumer, markets, relevant laws and grievances

CO2: Familiarize with the consumer protection laws, objectives and concepts

CO3: Awareness of Grievance Redressal Mechanism under the Indian Consumer Protection Law and Case studies.

CO4: Comprehend the business firms' interface with consumers and the consumer related regulatory and business environment.

CO5: Awareness of contemporary issues in consumer affairs and knowledge of quality and standards.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	1	1	1	1	-
CO2	2	2	-	-	-	-	-	1	1	1	1	-
CO3	2	2	-	-	-	-	-	1	1	1	1	-
CO4	2	2	-	-	-	-	-	1	1	1	1	-
CO5	2	2	-	-	-	-	-	1	1	1	1	-

Department of Computer Science and Engineering

Computer Animation
(Value Added Course)

Semester: III **Hours of Instruction/week: 2hrs**

Course Code: 24BEOV01

Course Learning Objectives (CLOs):

CLO1: To create the application with movie effects, procedural animation, motion capture and hand designed animations.

CLO2: To Explore Photoshop and flash, and use it to find out more about the tools in the toolbox.

UNIT - I **Photoshop** **8**

Photoshop's Environment –Sizing Image–Selecting Image Areas – Layers – Image Modes –Color and Painting– Text, Layer Effects and Filters.

UNIT - II **Flash** **8**

Flash Basics – Creating and Editing Shapes – Working with Graphics – Creating and editing symbols.

UNIT - III **Working with Layers in Flash** **8**

Layers- Timeline – Frame by Frame Animation –Motion Presets– Creating Motion Tween – Animation techniques - Importing Slideshow Content.

UNIT - IV **Design using Photoshop** **8**

Design of Invitation cards, Greetings, Flex Boards, Brochures, Posters etc – Material Printing – Logo Designing.

UNIT - V **Design using Flash** **8**

Simple Cartoons Movie – Advertisements – Animation.

Total Hours: **40**

References:

1 Alex Michael. (2013). *Animating with Flash 8: Creative Animation Techniques.* CRC Press.

2 Mark Galer & Philip Andrews. (2013). *Photoshop CC: Essential Skills A Guide to Creative Image Editing.* Focal Press. Reprint Edition.

3 Bonnie Blake (2007). *How to do everything with Flash 8 - A Beginner's Guide***.** Dreamtech Press

4 Deke McClelland. (2005). *Photoshop ver. (8) CS Bible*. Wiley–Dreamtech India

Course Outcomes:

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

CO1: Create images in Photoshop employing text, layer effects, and filters to enhance visual compositions

CO2: Demonstrate in Flash by creating and editing shapes, manipulating graphics to enhance animation projects.

CO3: Implement various animation techniques to create dynamic and engaging visual narratives using animation software.

CO4: Design invitation cards, greetings, flex boards, brochures, posters, and other promotional materials.

CO5: Create simple cartoon movies, design advertisements, and produce animations using Flash.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	-	-	-	3	2	1	3
CO2	2	2	3	2	3	-	-	-	3	2	1	3
CO3	2	2	3	2	3	-	-	-	3	2	1	3
CO4	2	2	3	2	3	-	-	-	3	2	1	3
CO5	2	2	3	2	3	-	-	-	3	2	1	3

Mathematics – IV (Linear Algebra and Queueing Theory)

(Common to Artificial Intelligence and Data Science/Computer Science and Engineering/Computer Science and Engineering (Artificial Intelligence and Machine Learning)/Computer Science and Engineering (Internet of Things and Cyber Security Including Block Chain Technology))

Semester: IV **Hours of Instruction/week: 3T+1Tu**

Course Code: 24BESM09 **No. of credits: 4**

Course Learning Objectives (CLOs):

CLO1: To enhance knowledge in the basic concepts of linear algebra

CLO2: To provide mathematical support and develop queueing models in real life problems

UNIT - I Matrices and Linear Equations **12**

Introduction to Linear Algebra - Algebra of Matrices - Systems of linear equations - Row reduction and echelon form - Rank of a matrix – Inverse of a matrix - Determinants - Eigen values and Eigen vectors - Cramer's rule - Nature of a matrix.

UNIT - II Vector Spaces **12**

Vector space - Subspace - Linear combination - Linear span - Linear dependence and independence - Basis - Dimension - Inner product (dot product) - Orthogonal vectors - Orthonormal vectors

UNIT - III Orthogonality and Least Squares **12**

Linear transformations - Orthogonal and orthonormal basis - Orthogonal complement - Orthogonal projection - Gram Schmidt Process - Least square applications.

UNIT - IV Random Processes and Markov Chain **12**

Markov Process - Poisson process – Birth - death processes - Markov chains - Transition probabilities

UNIT - V Queueing Models **12**

Queueing systems - Introduction to queuing models - Characteristics of queuing models -M/M/l and M/M/C queues with finite and infinite waiting space - M/G/1 queues (Steady state solutions only) - Pollczek- Khinchine formula (Without proof)

Total Hours: **60**

References*:*

1 David C. Lay. (2010). *Linear Algebra and its Applications*, Addison-Wesley. 2nd Edition.

2 Poole. D. (2005). *Linear Algebra: A Modern Introduction*, Brooks/Cole. 2nd Edition.

3 Krishnamurthy. V. Mainra. V. P. & Arora. J. L. (2005). *An Introduction to Linear Algebra.* Affiliated East-West Press.

4 Taha H. A. (2010). *Operations Research*, Pearson Education, Asia. 8th Edition.

5 Veerarajan. T. (2019). *Probability and Statistics, Random Processes and Queueing Theory*. Tata Mc Graw Hill.

6 Herstein. I. N. (1996). *Abstract Algebra*.Wiley. 3rd Edition.

7 Dubey. B. (2008). *Introductory Linear Algebra*. Asian Books Private Limited.

8 Kunneth Hoffman & Ray Kunze (2015). *Linear Algebra*. Prentice Hall India Learning Private Limited. 2nd Edition.

Course Outcomes:

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

CO1: Identify linear system of equations, Eigen values and Eigen vectors

CO2: Examine about vector spaces and the operations performed on it

CO3: Understand orthogonality principle of vectors to solve problems

CO4: Acquire skills in handling random processes

CO5: Solve the real problems using queuing theory

CO-PO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	1	-	-	-	-	-	2
CO2	3	3	2	1	1	1	-	-	-	-	-	2
CO3	3	3	2	1	1	1	-	-	-	-	-	2
CO4	3	3	2	1	1	1	-	-	-	-	-	2
CO5	3	3	2	1	1	1	-	-	-	-	-	2

Operating Systems

Semester: IV **Hours of Instruction/week: 3T**

Course Code: 24BEOC09 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To learn the basic concepts and functions of operating system.
CLO2: To analyze the concepts of process scheduling algorithms, deadlock, memory management schemes and File handling.

UNIT - I Operating Systems Overview 9

Introduction –Functions and Types of OS – Operating System Structure –Operating System Operations – Process Management – Memory Management – Storage Management – Protection Security – Operating System Services – User and Operating System Interface –System Calls – System Programs – OS Generation – System Boot.

UNIT - II Process Management 9

Process Concept – Process Scheduling – Operations on Processes – Inter-process Communication – Threads – Overview – Multithreading models –Thread libraries – Threading issues –CPU Scheduling – Scheduling criteria – Scheduling algorithms – Multiple – processor scheduling – Real time scheduling.

UNIT - III Concurrency and Deadlock 9

Process Synchronization – The critical-section problem –Synchronization hardware – Mutex locks – Semaphores – Classic problems of synchronization – Deadlock – System model – Deadlock characterization – Methods for handling deadlocks – Deadlock prevention – Deadlock avoidance – Deadlock detection – Recovery from deadlock.

UNIT - IV Memory Management 9

Main Memory – Background – Swapping – Contiguous Memory Allocation – Paging – Segmentation. Virtual Memory – Background – Demand Paging – Page Replacement – Allocation of Frames - Thrashing.

UNIT - V Secondary Storage Management 9

File Concept – Access Methods – Directory Structure – File Sharing – Protection – File System Implementation – Directory Implementation – Allocation Methods – Free-space Management– Disk Structure – Disk Scheduling – Swap Space Management – Linux OS: introduction to Linux and Linux utilities – Windows OS: Windows operating Environment – Case Study: Mobile OS.

Total Hours: **45**

References:

1 Abraham Silberschatz, Peter Baer Galvin & Greg Gagne. (2018). *Operating System Concepts*. John Wiley & Sons (Asia) Pvt. Ltd. 9th Edition

2 Andrew S. Tanenbaum. (2015). *Modern Operating Systems*. Prentice Hall of India Pvt. Ltd. 4th Edition

3 William Stallings (2018). *Operating Systems: Internals and Design Principles*. Pearson Education. 9th Edition.

4 www.nptel.ac.in

Course Outcomes:

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

CO1: Interpret the basic concepts and functions of operating systems.

CO2: Explain the process management in OS and compare different CPU scheduling algorithms.

CO3: Apply concurrency and deadlock concepts and techniques to solve real-world problems.

CO4: Compare various memory management schemes in OS.

CO5: Examine the secondary storage structure and different operating systems.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	-	1	-	3	2	2	2
CO2	3	2	3	2	2	-	1	-	2	1	2	3
CO3	3	3	3	2	3	-	-	-	2	2	1	2
CO4	2	2	2	2	2	-	-	-	2	2	2	2
CO5	3	3	2	2	2	-	-	-	3	2	3	2

Artificial Intelligence

Semester: IV **Hours of Instruction/week: 3T**

Course Code:24BEOC10 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To learn the different problem solving and search strategies in AI and analyze the optimization techniques.

CLO2: To understand the knowledge representation and logic in solving AI problems, planning and reasoning.

UNIT - I AI Foundation and Intelligent Agents **9**

Introduction: What is AI - Foundations of AI - History of AI - Intelligent agent – Rationality - Performance measures - Nature of environments - Structure and types of agents - Problem solving agents: Toy problems - Real world Problems - Case study: Vacuum cleaner world.

UNIT- II Search Methods and Optimization Techniques **9**

Uninformed search: Breadth first search - Depth first search - Depth limited search - Iterative deepening DFS - Bidirectional search - Informed search - Greedy Best First Search - A* search - Heuristic functions - Optimization - Hill climbing - Simulated annealing - Local beam search - Genetic algorithm - Case study: 8 puzzle problem.

UNIT - III Backtracking and Knowledge Representation **9**

Backtracking - Constraint satisfaction problems - Gaming - Adversarial search - Optimal decisions in games - Alpha Beta pruning - Case study: 8 queens' problem. Knowledge based agents - Propositional logic - First order logic - Forward and backward chaining - Ontological engineering - Case study: Wumpus world problem.

UNIT - IV Planning and Reasoning **9**

Planning - Classical planning - State space search - Progression and Regression - Partial order planning - Planning and acting in real world - Reasoning - Acting under uncertainty - Bayes'rule - Probabilistic reasoning - Semantics and inference in Bayesian networks - Decision networks, Case study: Air cargo transport problem.

UNIT - V Learning and AI Applications **9**

Learning - Supervised learning - Explanation based learning - Probabilistic learning - Reinforcement learning - Applications - NLP - Speech Recognition - Object Recognition – Robotics - Case study: Word2Vec Problem.

Total Hours: **45**

References:

1 Stuart J.Russel & Peter Norvi. (2009). *Artificial Intelligence A Modern Approach*. Pearson Education. 3rd Edition.

2 Elaine Rich, Kevin Knight (2009). *Artificial Intelligence.* Tata McGraw Hill. 3rd Edition.

3 M. Tim Jones. (2008). *Artificial Intelligence: A Systems Approach (Computer Science)*. Jones and Bartlett Publishers, Inc. 1st Edition,

4 Bratko. (2011). *Prolog: Programming for Artificial Intelligence.* Addison-Wesley Educational Publishers Inc. 4th Edition.

5 Gerhard Weiss. (2013). *Multi Agent Systems*. MIT Press. 2nd Edition.

Course Outcomes:

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

CO1: Explore the foundation of AI and working of intelligent agents.

CO2: Acquire knowledge about the search algorithm and optimization techniques for solving AI problems

CO3: Apply the concept of knowledge representation to solve real world problems.

CO4: Analyze the reasoning techniques to solve the problem with uncertainty conditions.

CO5: Implement AI algorithms to work with real time applications.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	2	-	-	-	1	1	2
CO2	3	3	2	2	1	2	-	-	-	1	1	2
CO3	3	3	3	3	2	2	-	-	-	1	1	2
CO4	3	3	3	3	2	2	-	-	-	1	1	2
CO5	3	3	3	3	2	2	-	-	-	1	1	2

Computer Networks

Semester: IV **Hours of Instruction/week: 3T+2P**

Course Code: 24BEOC11 **No. of credits: 4**

Course Learning Objectives (CLOs):

CLO1: To focus on the fundamental concepts of computer networking, protocols, architectures, and applications.

CLO2: To gain expertise in design, implement and analyze performance perspective of ISO- OSI layered Architecture.

UNIT - I Introduction to Computer Networks **9**

Introduction: Computer networks and distributed systems, Classifications of computer networks, Preliminaries of layered network structures. Data communication Components: Representation of data and its flow, Various connection topology, Protocols and Standards, OSI model, Transmission MediA. LAN: Wired LAN, Wireless LAN, Virtual LAN. Techniques for Bandwidth utilization: Multiplexing -Frequency division, Time division and Wave division, Concepts on spread spectrum.

UNIT - II Data Link Layer and Medium Access Sub Layer **9**

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

UNIT - III Network Layer **9**

Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP– Delivery, Forwarding and Unicast Routing protocols.

UNIT - IV Transport Layer **9**

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service (QoS), QoS improving techniques - Leaky Bucket and Token Bucket algorithms.

UNIT - V Application Layer **9**

DNS, DDNS, TELNET, EMAIL, FTP, WWW, HTTP, SNMP, Bluetooth, Firewalls.

Total Hours: **45**

List of Experiments

1. Network System Administration: Understanding the functionalities of switches and routers.
2. Network configuration commands using Linux.
3. Error detection and correction mechanisms.
4. Flow control mechanisms.
5. Simulation of unicast routing protocols.
6. Observing Packets across the network and Performance Analysis of Routing protocols.
7. Socket programming (TCP and UDP) – Multi client chatting.
8. Develop a DNS client server to resolve the given host name or IP address.

30 hours

References:

1 Tanenbaum. (2013). *Computer Networks*, Pearson Education. 5th Edition.

2 William Stallings. (2013). *Data and computer communications.* Pearson Education India.

3 Behrouz A Forouzan, Firouz Mosharraf. (2011). *Computer Networks A Top- Down Approach.* McGraw Hill Education.

4 M.Dave. (2012). *Computer Networks.* Centage learning.

Course Outcomes:

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

CO1: Interpret the different building blocks of Communication network and its architecture.

CO2: Implement various error detection and correction mechanisms, flow control mechanisms and various routing protocols.

CO3: Contrast different types of switching networks and analyze the performance of network.

CO4: Analyze the various features and operations of transport layer.

CO5: Examine the functionalities of application layer protocols.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	-	1	2	2	1
CO2	3	3	3	3	3	-	-	-	2	2	2	2
CO3	2	3	3	3	3	-	-	-	2	2	2	2
CO4	2	3	3	3	3	-	-	-	2	2	1	2
CO5	2	2	2	2	2	-	-	-	1	1	1	1

Design and Analysis of Algorithms

Semester: IV **Hours of Instruction/week: 3T**

Course Code: 24BEOC12 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To analyse the efficiency of algorithms and understand different algorithm design techniques.

CLO2: To solve programming problems using state space tree and apply the concepts of NP Completeness, approximation algorithms and randomized algorithms.

UNIT - I Introduction 9

Algorithm analysis: Notion of an Algorithm – Fundamentals of Algorithmic - Problem Solving – Important Problem Types - Time and space complexity - Asymptotic Notations and its properties - Best case, Worst case and average case analysis – Recurrence relation: Substitution method - Recursion tree method and Masters' theorem.

UNIT - II Brute Force and Divide and Conquer Methods 9

Brute Force: Closest - Pair and Convex - Hull Problems - Exhaustive Search – Traveling Salesman Problem – Knapsack Problem – Assignment problem.

Divide and conquer method: Merge sort – Quick sort – Binary search – finding maximum and minimum – Strassen's Matrix Multiplication.

UNIT - III Dynamic Programming and Greedy Methods 9

Dynamic Programming: Elements of dynamic programming -Warshalls and Floyds Algorithms - Multi stage graph - Optimal Binary Search Trees -Travelling salesman problem.

Greedy Technique: Elements of the greedy strategy– Knapsack problem – Prim's algorithm- Kruskal's Algorithm - Dijkstra's Algorithm – Huffman trees.

UNIT - IV Backtracking, Branch and Bound Methods 9

Backtracking: N-Queens Problem - Graph coloring - Hamiltonian's Circuit - Subset sum problem. Branch and Bound: -FIFO, LIFO, LC Branch and Bound solution -0/1 Knapsack - Assignment Problem - Traveling Salesman Problem.

UNIT - V NP-Complete and Approximation Algorithm 9

NP-Completeness: Polynomial time algorithms – Polynomial time verification - NP-algorithms - NP-hardness and NP-completeness and reducibility– NP-complete problems -Approximation Algorithms: Vertex-cover problem - traveling-salesman problem - The set-covering problem - Randomization and linear programming.

Total Hours: **45**

References:

1 Thomas H Cormen. Charles E Leiserson. Ronald L Revest.Clifford Stein. (2022). *Introduction to Algorithms*. The MIT Press Cambridge. Massachusetts London. 4th Edition.

2 Anany Levitin, (2017). *Introduction to the Design and Analysis of Algorithms*. Pearson Education. 3rd Edition.

3 Jon Kleinberg & Éva Tardos. (2013). *Algorithm Design*. Pearson Education. 1st Edition.

4 Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani. (2006). *Algorithms.* McGraw-Hill Education.

5 Alfred V. Aho, John E. Hopcroft & Jeffrey D. Ullman. (2006). *Data Structures and Algorithms*. Pearson Education. Reprint Edition.

6 Michael T. Goodrich &Roberto Tamassia. (2006). *Algorithm Design: Foundations, Analysis, and Internet Examples*. Wiley. 2nd Edition.

7 S. Sridhar. (2014). *Design and Analysis of Algorithms*. Oxford University Press.

8 www.nptel.ac.in

Course Outcomes:

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

CO1: Examine the efficiency of algorithms using asymptotic notations and correctness of algorithms

CO2: Make use of algorithm design techniques like brute force and divide and conquer to solve problems

CO3: Identify optimal solution by applying dynamic programming approach and greedy method

CO4: Demonstrate the use of state space tree using Backtracking, branch and bound methods for solving problems

CO5: Analyze the NP Complete algorithms and solve problems using approximation and randomized algorithms

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	-	1	-	1	-	-	1
CO2	2	3	3	3	2	-	1	-	1	-	-	1
CO3	1	2	3	3	1	-	2	-	1	-	-	1
CO4	1	1	3	3	1	-	-	-	1	-	-	1
CO5	1	1	2	3	1	-	-	-	1	-	-	1

Distributed Computing

Semester: IV **Hours of Instruction/week: 3T**

Course Code: 24BEOC13 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To introduce the computation and communication models and illustrate the issues of synchronization and collection of information in distributed systems.

CLO2: To elucidate distributed mutual exclusion, deadlock detection, fault tolerance mechanisms in distributed systems and the features of Peer-to-Peer systems and memory consistency models.

UNIT - I Introduction **9**

Definition - Relation to computer system components – Motivation – Relation to parallel multiprocessor/multicomputer systems – Message-passing systems versus shared memory systems – Primitives for distributed communication – Synchronous versus asynchronous executions – Design issues and challenges; A model of distributed computations: A distributed program – A model of distributed executions – Models of communication networks – Global state of a distributed system.

UNIT - II Logical Time And Global State **9**

Logical Time: Physical clock synchronization: NTP – A framework for a system of logical clocks – Scalar time – Vector time; Message ordering and group communication: Message ordering paradigms – Asynchronous execution with synchronous communication – Synchronous pro- gram order on an asynchronous system – Group communication – Causal order (CO) Total order; Global state and snapshot recording algorithms: Introduction – System model and definitions – Snapshot algorithms for FIFO channels.

UNIT - III Distributed Mutex and Deadlock **9**

Distributed mutual exclusion algorithms: Introduction – Preliminaries – Lamport's algorithm – Ricart–Agrawala algorithm – Quorum-based mutual exclusion algorithms – Maekawa's algorithm – Token-based algorithms – Suzuki–Kasami's broadcast algorithm; Deadlock detection in distributed systems: Introduction – System model – Preliminaries – Models of deadlocks – Knapp's classification of distributed deadlock detection algorithms – Mitchell and Merritt's algorithm for the single resource model – Chandy-Misra-Haas algorithm for the AND model – Chandy-Misra-Haas algorithm for the OR model.

UNIT - IV Consensus and Recovery **9**

Consensus and agreement algorithms: Problem definition – Overview of results – Agreement in a failure-free system (synchronous or asynchronous) – Agreement in (message-passing) synchronous systems with failures; Checkpointing and rollback recovery: Introduction – Back- ground and definitions – Issues in failure recovery – Checkpoint-based recovery – Log-based rollback recovery – Koo-Toueg coordinated checkpointing algorithm – Juang-Venkatesan algorithm for asynchronous checkpointing and recovery.

UNIT - V Peer to Peer and Distributed Shared Memory 9

Peer-to-peer computing and overlay graphs: Introduction – Data indexing and overlays – Tapestry; Distributed shared memory: Abstraction and advantages – Memory consistency models – Lamport's Bakery Algorithm.

Total Hours: **45**

References:

1 Kshemkalyani Ajay D. & Mukesh Singhal. (2011). *Distributed computing: Principles, Algorithms and Systems*. Cambridge University Press.

2 George Coulouris, Jean Dollimore & Tim Kindberg. (2012). *Distributed Systems Concepts and Design*. Pearson Education. 5th Edition

3 Pradeep K. Sinha. (2007). *Distributed Operating Systems: Concepts and Design*. Prentice Hall of India.

4 Tanenbaum A. S. & Van Steen M. (2007). *Distributed Systems: Principles and Paradigms*. Pearson Education.

5 Liu M. L. (2004). *Distributed Computing, Principles and Applications*. Pearson Education.

6 Nancy A Lynch. (2003). *Distributed Algorithms*. Morgan Kaufman Publishers, USA.

Course Outcomes:

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

CO1: Explain the fundamentals, computation and communication models of distributed systems.

CO2: Solve synchronization, group communication and state consistency problems.

CO3: Use distributed mutual exclusion algorithms and resource sharing techniques in distributed systems.

CO4: Apply the working model of Consensus and agreement algorithms and recovery process in distributed systems.

CO5: Analyse the peer-to-peer system and distributed shared memory.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	2	1	-	-	2	2	1	2
CO2	2	1	3	3	3	2	-	1	2	2	2	2
CO3	2	2	2	2	3	2	-	1	2	2	2	2
CO4	2	2	3	3	3	2	-	1	2	2	2	2
CO5	2	3	2	3	3	2	-	1	2	2	2	2

Operating Systems Laboratory

Semester: IV **Hours of Instruction/week: 3P**

Course Code: 24BEOC14 **No. of credits: 1**

Course Learning Objective (CLO):

CLO1: To implement the concepts of operating system in Unix / Linux environment and learn various management schemes in operating systems.

List of Experiments:

1. Basics of Unix / Linux commands
2. Write programs using the following system calls of Linux operating system:

   fork, exec, getpid, exit, wait, close, stat, opendir, readdir
3. Shell programming
4. Implementation of Shared memory in IPC
5. Implementation of Semaphores
6. Write C programs to implement the various CPU Scheduling Algorithms
7. Bankers Algorithm for Deadlock Avoidance
8. Implementation of Deadlock Detection Algorithm
9. Implementation of the following Memory Allocation Methods for fixed partition:

   a) First Fit b) Worst Fit c) Best Fit
10. Implementation of the following Page Replacement Algorithms:

    a) FIFO b) LRU c) Optimal
11. Implementation of the following File Allocation Strategies:

    a) Sequential b) Indexed c) Linked
12. Write C programs to implement the various DISK Scheduling Algorithms.

Total Hours: **45**

Software Requirements:

Linux, Turbo C

References:

1 Abraham Silberschatz. Peter B.Galvin & Greg Gagne. (2018). *Operating System Concepts*. Wiley Publisher. 9th Edition.

2 William Stallings. (2018). *Operating Systems: Internals and Design Principles*. Pearson Education. 9th Edition.

Course Outcomes:

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

CO1: Write Unix / Linux commands and perform shell programming.

CO2: Implement various CPU scheduling algorithms, deadlock avoidance and detection algorithms to handle the deadlock

CO3: Implement page replacement algorithms, file and disk allocation strategies for user process.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	-	-	-	2	3	3	3
CO2	3	2	3	2	2	-	-	-	3	2	2	2
CO3	3	3	2	2	2	-	-	-	3	3	2	2

Artificial Intelligence Laboratory

Semester: IV **Hours of Instruction/week: 3P**

Course Code: 24BEOC15 **No. of credits: 1**

Course Learning Objective (CLO):

CLO1: To write python code to solve wide range of real-world problems and build intelligent applications.

List of Experiments:

1. Study of Tools and Libraries in Python for Artificial intelligence
2. Implementation of simple python programs
3. Implementation of Search Strategies
4. Implementation of Logic programming to solve problems
5. Design simple games like Hangman and Tic-Tac-Toe
6. Plotting Graphs in python
7. Implementation of Image processing functions
8. Build applications using NLTK package
9. Creation of simple chatbot
10. Design of Voice Assistant
11. Study of AI applications
12. Creation of Intelligent Applications

Total Hours: **45**

Software Requirements:

Python

References:

1 S.Russell & P.Norvig. (2015). *Artificial Intelligence: A Modern Approach*. Prentice Hall. 3rd Edition

2 Prateek Joshi. (2017). *Artificial Intelligence with Python*. Packet Publishing.

3 Anthony Williams. (2017). *Python Programming.* CreateSpace Independent Publishing Platform. Combined Edition.

Course Outcomes:

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

CO1: Create Python programs for Search Strategies and apply Logic programming to solve problems

CO2: Implement Image processing functions and build applications using NLTK package

CO3: Design simple games, chatbots and voice assistant and create Intelligent Applications

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	2	-	-	-	1	1	2
CO2	3	3	2	2	1	2	-	-	-	1	1	2
CO3	3	3	3	3	2	2	-	-	-	1	1	2

School of Engineering

Essence of Indian Knowledge Tradition
(Non-Credit Mandatory Courses)

(Applicable for the B.E students admitted from the academic year 2024-2025 & onwards)

Semester IV **Hours of Instruction/week: 3T**

Course Code: 24BEMC04

Course Learning Objectives (CLOs):

CLO1: Gain knowledge in Indian Philosophical Foundations.
CLO2: Know Indian Languages and Literature and the fine arts in India & their Philosophy.
CLO3: Explore the Science and Scientists of Medieval and Modern India.

UNIT - I **Introduction to Indian Philosophy** **9**

Basics of Indian Philosophy, culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian culture, Ancient Indian, Medieval India, Modern India.

UNIT - II **Indian Philosophy & Literature** **9**

Vedas Upanishads, schools of Vedanta, and other religion Philosophical Literature. Philosophical Ideas the role of Sanskrit, significance of scriptures to current society, Indian Philosophies, literature of south India. Indian languages and Literature-II: Northern Indian languages & Philosophical & cultural & literature.

UNIT- III **Religion and Philosophy** **9**

Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only).

UNIT - IV **Indian Fine Arts & Its Philosophy (Art, Technology & Engineering)** **9**

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in Indian, development of science in ancient, medieval and modern Indian.

UNIT - V **Education System in India** **9**

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Scientists of Medieval India, Scientists of Modern India. The role Gurukulas in Education System, Value based Education.

Total Hours: 45

References:

1. Kapoor, K. (2005). *Text and Interpretation: The India Tradition*.
2. *Science in Samskrit*. (2007). Samskrita Bharti Publisher.
3. NCERT – "*Position paper on Arts, Music, Dance and Theatre*".
4. Narain, S. (1993). *Examinations in Ancient India*.
5. Prakash, S. (1989). *Founders of Sciences in Ancient India*.
6. Mysore Hiriyanna. (2008). *The essentials of Indian philosophy*. Motilal Banarsidass Publishers.
7. Satischandra Chatterjee, & Dhirendra Mohan Datta. (2016). *An introduction to Indian philosophy*. Motilal Banarsidass Publishers Private Limited.

Course Outcomes:

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

CO1: Understand philosophy of Indian culture
CO2: Distinguish the Indian languages and literature among difference traditions
CO3: Learn the philosophy of ancient, medieval and modern India.
CO4: Acquire the information about the fine arts in India.
CO5: Know the contribution of scientists of different eras.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	1	2	2	1	1
CO2	-	-	-	-	-	-	-	1	2	2	1	1
CO3	-	-	-	-	-	-	-	1	2	2	1	1
CO4	-	-	-	-	-	-	-	1	2	2	1	1
CO5	2	2	2	2	1	1	1	1	2	2	1	1

Communication Skills

(For B.E. students admitted in 2024-2025 and onwards)

Semester IV **Hours of Instruction/week: 2T**

Course Code: 24BECS01

Course Learning Objectives (CLOs):

CLO1: To help learners achieve proficiency in language in various real time situations

CLO2: To enhance the communication skills of the learners through engaging activities and to encourage good reading habit among the students.

UNIT - I Effective Communication 6

Active listening, focused discussion, body language, gestures

Ice-breaking Sessions (Group Work - oral): Self-introduction, Strengths and Weaknesses, Short term and long-term goals, Your Role Model – why – reasons.

Role play: Interview with a celebrity (M.S.Dhoni, Dr.Kalam, Amitabh Bachchan).

Brainstorming (Storm in a tea cup): Examples- Canteen food, How to make Maggie Noodles or a cup of tea – (with flow chart).

Discussion: Example topics- Open Book exams, What appeals to you in a person – Beauty or Brain? Enriching experience with a pet.

UNIT - II Creative Thinking and Communication 6

7 Cs of Communication, Presentation Skills, Problem solving & decision making, resolving conflicts, Analyzing ability, organizing effectively.

Activities: Communication games, extempore, simulations for workplace conflicts, role plays for problem solving and decision-making, open-ended stories.

UNIT - III Comprehensive Skills & Vocabulary Enrichment 6

Building comprehensive skills, Instances of its application, Anagrams, Homonyms, Homophones, Palindromes, Word Pyramid, Word Ladder, Linking words.

Activities: Listening comprehension, reading comprehension, summarizing a story and presentation, dramatization (Group) Critical Review of a movie, Enacting a play (contemporary themes/issues eg. Generation Gap, College Life, Problems faced by youth, etc.) Analysis of the plays Role Play (oral): Meeting a Bank Manager for Education Loan.

UNIT - IV Debating Skills and Oral Practice 6

Enriching Public Speaking skills, Basics of debating, Dos & Don'ts in debate, Critical thinking and analysis, Types and elements of debate.

Activities: Mock debate sessions, Public speaking simulations, Oral team games and activities, criticism analysis.

UNIT - V Communication Skills (Practical) 6

'Hands-on' In Communication Laboratory: Pronunciation practice, Listen and repeat, voice modulation, pitch, intonation, neutral accent.

Vocabulary Enrichment games: Dialogue completion, Language games on computer Crosswords, Find missing letters, industry-specific, domain specific articles for reading (from newspapers).

Planning/checklists (Oral and written): Meeting a service provider for Internet connection/data card/cellphone, organising a seminar/workshop, Your brother's engagement function.

Thinking out of the box for problem solving (Oral): Contextualized Jargon, If there is a bus strike, Bank strike, bus breakdown, You lost your purse while traveling, If someone tries to attack you.
Need-based Discussions: How to open an e mail account, Special features in Facebook, How to become member in FB, You Tube – advantages & disadvantages, Features in Google – News, Books, Scholar, Maps, etc.
Blogging: Expressing views, Case study – Dove soap or Vivel.

Total Hours: 30

Reference Books:

1. Ahuja, B.N. and S.S. Chopra. (1989). *Communication.* New Delhi: Surjeet Publications.
2. Butterfield, J. (2017). *Problem solving and decision making*. Boston, MA: Cengage Learning.
3. Collins, Patrick. (2009). *Speak with Power and Confidence*. New York: Sterling.
4. Fitikides, T. J. (1984). *Common Mistakes in English*. London: Orient Longman.
5. Hasson, Gill. (2012). *Brilliant Communication Skills.* Pearson Education, Great Britain.
6. Raman, Meenakshi & Sangeeta Sharma. (2011). *Technical Communication: Principles and Practice*. Second Edition, Oxford University Press New Delhi.

Course Outcomes:

Upon completion of this course, students will be able to:

- **CO1:** Demonstrate improved competence in oral and written communication
- **CO2:** Be prepared and respond to various situations effectively
- **CO3:** Adopt refined use of language in written communication
- **CO4:** Exhibit enhanced understanding of the professional use of English language
- **CO5:** Practice self-directed learning

Data Mining and Warehousing

Semester: V **Hours of Instruction/week: 3T**
Course Code:24BEOC16 **No. of Credits: 3**

Course Learning Objectives (CLOs):

CLO1: To illustrate the importance of Data Warehousing, Data Mining and its applications.

CLO2: To extract knowledge from data repository for data analysis, frequent pattern, classification and prediction.

UNIT - I Data Warehousing 9

Introduction to data warehousing - Data warehousing components - Building a data warehouse - Difference between database system and data warehouse - Data warehouse architecture - 3 Tier architecture - Warehouse schema design - Data extraction - Cleanup & transformation tools - multi-dimensional data model - Data cubes - Stars, Snowflakes, Fact constellations - Concept hierarchy - Online analytical processing - Typical OLAP operations.

UNIT- II Introduction to Data Mining 9

Introduction of data mining - Definition and functionalities, Classification of DM systems, DM task primitives, Integration of a data mining system with a database and data warehouse - Issues in DM, KDD process - Data Pre-processing - Data mining primitives - Languages and system architectures - Concept description: Characterization and comparison - Analytical characterization - Mining class comparison.

UNIT- III Association Rule Mining 9

Association rule mining, Mining of single dimensional Boolean association rules, Multilevel association rules and multidimensional association rules, Correlation analysis, Constraint based association mining.

UNIT - IV Classification and Clustering 9

Basic issues regarding classification and predication - Classification by decision Tree - Bayesian classification - Classification by back propagation - Associative classification – Prediction - Classifier accuracy - Cluster analysis: Basic issues - Clustering using partitioning methods - Hierarchical methods - Density based methods - Grid based methods and model-based methods - Algorithms for outlier analysis.

UNIT-V Advanced Mining 9

Introduction to spatial mining - Text mining and web mining with related algorithms - Introduction to Big data analytics.

Total Hours: **45**

References:

1. Jiawei Han & Micheline Kamber. (2012). *Data Mining: Concepts and Techniques*. Elsevier. 3rd Edition
2. Pang-NingTan, Michael Steinbach & Vipin Kumar. (2016). *Introduction to Data Mining.* Pearson Education.
3. Arun K. Pujari. (2005). *Data Mining*, University Press. 8th Edition.
4. Paulraj Ponnian. (2010). *Data Warehousing Fundamentals*, John Willey. 2nd Edition.

Course Outcomes:

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

CO1: Acquire knowledge on warehousing architectures and tools for systematically organizing large database and use their data to make strategic decisions.

CO2: Interpret the basic concepts of data mining and prepare the data for analysis using preprocessing methods.

CO3: Apply Association Rule mining algorithms to characterize the patterns discovered.

CO4: Discover interesting patterns from large amounts of data to analyze for predictions, classification and clustering.

CO5: Analyze the patterns extracted from large-scale spatial, textual and web-based datasets

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	2	3	1	-	-	2	1	2	1
CO2	2	3	3	2	3	2	-	-	2	1	2	2
CO3	2	2	3	2	3	2	-	-	2	2	2	2
CO4	2	3	3	2	3	2	-	-	2	2	2	2
CO5	2	3	3	2	3	2	-	-	2	2	2	2

Cloud Computing and Virtualization

Semester: V **Hours of Instruction/week: 3T**
Course Code: 24BEOC17 **No. of Credits: 3**

Course Learning Objectives (CLOs):

CLO1: To gain expertise in server, network and storage virtualization.
CLO2: To be able to set up a private cloud.

UNIT - I Introduction to Cloud Computing 9

History - Roots of Cloud Computing - Layers and Types of Cloud - Desired Features of a Cloud - Benefits and Disadvantages of Cloud Computing - Cloud Infrastructure Management - Importance of Virtualization in Cloud - Cloud deployment models - Cloud delivery models.

UNIT- II Cloud Implementation 9

Exploring the Cloud Computing Stack - Connecting to the Cloud - Decision Factors for Cloud Implementations - Public, Private and Hybrid Cloud – Overview - Infrastructure as a Service (IaaS) Cloud Delivery Model - Platform as a Service (PaaS) Cloud Delivery Model - Software as a Service (SaaS) Cloud Delivery Model.

UNIT- III Introduction to Virtualization 9

History of Virtualization - Benefits of Virtualization - Types of Virtualization - Virtualization and cloud computing - Types of hardware virtualization: Full virtualization - partial virtualization - para virtualization - Desktop virtualization: Software virtualization – Memory virtualization - Storage virtualization – Data virtualization – Network virtualization.

UNIT-IV Virtualized Data Center Architecture 9

VDC environments: Concept - Planning and Design - Business continuity and Disaster recovery principles - Managing VDC and Cloud environments and infrastructures - Security Concepts: Confidentiality – privacy – integrity – authentication - non-repudiation – availability - access control and Cryptographic Systems.

UNIT-V Case Study 9

Secure Data Analysis in GIS Database - Distributed Database - Secure Multi-Party Computation - Association Rule Mining Problem - Distributed Association Ruling Data Analysis in GIS System- Emergence of Green Computing in Modern Computing Environment.

Total Hours: **45**

References:

1. Dac-Nhuong Le, Raghvendra Kumar, GiaNhu Nguyen & Jyotir Moy Chatterjee. (2015). *Cloud Computing and Virtualization*. Wiley. 1st Edition.
2. Sosinsky B. (2011). *Cloud Computing Bible*. Wiley. 1st Edition.
3. GautamShroff. (2010). *Enterprise Cloud Computing Technology Architecture Applications.* Cambridge University Press. 1st Edition.
4. Greg Schulz. (2011). *Cloud and Virtual Data Storage Networking*. Auerbach Publications.
5. Buyya R., Broberg J. & Goscinski A. (2011). *Cloud Computing: Principles and Paradigm.* John Wiley & Sons. 1st Edition.

Course Outcomes

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

CO1: Interpret the fundamental concepts of cloud computing and employ the deployment and delivery models of cloud computing.

CO2: Identify the different types of cloud computing and cloud based services

CO3: Apply the concept of virtualization in the cloud computing

CO4: Analyse the virtualize data center environment, infrastructure and security models in the cloud environment.

CO5: Examine the application of cloud computing in different database environment.

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	1	3	3	3	1	1	1	1	-
CO2	2	2	2	2	2	2	2	1	1	-	2	2
CO3	2	3	3	3	2	3	1	-	-	-	-	-
CO4	1	2	2	3	3	2	2	3	1	-	1	-
CO5	1	3	3	3	2	3	3	2	-	2	-	1

Big Data Analytics

Semester: V **Hours of Instruction /week: 3T**
Course Code: 24BEOC18 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To understand big data and use NoSQL big data management

CLO2: To work with MapReduce applications and Hadoop related tools for Big Data Analytics

UNIT - I Introduction **9**

Big Data – Definition, Characteristic Features – Big Data Applications – Big Data vs Traditional Data – Risks of Big Data – Structure of Big Data – Web Data – Evolution of Analytic Scalability – Evolution of Analytic Processes, Tools and methods – Analysis Vs Reporting – Modern Data Analytic Tools.

UNIT - II NoSql Data Management **9**

Introduction to NoSQL – aggregate data models – key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models– master-slave replication – consistency - Cassandra – Cassandra data model – Cassandra examples – Cassandra clients.

UNIT - III Map Reduce **9**

Map Reduce workflows – unit tests with MRUnit – test data and local tests – anatomy of Map Reduce job run – classic Map-reduce – YARN – failures in classic Map-reduce and YARN – job scheduling - – shuffle and sort – task execution – MapReduce types – input formats – output formats.

UNIT- IV Hadoop **9**

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures - Cassandra – Hadoop integration

UNIT -V Hadoop Related Tools **9**

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis - Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts - Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.

Total Hours: **45**

References:

1. Bill Franks. (2012). *Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics*. John Wiley & Sons, Incorporated, United States. 1st Edition.
2. Michael Minelli, Michelle Chambers, & Ambiga Dhira. (2013). *Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses.*John Wiley & Sons, Inc.
3. Eric Sammer. (2012). *Hadoop Operations*. O' Reilley.
4. P. J. Sadalage & M. Fowler. (2013). *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence.* Addison Wesley Professional, United States. 3rd Edition.
5. www.nptel.ac.in.

Course Outcomes:

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

CO1: Acquire the fundamental concepts of big data analytics.

CO2: Identify the various NoSql database models.

CO3: Apply appropriate Map Reduce analytics for solving computational problems

CO4: Identify HDFS, Hadoop's Input/Output mechanisms, file-based data structures for storing and processing data in Hadoop.

CO5: Use Hadoop-related tools such as HBase, Pig, and Hive for big data analytics.

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	1	-	-	1	1	1	1
CO2	2	3	3	2	3	1	-	-	2	2	2	3
CO3	3	3	3	2	3	1	-	-	2	2	3	3
CO4	2	3	3	2	3	1	-	-	2	2	2	3
CO5	3	3	3	2	3	1	-	-	2	2	3	3

Theory of Computation

Semester: V **Hours of Instruction /week: 3T**
Course Code: 24BEOC19 **No. of credits: 3**

Prerequisite: Basic concepts of discrete mathematics.

Course Learning Objectives (CLOs):
CLO1: To understand foundations of computation, Turing machines, Undecidability and NP class problems.
CLO2: To construct models of regular expressions, design context free grammar and push down automata.

UNIT - I Introduction to Automata Theory 9

Mathematical preliminaries Finite Automata (FA) – Central Concepts of Automata Theory - Need for automata theory - Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Equivalence of NFA and DFA – Finite Automata with Epsilon transitions – Applications of Finite Automata.

UNIT- II Regular Expressions and Languages 9

Regular Expressions: Definitions – Equivalence of Regular Expression and Finite Automata: Thomson Method – Basic Method– State Elimination Method – Arden's Theorem. Proving languages not to be regular – Closure Properties of Regular Language – Equivalence and Minimization of Automata (DFA).

UNIT- III Context Free Grammar and Normal Forms 9

Context-Free Grammar (CFG): Definition – Derivations – Parse Trees – Ambiguity – Simplification of Grammars – Conversion to Normal Forms: Chomsky (CNF) – Greibach (GNF). Pumping Lemma for Context –Free Languages – Applications of Pumping Lemma – Closure Properties of CFL.

UNIT- IV Pushdown Automata 9

Pushdown Automata (PDA): Introduction – Definition – Instantaneous Description of Pushdown Automata – Design Examples – The Languages of Pushdown Automata – The Language acceptance by Final State and Empty Stack. Equivalence of PDA and CFG: Construction of PDA from CFG – Construction of CFG from PDA – Deterministic Pushdown Automata.

UNIT- V Turing Machine and Undecidablity 9

Definition – Notation – Instantaneous Description and Languages – Design of TM – Programming Techniques for TM: Storage in State – Multiple Tracks – Subroutines. Variants of TM: Multitape – Nondeterministic – Enumerators. Universal Turing Machine – A language that is not Recursively Enumerable (RE) – Undecidable problems about Turing machine –Rice Theorem-Post's correspondence problem.

Total Hours: **45**

References:

1. Hopcroft J.E., Motwani R. & Ullman J.D. (2014). *Introduction to Automata Theory, Languages and Computations*. Pearson Education. India. 3rd Edition.
2. Michael Sipser. (2014). *Introduction to the Theory of Computation.* Cengage Learning India Pvt. Ltd. 3rd Edition.
3. John C Martin. (2011). *Introduction to Languages and the Theory of Computation*. Tata McGraw Hill. 4th Edition.
4. Harry R. Lewis & Christos H Papadimitriou. (2015). *Elements of the Theory of Computation*. Prentice Hall of India. 2nd Edition.
5. Peter Linz. (2016). *An Introduction to Formal Language and Automata*. Jones & Bartlett Learning. 6th Edition.
6. K.L.P.Mishra & N. Chandrasekaran. (2010). *Theory of Computer Science: Automata Languages and Computation.* Prentice Hall of India. 3rd Edition.

Course Outcomes:

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

CO1: Compare and analyze various finite automata and convert NFA to DFA.

CO2: Construct finite automata to regular expression and identify the properties of regular language.

CO3: Construct context free grammars to generate strings from a context free language and convert them into normal forms.

CO4: Construct pushdown automata and convert pushdown automata to context-free grammar.

CO5: Design Turing machines for various problems and analyze the undecidability of languages.

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	-	-	-	-	-	2
CO2	3	3	3	3	3	2	-	-	-	-	-	2
CO3	3	3	3	3	3	2	-	-	-	-	-	2
CO4	3	3	3	3	3	1	-	-	-	-	-	2
CO5	3	3	3	3	2	1	-	-	-	-	-	2

Linux Programming

Semester: V **Hours of Instruction /week: 3T**
Course Code:24BEOC20 **No. of credits: 3**

Prerequisite: Operating Systems

Course Learning Objectives (CLOs):
CLO1: To acquire knowledge of basic Linux OS, commands, and terminologies
CLO2: To develop programs using Shell scripting and acquire skills related to Linux file system

UNIT - I Linux utilities 9

A brief history of LINUX - Architecture of LINUX - Features of LINUX - Introduction to vi editor - Linux commands - PATH, Man, Echo, Printf, Script, Passwd, Uname, Who, Date, Stty, Pwd, cd, mkdir, rmdir, ls, cp, mv, rm, cat, more, wc, lp, od, tar, gzip - File handling utilities - Security by file permissions - Process utilities - Disk utilities - Networking commands- unlink, du, df, mount, umount, find,unmask, ulimit, ps, w, finger, arp, ftp, telnet, rlogin - Text Processing utilities and backup utilities - Tail, head , sort, nl, uniq, grep, egrep, fgrep, cut, paste, join, tee, pg, comm, cmp, diff, tr, awk, cpio

UNIT - II Introduction to Shell Programming 9

Linux Session - Standard Streams – Redirection – Pipes - Tee Command - Command Execution - Command-Line Editing – Quotes - Command Substitution - Job Control- Aliases – Variables - Predefined Variables – Options - Shell Environment Customization - Filters: Filters and Pipes - Concatenating files - Display Beginning and End of files - Cut and Paste – Sorting - Translating Characters - Files with Duplicate Lines - Count Characters - Words or Lines - Comparing Files.

UNIT - III File Structure and File Management 9

GREP: Operation - grep Family - Searching for File Content – Sed – Scripts - Operation- Addresses – commands – Applications - grep and sed - UNIX FILE STRUCTURE - Introduction to UNIX file system - inode (Index Node) - File descriptors - System calls and device drivers - File Management - File Structures - System Calls for File Management – create - open – close - read- write – lseek - link- symlink- unlink - stat- fstat – lstat – chmod – chown - Directory API – opendir – readdir – closedir – mkdir – rmdi r- umask.

UNIT - IV Process and Signals 9

Process - Process Identifiers - Process structure - Process table - viewing processes - System processes - Process scheduling - Starting new processes - Waiting for a process - Zombie processes - Orphan process – fork – vfork – exit – wait – waitpid – exec - Signals functions - Unreliable signals - Interrupted system calls – kill – raise – Alarm – Paus e- Abort – System - Sleep functions - Signal sets - File locking: Creating lock files - locking regions - Use of read and write with locking - Competing locks - Other lock commands - Deadlocks.

UNIT - V Inter Process Communication **9**

Pipe - process pipes - The pipe call- Parent and child processes and named pipes – Fifos - Semaphores – Semget – Semop – Semctl - Message queues – Msgget – msgsnd – msgrcv – msgct l- Shared Memory – Shmget – shmat – shmdt – shmctl - ipc status commands – Socket - Socket Connections - Socket Attributes - Socket Addresses – Socket Connect – Bind – Listen – Accept - Socket Communications.

Total Hours**: 45**

References:

1 W. Richard. Stevens. (2013). *Advanced Programming in the UNIX Environment*. Pearson Education. 3rd Edition

2 Behrouz A. Forouzan & Richard F. Gilberg. (2003). *Unix and shell Programming*. Cengage India Private Limited. 1st Edition.

3 Robert Love. (2013). *Linux System Programming*. O'Reilly Media. 2nd Edition.

4 W.R. Stevens. (2005). *Advanced Programming in the UNIX Environment*. Pearson Education.

5 Graham Glass- King Ables. (2021). *UNIX for Programmers and Users*. Pearson Education. 3rd Edition.

Course Outcomes:

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

CO1: Acquire the knowledge of using various Linux commands that are used to manipulate system operations

CO2: Develop Shell Programming using Linux commands.

CO3: Acquire the knowledge on File structure and File management

CO4: Identify the use of process, signals and their functions

CO5: Analyze the working process of interprocess communication.

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	2	-	-	-	1	-	-	1
CO2	3	3	3	3	3	-	-	-	2	-	-	1
CO3	3	3	3	3	3	-	-	-	2	-	-	1
CO4	3	3	3	3	3	-	-	-	2	-	-	1
CO5	3	2	3	2	3	-	-	-	3	-	-	2

Data Mining and Big Data Analytics Laboratory

Semester: V **Hours of Instruction/week: 3P**
Course Code: 24BEOC21 **No. of credits: 1**

Course Learning Objective (CLO):

CLO1: To explore tools and techniques for working with data mining and big data to solve practical problems

List of Experiments:

1. Pre-processing of Datasets
2. Implementation of Clustering algorithms
3. Implementation of Classification algorithms
4. Implementation of Association Rules.
5. Implementation of Data Analysis-Visualization
6. Installing Hadoop- understanding different Hadoop modes- Startup scripts- Configuration files.
7. Implementation of file management tasks in Hadoop (Adding files and directories- retrieving files and Deleting files).
8. Implement of Matrix Multiplication with Hadoop Map Reduce.
9. Implement a Word Count Map Reduce program
10. Installation of Hive along with practice examples
11. Installation of HBase- Installing thrift along with Practice examples
12. Case Study on any Commercial applications

Total Hours: **45**

Software Requirements:

Weka tool, R, Hadoop, Hive and HBase

References:

1 Jiawei Han 7 Michaeline Kamber. (2012). *Data Mining: Concepts and Techniques*. Morgan Kaufmann. 3rd Edition.

2 Pang-Ning Tan.Michael Steinbach & Vipin Kumar. (2009). *Introduction to Data Mining*. Pearson Education India.

3. Kim H. Pries & Robert Dunnigan. (2015). *Big Data Analytics: A Practical Guide for Managers*. CRC Press.

4. Michael Minelli- Michelle Chambers & Ambiga Dhiraj. (2013). *Big Data- Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses.* John Wiley & Sons-Inc..

5. Eric Sammer. (2012). *Hadoop Operations.* O' Reilley Media.

6. Lars George. (2011). *HBase: The Definitive Guide.* O' Reilley Media.

Course Outcomes:

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

CO1: Demonstrate the various data mining algorithms, techniques and apply preprocessing methods for any given raw data.

CO2: Evaluate systematically supervised and unsupervised models and algorithms with respect to their accuracy

CO3: Apply the tools and techniques in big data analytics to solve problems.

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	1	3	1	-	1	2	2	2	3
CO2	3	3	3	2	3	1	-	1	2	2	2	3
CO3	3	3	3	2	3	1	-	1	2	2	2	3

Cloud Computing Laboratory

Semester: V **Hours of Instruction /week: 3P**
Course Code:24BEOC22 **`No. of credits: 1**

Course Learning Objective (CLO):

CLO1: To develop web applications in cloud and learn the design and development process involved in creating a cloud-based application.

List of Experiments:

1. Install Virtual box/VMware Workstation with different flavors of Linux.
2. Install Virtual box/VMware Workstation with different flavors of Linux or windows OS on top of windows7 or 8.
3. Install a C compiler in the virtual machine created using virtual box and execute imple programs
4. Install Google App Engine. Create hello world app and other simple web applications using python/java.
5. Apply GAE launcher to launch the web applications.
6. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in Cloud Sim.
7. Procedure to transfer the files from one virtual machine to another virtual machine.
8. Procedure to launch virtual machine (Online Openstack Demo Version)
9. Install Hadoop single node cluster and run simple applications like wordcount.
10. Demonstrate AWS S3 bucket.
11. Demonstrate AWS IAM console.
12. Mini Project

Total Hours: **45**

Software Requirements:

Hadoop, Own Cloud, VMWare, CloudSim, python/java, Linux.

References:

1 Thomas Erl- Zaigham Mahmood & Ricardo Puttini. (2013). *Cloud Computing Concepts- Technology & Architecture*. Prentice Hall of India.

2 A.Srinivasan & J. Suresh. (2014). *Cloud Computing- A practical approach for learning and Implementation*. Pearson Education.

Course Outcomes:

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

CO1: Design and deploy a web application in a PaaS environment.

CO2: Simulate a cloud environment to implement new schedulers and install and use a generic cloud environment that can be used as a private cloud.

CO3: Manipulate large data sets in a parallel environment.

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	-	-	-	2	1	2	2
CO2	2	3	2	2	2	1	-	-	2	2	2	2
CO3	2	2	3	2	2	1	1	1	2	1	2	2

School of Engineering

Design Thinking

(Non-Credit Mandatory Courses)

(Applicable for the B.E students admitted from the academic year 2024-2025 & onwards)

Semester V **Hours of Instruction/week: 1T+2P**

Course Code: 24BEMC05

Course Learning Objectives (CLOs):

CLO1: To provide the new ways of creative thinking
CLO2: To learn the innovation cycle of Design Thinking process for developing innovative products.

UNIT - I An Insight to Learning **9**

Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting, Remembering Memory: Understanding the Memory process, Problems in retention, Memory enhancement techniques, Emotions: Experience and Expression: Understanding Emotions: Experience and Expression, Assessing Empathy, Application with Peers.

UNIT - II Basics of Design Thinking **9**

Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts and Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test. Being Ingenious and Fixing Problem: Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving.

UNIT - III Process of Product Design **9**

Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and 15 functions, Assignment – Engineering Product Design Prototyping and Testing: What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing

UNIT - IV Celebrating the Difference **9**

Understanding Individual differences and uniqueness, Group Discussion and Activities to encourage the understanding, acceptance and appreciation of Individual differences. Design Thinking and Customer Centricity: Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design

UNIT - V Feedback, Re-Design and Re-Create **9**

Feedback loop, Focus on user Experience, Address ergonomic challenges, user focused design, rapid prototyping and testing, final product, final Presentation, Solving Practical Engineering Problem through Innovative Product Design and Creative Solution.

Total Hours: 45

References:

1. Burgelman, R. A., Christensen, C., & Wheelwright, S. C. (2009). *Strategic Management of Technology and Innovation*. McGraw-Hill/Irwin.
2. Idris Mootee. (2013). *Design Thinking for Strategic Innovation*. John Wiley & Sons.

3. Martin, R. L. (2009). *The design of business: Why design thinking is the next competitive advantage.* Harvard Business Press.
4. Hasso Plattner, Christoph Meinel, & Leifer, L. (2015). *Design Thinking Research: Building Innovators*. Springer International Publishing.
5. Liedtka, J., King, A., & Bennett, K. (2013). *Solving Problems with Design Thinking Ten Stories of What Works.* New York; Chichester, West Sussex Columbia University Press.
6. Asmaraningtyas, L.W., Rahmawati, I.D., & Fitriyah, H. (2024). *Green Business Innovation: Sustainable Business Model Development through Integration of Business Model Canvas, Design Thinking, and Islamic Business Ethics.* Golden Ratio of Marketing and Applied Psychology of Business.

Course Outcomes:

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

CO1: Compare and classify the various learning styles and memory techniques and apply them in their engineering education Discuss the characteristics of semiconductor diodes.

CO2: Analyze and inspect emotional expressions in designing products.

CO3: Develop new ways of creative thinking.

CO4: Propose real-time innovative engineering products designs and choose appropriate frameworks, strategies, techniques during prototype development.

CO5: Perceive individual differences and its impact on everyday decisions and further create a better customer experience.

CO- PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	3	1	-	-	-	-	-	-	-	-
CO3	3	3	3	1	-	-	-	-	-	-	-	-
CO4	3	3	3	-	1	1	1	1	2	2	1	2
CO5	3	3	3	-	1	1	1	1	2	2	1	2

Soft Skills
(For B.E. students admitted in 2024-2025 and onwards)

Semester V **Hours of Instruction/week: 2T**

Course Code: 24BESS01

Course Learning Objectives (CLOs):

CLO1: To encourage all round development of students and to develop the right attitude through individual and group activities.

CLO2: To help students understand self and other's personality better, to maintain a positive attitude and stay motivated all the time.

UNIT- I Attitude Development **6**

Self Esteem & Attitude testing, Developing a positive attitude, Attitude in the workplace, Adaptability.

Activities: Psychometrics, Inspirational Stories, Role Playing, quiz, Interactive and Feedback Exercises.

UNIT - II Goal Setting & Leadership Skills **6**

Guidelines for Goal setting, SMART Goals, Types of goals, Personal & Professional goals, Long term & Short term goals.

Qualities of a Leader, Strategies for Effective Time Management, Problem solving & decision making, Leadership & Assertiveness.

Activities: Listing of goals (Academic, Health, Financial & Social), Goal measurement – self audit exercise, Leadership test, simulations, team games.

UNIT - III Communication at the Workplace **6**

Small talk, dialogue, debate, discussion, overcoming shyness, hesitation and cultural codes, interview techniques, group discussions, oral presentation skills, listening and observational Skills, body language, Intermediary Communication, Event Management, overcoming mental blocks, prejudices, developing proficiency in communicating through telephone, tele-conferencing, Web Chat etc.

Activities: Public Speaking Exercise on any topic of choice, Situational games, Mock Interview, Book Review, Biographical Sketch and Presentation, Group Discussion, Exercise on Current Affairs and Social Issues, Role Playing Exercise to highlight Non Verbal Skills.

UNIT - IV Stress Management and Emotional Intelligence Skills **6**

Change and stress, General principles of stress management, stress coping ability and stress inoculation training,

Emotional intelligence and Change Management, Dealing with crisis and disasters, concepts of Emotional Intelligence, conflict stimulation and conflict resolution techniques for effective management.

Activities: Exchange of Personal anecdotes, Psychometrics, Team Games Games like Were Wolf, Win Win Team Negotiation Exercise

UNIT - V Employability Quotient **6**

What is employability quotient, how to raise your employability quotient, employment readiness

Preparation for employment- roadmap to employment, drafting a CV, Group discussion & interview training

Activities: Hands on job search training, aptitude training, CV building, GD recording and Mock interview sessions

Total Hours: 30

Reference Books:

1. Bhatia, R.L. (1994). *Managing Time for a Competitive Edge*. A H Wheeler Publishing.
2. Prasad, H. M. (2001). *How to Prepare for Group Discussion and Interview.* New Delhi: Tata McGraw-Hill Publishing Company Limited.
3. Raman, Sharma. (2011). *Technical Communication*. Oxford University.
4. Rao, M.S. (2013). *Soft Skills – Enhancing Employability: Connecting Campus with Corporate*. SRS books.
5. Sabina Pillai & Agna Frenandez. (2018). *Soft Skills & Employability Skills***.** Cambridge University Press.
6. Tim Hindle. (2009). *Reducing Stress, Essential Managers.* DK Publishers.

Course Outcomes:

Upon completion of this course, students will be able to:

- **CO1:** Illustrate increased awareness about the self
- **CO2:** Display enhanced knowledge of social and professional etiquette
- **CO3:** Work effectively in teams
- **CO4:** Practice positive thinking in interpersonal relationships
- **CO5:** Acquire confidence in stress management and cultivate emotional intelligence

Internet and Web Technology

Semester: VI **Hours of Instruction/week: 3T**

Course Code: 24BEOC23 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To categorize the basic concepts of Web servers, programming and JavaScript.
CLO2: To interpret the working of an Angular JS as a web services to implement the handling of data IO in Mango DB.

UNIT - I Website Basics, HTML 5, CSS 3, Web 2.0 9

Web Essentials: Clients, Servers and Communication – The Internet – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image –Frames-Forms- HTML5 control elements – Drag and Drop – Audio – Video controls - CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations.

UNIT - II Client Side Programming 9

Core JavaScript – lexical structure- types-values and variables- expression and operators-statements-objects-arrays-functions- classes and modules- pattern matching with regular expressions- java script in web browser-The window objects-scripting documents-Handling events.

UNIT - III Server Side Programming 9

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- Database Connectivity: JDBC perspectives, JDBC program example – JSP: Understanding Java Server Pages-JSP Standard Tag Library (JSTL)-Creating HTML forms by embedding JSP code - XML.

UNIT - IV AngularJS 9

Using Events, Listeners, Timers, and Callbacks in Node.js-5 Handling Data I/O in Node.js- Accessing the File System from Node.js- Implementing HTTP Services in Node.js- implementing Socket Services in Node.js- Scaling Applications Using Multiple Processors in Node.js- Implementing Express in Node.js- Understanding NoSQL and MongoDB- Manipulating MongoDB Documents from Node.js- Accessing MongoDB Documents from Node.js- Advanced MongoDB Concepts.

UNIT - V Node JS and MongoDB 9

Using Events, Listeners, Timers, and Callbacks in Node.js-5 Handling Data I/O in Node.js- Accessing the File System from Node.js- Implementing HTTP Services in Node.js- implementing Socket Services in Node.js- Scaling Applications Using Multiple Processors in Node.js- Implementing Express in Node.js- Understanding NoSQL and MongoDB- Manipulating MongoDB Documents from Node.js- Accessing MongoDB Documents from Node.js- Advanced MongoDB Concepts.

Total Hours: **45**

References:

1 Deitel & Deitel. (2019). *Internet and World Wide Web How to Program*. Pearson Education.

2 Robert W. Sebesta. (2015). *Programming the World Wide Web*. Addison-Wesley. 8th Edition

3 Brad Dayley. (2014). *Node.js, MongoDB, and AngularJS Web Development*. Addison-Wesley Professional.

4 Marty Hall & Larry Brown. (2003). C*ore servlets and java server pages volume 1: core technologies*. Pearson Education

5 Brad Green & ShyamSeshadri. (2013). *AngularJS*. O'Reilly. 1st Edition.

6 RashimMogha- V VPreetham (2011). *Java Web Services Programming*. Wiley India Ltd.

7 David Flanagan (2011). *JavaScript The Definitive Guide*. O'Reilly Media. Inc.

8 www.nptel.ac.in

Course Outcomes:

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

CO1: Construct a basic website using HTML and Cascading Style Sheets.

CO2: Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms

CO3: Develop server-side programs using Servlets and JSP.

CO4: Develop web server applications using Angular JS.

CO5: Use Node JS to develop interactive web applications with MongoDB

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	-	-	-	1	3	3	2
CO2	2	2	2	2	3	-	-	-	2	2	3	3
CO3	3	2	3	2	3	-	-	-	1	2	3	2
CO4	3	2	3	2	3	-	-	-	2	2	3	3
CO5	2	3	2	2	3	-	-	-	2	2	3	3

Machine Learning

Semester: VI **Hours of Instruction/week: 3T**

Course Code:24BEOC24 **No. of Credits: 3**

Course Learning Objectives (CLOs):

CLO1: To introduce the fundamental concepts of machine learning and its applications.

CLO2: To understand the methods of solving real life problems using the machine learning techniques.

UNIT - I Introduction **9**

Machine learning: What and why? - Examples of Machine Learning Applications - Types Of Machine Learning Supervised Learning - Machine Learning Process- The Curse of Dimensionality, Overfitting - Training, Testing, and Validation Sets - The Confusion Matrix & Basic Statistics - Bias Variance Tradeoff.

UNIT- II Neurons, Neural Networks and Linear Discriminants **9**

Hebb's Rule - Neural Networks - The Perceptron - Linear Separability & Linear Regression. The Multi-layer Perceptron: Biases, Algorithm - Local minima and Stochastic gradient Descent Examples Of Using The MLP: Regression Problem & Classification Example - Deriving Back-Propagation.

UNIT - III Dimensionality Reduction and Evolutionary Models **9**

Linear Discriminant Analysis (LDA) - Principal Components Analysis (PCA), Factor Analysis - Independent Components Analysis -Probabilistic Model - Gaussian Mixture Models: EM Algorithm - Nearest Neighbour Methods - Support Vector Machines.

UNIT- IV Learning Techniques **9**

Evolutionary Learning - The Genetic Algorithms (GA)- Reinforcement Learning - Decision Trees - Classification And Regression Trees (CART) - Ensemble Learning: Boosting, Bagging, Random Forests - Unsupervised Learning : K-Means – Algorithm - Vector Quantisation.

9

UNIT -V Graphical Models

Bayesian Networks - Markov Random Fields - Hidden Markov Models (HMMS) - Markov Chain Monte Carlo (MCMC) Methods - Deep Belief Networks (DBN)

Total Hours**:** **45**

References:

1. Stephen Marsland. (2014). *Machine Learning – An Algorithmic Perspective*, 2nd Edition. Chapman and Hall / CRC Machine Learning and Pattern Recognition Series.
2. Ethem Alpaydin. (2014). *Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)*. MIT Press.3rd Edition
3. William F.Clocksin & Christopher S.Mellish, (2003). *Programming in Prolog: Using the ISO Standard*. Springer. 5th Edition
4. Gerhard Weiss, (2013). *Multi Agent Systems*. MIT Press. 2nd Edition
5. David L.Poole & Alan K.Mackworth. (2010). *Artificial Intelligence: Foundations of Computational Agents*. Cambridge University Press.

Course Outcomes:
At the end of the course student will be able to:

CO1: Acquire knowledge on fundamentals of machine learning.

CO2: Apply the Neural Networks and Linear Discriminants concepts for any given problem.

CO3: Choose and apply dimensionality reduction techniques and Evolutionary Models learning algorithms for any given problem.

CO4: Apply the appropriate machine learning techniques for any given problem.

CO5: Design a system that uses the appropriate graph models of machine learning.

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	-	-	-	-	-	-	3
CO2	2	2	2	2	3	-	-	-	-	-	-	3
CO3	1	1	3	3	3	-	-	-	-	2	-	3
CO4	2	3	3	3	3	2	-	-	-	2	-	3
CO5	2	3	3	3	3	2	-	-	-	2	-	3

Cryptography and Cyber Security

Semester: VI **Hours of Instruction/week: 3T**

Course Code: 24BEOC25 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To learn the fundamental concepts related to security, analyse the security of in-built cryptosystems and develop cryptographic algorithms for information security.

CLO2: To comprehend the various types of data integrity, authentication schemes and understand cybercrimes and cyber security.

UNIT - I Introduction to Security 9

Computer Security Concepts – The OSI Security Architecture – Security Attacks – Security Services and Mechanisms – A Model for Network Security – Classical encryption techniques: Substitution techniques, Transposition techniques, Steganography – Foundations of modern cryptography: Perfect security – Information Theory – Product Cryptosystem – Cryptanalysis.

UNIT - II Symmetric Ciphers 9

Number theory – Algebraic Structures – Modular Arithmetic - Euclid‘s algorithm – Congruence and matrices – Group, Rings, Fields, Finite Fields -Symmetric Key Ciphers: SDES – Block Ciphers – DES, Strength of DES – Differential and linear cryptanalysis – Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Pseudorandom Number Generators – RC4 – Key distribution.

UNIT - III Asymmetric Cryptography 9

Mathematics of Asymmetric Key Cryptography: Primes – Primality Testing – Factorization – Euler’s totient function, Fermat’s and Euler’s Theorem – Chinese Remainder Theorem – Exponentiation and logarithm - Asymmetric Key Ciphers: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange -– Elliptic curve arithmetic – Elliptic curve cryptography.

UNIT - IV Integrity and Authentication Algorithms 9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function: HMAC, CMAC – SHA – Digital signature and authentication protocols – DSS – Schnorr Digital Signature Scheme – ElGamal cryptosystem – Entity Authentication: Biometrics, Passwords, Challenge Response protocols – Authentication applications – Kerberos - Mutual Trust: Key management and distribution – Symmetric key distribution using symmetric and asymmetric encryption – Distribution of public keys – X.509 Certificates

UNIT - V Cyber Crimes and Cyber Security 9

Cyber Crime and Information Security – classifications of Cyber Crimes – Tools and Methods – Password Cracking, Keyloggers, Spywares, SQL Injection – Network Access Control – Cloud Security – Web Security – Wireless Security

Total Hours: **45**

References:

1 William Stallings. (2017). *Cryptography and Network Security - Principles and Practice*. Pearson Education. 7th Edition.

2 Nina Godbole & Sunit Belapure. (2011). *Cyber Security: Understanding Cyber crimes, Computer Forensics and Legal Perspectives*. Wiley India. 1st Edition.

3 Behrouz A. Ferouzan & Debdeep Mukhopadhyay. (2015). *Cryptography and Network Security*. Tata Mc Graw Hill. 3rd Edition.

4 Charles Pfleeger, Shari Pfleeger & Jonathan Margulie. (2015). *Security in Computing.* Prentice Hall. New Delhi. 5th Edition.

5 William Stallings. (2017). *Cryptography and Network Security - Principles and Practice*. Pearson Education. 7th Edition.

Course Outcomes:

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

CO1: Acquire knowledge on the fundamentals of networks security, security architecture, threats and vulnerabilities.

CO2: Identify the different cryptographic operations of symmetric cryptographic algorithms.

CO3: Use the different cryptographic operations of public key cryptography.

CO4: Apply the various Authentication schemes to simulate different applications.

CO5: Analyse various types of cybercrimes and cyber security.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	2	-	-	-	1	1	-	1
CO2	3	3	3	2	3	-	-	-	2	2	1	2
CO3	3	3	3	2	3	-	-	-	2	2	1	2
CO4	3	3	3	2	3	-	-	-	2	2	1	2
CO5	3	3	2	2	3	-	-	-	2	2	1	2

Compiler Design

Semester: VI **Hours of Instruction/week: 3T**

Course Code: 24BEOC26 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To learn the various phases of compiler and intermediate code generation.
CLO2: To implement code generator and code optimization.

UNIT - I Introduction to Compilers and Lexical Analysis 9

Introduction- Translators- Compilation and Interpretation- Language processors -The Phases of Compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – Finite Automata – Regular Expressions to Automata NFA, DFA – Minimizing DFA - Language for Specifying Lexical Analyzers – Lex tool.

UNIT - II Syntax Analysis 9

Role of Parser – Grammars – Context-free grammars – Writing a grammar Top Down Parsing - General Strategies - Recursive Descent Parser Predictive Parser-LL(1) - Parser-Shift Reduce Parser-LR Parser- LR (0)Item Construction of SLR Parsing Table - Introduction to LALR Parser - Error Handling and Recovery in Syntax Analyzer-YACC tool - Design of a syntax Analyzer for a Sample Language

UNIT - III Syntax Directed Translation & Intermediate Code Generation 9

Syntax directed Definitions-Construction of Syntax Tree-Bottom-up Evaluation of S-Attribute Definitions- Design of predictive translator - Type Systems-Specification of a simple type Checker-Equivalence of Type Expressions-Type Conversions. Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking, Back patching.

UNIT - IV Run-Time Environment and Code Generation 9

Runtime Environments – source language issues – Storage organization – Storage Allocation Strategies: Static, Stack and Heap allocation - Parameter Passing-Symbol Tables - Dynamic Storage Allocation - Issues in the Design of a code generator – Basic Blocks and Flow graphs - Design of a simple Code Generator - Optimal Code Generation for Expressions– Dynamic Programming Code Generation.

UNIT - V Code Optimization 9

Principal Sources of Optimization – Peep-hole optimization - DAG- Optimization of Basic Blocks - Global Data Flow Analysis - Efficient Data Flow Algorithm – Recent trends in Compiler Design.

Total Hours: **45**

References:

1 Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman (2009). *Compilers: Principles, Techniques and Tools*. Pearson Education. 2nd Edition

2 Randy Allen, Ken Kennedy (2002). *Optimizing Compilers for Modern Architectures: A Dependence based Approach.* Morgan Kaufmann Publishers.

3 Steven S. Muchnick (2003). *Advanced Compiler Design and Implementation*. Morgan Kaufmann Publishers - Elsevier Science India. Indian Reprint.

4 Keith D Cooper and Linda Torczon (2004). *Engineering a Compiler*. Morgan Kaufmann Publishers Elsevier Science.

5 V. Raghavan (2010). *Principles of Compiler Design*. Tata McGraw Hill Education Publishers.

Course Outcomes:

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

CO1: Acquire knowledge of different phases of compiler, represent language tokens using regular expressions, context free grammar and finite automata.

CO2: Compare top down with bottom-up parsers and construct different parsing tables.

CO3: Design syntax directed translation schemes for a given context free grammar and generate intermediate code representations.

CO4: Classify various storage allocation strategies and explain the instruction set for code generation.

CO5: Apply the optimization techniques and generate machine code for high level language program.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	3	-	-	-	1	1	-	2
CO2	2	3	3	2	3	-	-	-	1	1	-	2
CO3	2	3	3	2	2	-	-	-	1	1	-	2
CO4	2	3	3	2	2	-	-	-	2	1	-	2
CO5	2	3	3	2	2	-	-	-	2	1	-	3

Internet and Web Technology Laboratory

Semester: VI **Hours of Instruction/week: 3P**

Course Code: 24BEOC27 **No. of credits: 1**

Course Learning Objectives (CLOs):

CLO1: To design and implement applications using the concepts of Web Technology.

List of Experiments:

1. Create a web page with the following using HTML.
    i. To embed an image map in a web page.
    ii. To fix the hot spots.
    iii. Show all the related information when the hot spots are clicked.
2. Create a web page with all types of Cascading style sheets.
3. Client Side Scripts for Validating Web Form Controls using DHTML.
4. Write programs in Java using Servlets:
    i. To invoke servlets from HTML forms.
    ii. Session Tracking.
5. Write programs in Java to create three-tier applications using JSP and Databases
    i. For conducting on-line examination.
    ii. For displaying student mark list.

    Assume that student information is available in a database which has been stored in a database server
6. Write a javascript program for validating Registration Form
7. Write a program for implementing XML document for Customer Details.
8. Programs using XML – Schema – XSLT/XSL.
9. Design a dynamic web page with validation using Angular.JS templates.
10. Create a web page with the following using Angular.JS services.
    i. Expressions
    ii. Filters
    iii. Events and change notification
11. Simple application to demonstrate Database Connectivity using MongoDB.
12. Mini Project to develop a website applying the web technology concepts.

Total Hours: **45**

Software Requirements:

HTML5. Angular JS,Mongo DB, Visual Studio Code ++

References:

1 Deitel & Deitel. (2019). *Internet and World Wide Web How to Program*. Pearson Education.
2 Robert W. Sebesta. (2015). *Programming the World Wide Web*. Addison-Wesley. 8th Edition
3 Brad Dayley. (2014). *Node.js. MongoDB, and AngularJS Web Development*. Addison-Wesley Professional.
4 Brad Green & ShyamSeshadri. (2013). *AngularJS*. O'Reilly Media. 1st Edition.
5 Rashim Mogha & V.V.Preetham.(2011). *Java Web Services Programming*. Wiley India Ltd.
6 David Flanagan. (2011). *JavaScript The Definitive Guide*. O'Reilly Media, Inc.

Course Outcomes:

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

CO1: Design applications using HTML, DHTML and Java Script.

CO2: Design the dynamic web pages using Java, JSP, Angular JS and XML.

CO3: Develop web application using MongoDB, Database Connectivity and identify the environments that are currently available on the market to design web sites.

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	-	-	-	1	3	3	2
CO2	2	2	2	2	3	-	-	-	2	2	3	3
CO3	3	2	3	2	3	-	-	-	1	2	3	2

Machine Learning Laboratory

Semester: VI **Hours of Instruction/week: 3P**

Course Code: 24BEOC28 **No. of credits: 1**

Course Learning Objective (CLO):

CLO1: To make use of the datasets in implementing the machine learning algorithms.

List of Experiments:

1. Familiarize with Numpy, Panda and Matplotlib by loading dataset in Python.
2. Implement k-nearest neighbours classification using python
3. Implement and demonstrate the FIND-S algorithm.
4. Implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples
5. Write a program to demonstrate the working of the decision tree based ID3 algorithm.
6. Build an Artificial Neural Network by implementing the Back propagation algorithm
7. Write a program to implement the naïve Bayesian classifier
8. Write a program to construct a Bayesian network considering medical data using Python ML library classes/API.
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris dataset.
10. Implement Linear regression with PyTorch.
11. Implement Linear regression with TensorFlow.
12. Mini Project.

Total Hours: **45**

Software Requirements:

Java, Python, MATLAB

References:

1 Christopher Bishop. (2016). *Pattern Recognition and Machine Learning*. Springer.

2 Ethem Alpaydin. (2014). *Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)*. MIT Press. 3rd Edition

3 Oliver Theobald. (2017). *Machine Learning with Python: A Practical Beginners' Guide.*

4 Trevor Hastie, Robert Tibshirani & Jerome Friedman. (2013). *The Elements of Statistical Learning*. Springer.

Course Outcomes:

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

CO1: Identify the implementation procedures for the machine learning algorithms.

CO2: Create Python programs for various machine learning algorithms.

CO3: Apply Machine Learning algorithms to solve real world problems.

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	2	-	-	-	1	1	2
CO2	3	3	2	2	1	2	-	-	-	1	1	2
CO3	3	3	3	3	2	2	-	-	-	1	1	2

School of Engineering

Professional Ethics

(Non – Credit Mandatory Course)

(Applicable for the B.E students admitted from the academic year 2024-2025 & onwards)

Semester: VI **Hours of Instruction/week: 3T**

Course Code: 24BEMC06

Course Learning Objectives (CLOs):

CLO1: To understand and create awareness of role of Engineers towards Human and moral values, and to identify the core values that shapes the ethical behavior of an engineer.

CLO2: To create awareness on professional ethics and Human Values and to impart moral and societal values among the learners.

UNIT - I Human Values **9**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT - II Engineering Ethics **9**

Senses of "Engineering Ethics" – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg‟s theory – Gilligan‟s theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT - III Engineering as Social Experimentation **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT - IV Safety, Responsibilities and Rights **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT - V Global Issues **9**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

Total Hours: **45**

References:

1. Mike W. Martin and Roland Schinzinger. (2003). *Ethics in Engineering*. Tata McGraw Hill, New Delhi.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S. (2004). *Engineering Ethics*. Prentice Hall of India, New Delhi.
3. Charles B. Fleddermann (2004). *Engineering Ethics*. Pearson Prentice Hall, New Jersey.

4. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins. (2009). *Engineering Ethics – Concepts and Case*s. Cengage Learning.
5. John R Boatright. (2003). *Ethics and the Conduct of Business*. Pearson Education, New Delhi.
6. World Community Service Centre. (2011). *Value Education*. Vethathiri publications, Erode.

Course Outcomes:

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

CO1: Identify the basic perception of profession, professional ethics, various moral &social issues, industrial standards, code of ethics and role of professional ethics in engineering field.

CO2: Analyze the safety and risk involved in engineering, responsibilities of an engineer for safety and risk benefit analysis.

CO3: Outline the knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives.

CO4: Discuss the ethical issues related to engineering and application of ethics in society

CO5: Realize the responsibilities and rights of an engineer in the society and the role of CSR in societal empowerment

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	-	-	-	-	-	2	2	-	-
CO2	3	3	3	1	-	-	-	-	2	2	-	-
CO3	3	3	3	1	-	-	-	-	3	2	-	-
CO4	3	3	2	-	-	-	-	-	2	2	-	-
CO5	3	-	2	-	-	-	-	-	2	2	-	-

Engineering Economics

Semester: VII **Hours of Instruction/week: 3T**

Course Code: 24BEHS08 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To enable students to understand the fundamental economic concepts applicable to Engineering.

CLO2: To learn the techniques of incorporating inflation factor in economic decision making.

UNIT - I Demand and Supply Analysis **9**

Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision Analysis - Demand - Types of demand - Determinants of demand - Demand function – Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function -Supply elasticity.

UNIT - II Production And Cost Analysis **9**

Production function - Returns to scale - Production optimization - Least cost input -Isoquants - Managerial uses of production function- Cost Concepts - Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.

UNIT - III Pricing **9**

Capital Budgeting – Decisions – Steps Involved in Capital Budgeting – Methods of Project Appraisal –Pay-back Period – Net Present Value and Internal Rate of Return - Project Management - Techniques – PERT – CPM Models– Case Analysis.

UNIT - IV Project Management **9**

Capital Budgeting – Decisions – Steps Involved in Capital Budgeting – Methods of Project Appraisal –Pay-back Period – Net Present Value and Internal Rate of Return - Project Management - Techniques – PERT – CPM Models– Case Analysis.

UNIT - V Economic Growth and Development **9**

Concepts of Macro Economics – National Income – Inflation – Control Measures -Monetary Policy – Fiscal Policy – Technological Innovation in Banking and Economic Development - Sustainable Development Goals – Circular Economy.

Total Hours: **45**

References:

1 Panneer Selvam, R. (2012). *Engineering Economics*. Prentice Hall of India Ltd. New Delhi.

2 Chan S.Park. (2011). *Contemporary Engineering Economics*. Prentice Hall of India.

3 Donald.G. Newman & Jerome. P.Lavelle. (2010). *Engineering Economics and analysis, Engg*. Press, Texas.

Course Outcomes:

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

CO1: Apply the basics of economics and cost analysis to engineering and take economically sound decisions.

CO2: Compare the economic theories and cost concepts.

CO3: Classify the different procedures of pricing.

CO4: Decide the capital budgeting for project appraisal.

CO5: Predict the national income, the functions of banks and concepts of globalization.

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	2	-	-	-	-	-	-	2	
CO2	1	3	2	2	-	-	-	-	-	-	3	1
CO3	1	2	2	2	-	-	-	-	-	-	3	1
CO4	2	3	3	2	2	-	-	-	-	-	3	1
CO5	1	3	3	2	-	-	-	-	-	-	3	2

Deep Learning

Semester: VII **Hours of Instruction/week: 3T**

Course Code: 24BEOC30 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To learn the concepts of deep learning for solving real life problems.
CLO2: To acquire knowledge on the applications of deep learning in various scenarios.

UNIT - I Introduction **9**

Need for Deep Learning - tensor operations - Activation Functions – Loss Functions - Deep Feed forward Networks – Regularization for Deep Learning (DL) – Optimization for Training Deep Models – Applications of DL

UNIT - II Convolutional Networks **9**

Convolution operation – Motivation – Pooling – Convolution variants – Down sampling, stride and padding –Local, convolution, tiled and full connections– CNN training – Structured outputs – Data types – Efficient convolution algorithms – Random or unsupervised features – Neuro scientific basis of CNN - Applications

UNIT - III Recurrent Neural Networks **9**

Recurrent Neural Networks (RNN) – Unfolding computational graphs – RNN design patterns - Backpropagation through time – Bidirectional RNN – Encoder Decoder Sequence-to-Sequence Architectures – Deep recurrent networks – Recursive neural networks - Challenge of long-term dependencies – LSTM and GRU –Attention and the Transformer

UNIT - IV Autoencoders, Representation Learning and Structured Models **9**

Autoencoders (AE) – AE variants - Applications of AE - Representation Learning – Greedy pre-training – Transfer learning and domain adaptation - Structured Probabilistic Models for Deep Learning - Using Graphs to Describe Model Structure- Sampling from Graphical Models - Restricted Boltzmann Machine

UNIT - V Deep Generative Models **9**

Sampling and Monte Carlo Methods – Deep Boltzman Machines —Directed Generative Nets – Variational Autoencoders - Generative Adversarial Networks– Normalizing flow models – Diffusion models – Deep Convolutional GAN

Total Hours: **45**

References:

1 Ian Goodfellow, Yoshua Bengio & Aaron Courville. (2017). *Deep Learning*. MIT Press.
2 Magnus Ekman. (2021). *Learning Deep Learning*. Addison-Wesley Professional.
3 Charu C. Aggarwal. (2018). *Neural Networks and Deep Learning*. Springer.
4 Adam Gibson, Josh Patterson. (2017). *Deep Learning: A Practitioner's Approach*. Oreilly Media.
5 Umberto Michelucci. (2018). *Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks*. Apress.
6 Nicholas Locascio & Nikhil Buduma (2017). *Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms*. Oreilly Media.
7 Giancarlo Zaccone, Md. Rezaul Karim & Ahmed Menshawy. (2017). *Deep Learning with TensorFlow: Explore neural networks with Python*. Packt Publisher.

Course Outcomes:

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

CO1: Acquire knowledge on the basic concepts of deep learning
CO2: Identify Convolution Neural Network models for various application
CO3: Apply Recurrent Neural Networks to solve real world problems
CO4: Implement the concept of Autoencoders, Representation Learning and Structured Models
CO5: Examine the various Deep Generative Models

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	2	-	-	-	1	1	2
CO2	3	3	2	2	1	2	-	-	-	1	1	2
CO3	3	3	3	3	2	2	-	-	-	1	1	2
CO4	3	3	3	3	2	2	-	-	-	1	1	2
CO5	3	3	2	1	1	2	-	-	-	1	1	2

Deep Learning Laboratory

Semester: VII **Hours of Instruction/week: 3P**

Course Code: 24BEOC31 **No. of credits: 1**

Course Learning Objectives (CLOs):

CLO1: To design and implement different techniques to develop simple autonomous agents that make effective decisions in fully informed and partially observable settings.

List of Experiments:

1. Write a program to train Simple Perceptron with Gradient Descent for regression
2. Write a program to train MLP with Back propagation for classification
3. Write a program for CNN with max pooling for MNIST Dataset
4. Implement Neural Machine Translation with Bahdanau and Loung Attention
5. Language modeling using RNN
6. Sentiment analysis using LSTM
7. Implement Time Series Prediction using LSTM
8. Implement Transformer using PyTorch
9. Implement Recommender systems using RBM
10. Implement Face Recognition using SSD.
11. Generating fake videos using autoencoders
12. Implement image generation using GAN

Total Hours: **45**

Software Requirements:

MATLAB, Python

References:

1 IanGood fellow, Yoshua Bengio & Aaron Courville. (2016). *Deep Learning*. MIT Press.
2 François Chollet. (2017). *Deep Learning with Python*. Manning Publications Co.
3 Rajiv Chopra. (2018). *Deep Learning –A Practical Approach*. Khana Publications

Course Outcomes:

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

CO1: Create a python program to train Perceptron, MLP and CNN for regression and classification
CO2: Implement Face Recognition, Recommender systems and Time Series Prediction using DL algorithms
CO3: Use GAN for image generation and autoencoders for fake videos generation.

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	2	-	-	-	1	1	2
CO2	3	3	2	2	1	2	-	-	-	1	1	2
CO3	3	3	3	3	2	2	-	-	-	1	1	2

School of Engineering

Disaster Management
(Non-Credit Mandatory Courses)
(Applicable for the B.E students admitted from the academic year 2024-2025 & onwards)

Semester: VII **Hours of Instruction/week: 3T**

Course Code: 24BEMC07

Course Learning Objectives (CLOs):

CLO1: To enable the students to create an awareness on Disasters and its types,
CLO 2: To study the risk management and development policies implemented by the government to protect from disaster.

UNIT – I Introduction to Disasters **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc. - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT – II Approaches to Disaster Risk Reduction (DRR) **9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- non-structural measures, Roles and responsibilities of-community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level-State Disaster Management Authority (SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT - III Inter-Relationship between Disasters and Development **9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT - IV Disaster Risk Management in India **9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT - V Disaster Management: Applications and Case Studies and Field Works 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

Total Hours: **45**

References:

1 Ghosh G.K. (2011). *Disaster Management.* APH Publishing Corporation.
2 Singhal J.P. (2019). *Disaster Management*. Laxmi Publications.
3 Tushar Bhattacharya. (2017). *Disaster Science and Management.* McGraw Hill India Education Pvt. Ltd.,
4 Gupta Anil K & Sreeja S. Nair. (2011). *Environmental Knowledge for Disaster Risk Management.* NIDM, New Delhi.
5 Anu Kapur. (2010). *Vulnerable* India: A Geographical Study of Disasters. IIAS and Sage Publishers, New Delhi.
6 *Govt. of India: Disaster Management Act*, Government of India, New Delhi, 2005.
7 *Government of India*, National Disaster Management Policy, 2009.
8 http://ndma.gov.in/ (Home page of National Disaster Management Authority)

Course Outcomes:

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

CO1: Discuss the basics of disasters, types and their impacts.
CO2: Explain about the Disaster Risk Reduction strategies and policies
CO3: Familiarize with the relationship between disasters and development.
CO4: Describe the disaster risk management policies and acts implemented in India.
CO5: Summarize case studies related to various disasters.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	1	-	-	1	-	-	3	2	1	1
CO2	2	-	1	-	-	1	-	-	3	2	1	1
CO3	2	-	1	-	-	-	-	-	3	2	1	1
CO4	1	-	2	-	1	2	-	-	3	2	1	1
CO5	1	-	2	-	1	-	-	-	3	2	1	1

Exploratory Data Analysis

PE1

Semester: V **Hours of Instruction/week: 3T**

Course Code: 24BEOE01 **No. of credits: 3**

Prerequisite: Basic knowledge of python and statistics

Course Learning Objectives (CLOs):

CLO1: To familiarize an overview of exploratory data analysis.
CLO2: To use Data exploration and visualization techniques for multivariate and time series data.

UNIT - I Exploratory Data Analysis 9

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.

UNIT - II EDA Using Python 9

Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.

UNIT - III Univariate Analysis 9

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality.

UNIT - IV Bivariate Analysis 9

Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches – Scatte rplots and Resistant Lines.

UNIT - V Multivariate And Time Series Analysis 9

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

Total Hours: **45**

References:

1 Suresh Kumar Mukhiya & Usman Ahmed. (2020). *Hands-On Exploratory Data Analysis with Python*. Packt Publishing.

2 Jake Vander Plas. (2017).*Python Data Science Handbook: Essential Tools for Working with Data*, O Reilly. 1st Edition

3 Catherine Marsh, Jane Elliott. (2008).*Exploring Data: An Introduction to Data Analysis for Social Scientists*. Wiley Publications. 2nd Edition.

4 Claus O. Wilke. (2019). *Fundamentals of Data Visualization*. O'Reilly Media.

Course Outcomes:

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

CO1: Explain the concept of exploratory data analysis and its related terminologies.

CO2: Implement the data visualization using Matplotlib.

CO3: Apply the univariate data exploration analysis.

CO4: Apply the bivariate data exploration analysis.

CO5: Use Data exploration and visualization techniques for multivariate and time series data.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	-	-	-	2	2	3	2
CO2	2	2	2	3	3	-	-	-	3	2	2	2
CO3	2	3	2	2	3	-	-	-	2	2	1	1
CO4	2	2	2	2	3	-	-	-	3	2	1	1
CO5	2	2	3	2	1	-	-	-	1	2	1	2

Social Media Analytics

PE1
Semester: V
Hours of Instruction/week: 3T

Course Code: 24BEOE02
No. of credits: 3

Prerequisite: Python, Data Mining

Course Learning Objectives (CLOs):

CLO1: To familiarize the concept of social media analytics and understand its significance.
CLO2: To develop skills required for analysing the effectiveness of social media for business purpose.

UNIT - I Introduction **9**

Introduction to Social Media Analytics (SMA) – Social media landscape – Need for SMA – SMA in Small organizations – SMA in large organizations – Application of SMA in different areas Network fundamentals and models – The social networks perspective – nodes – ties and influencers – Social network and web data and methods.

UNIT - II Mining Twitter **9**

Why Is Twitter All the Rage? Exploring Twitter's API – Fundamental Twitter Terminology – Creating a Twitter API Connection – Exploring Trending Topics – Searching for Tweets – Analyzing the 140 Character – Extracting Tweet Entities – Analyzing Tweets and Tweet Entities with Frequency Analysis – Computing the Lexical Diversity of Tweets – Examining Patterns in Retweets – Visualizing Frequency Data with Histograms.

UNIT - III Mining Facebook **9**

Analyzing Fan Pages – Examining Friendships – and More Overview – Exploring Facebook's Social Graph API – Understanding the Social Graph API – Understanding the Open Graph Protocol – Analyzing Social Graph Connections – Analyzing Facebook Pages – Examining Friendships.

UNIT - IV Mining LinkedIn **9**

Overview – Exploring the LinkedIn API – Making LinkedIn API Requests – Downloading LinkedIn Connections as a CSV File – Clustering Data – Clustering Enhances User Experiences – Normalizing Data to Enable Analysis – Measuring Similarity – Clustering Algorithms.

UNIT - V Data Mining and Text Mining in Social Media **9**

Introduction – Data Mining in a Nutshell – social media – Motivations for Data Mining in social media – Data Mining Methods for social media – Data Representation – Data Mining – A Process – Social Networking Sites: Illustrative Examples – Text Mining in Social Networks - Introduction – Keyword Search – Query Semantics and Answer Ranking – Keyword search over XML and relational data – Keyword search over graph data.

Total Hours: **45**

References:

1 Matthew A. Russell. (2013). *Mining of Social Web*. O'Reilly Media. 2nd Edition.

2 Matthew Ganis & Avinash Kohirkar. (2016). *Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media*. Pearson Education.

3 Boris Belousov, Hany Abdulsamad, Pascal Klink, Simone Parisi & Jan Peters. (2021). *Reinforcement Learning Algorithms: Analysis and Applications*. Springer.1st edition.

4 John G. Breslin, Alexander Passant & Stefan Decker. (2009). *The Social Semantic Web*. Springer.

Course Outcomes:

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

CO1: Explain the fundamentals of social media analytics, its applications and the methods for analysing social networks and web data.

CO2: Interpret the use of API to explore trending topics, search tweets, analyse tweet content and visualize data.

CO3: Analyze fan pages, friendships, and other social connections using Facebook's Social Graph API and Open Graph Protocol.

CO4: Apply the algorithms to perform mining in LinkedIn platform.

CO5: Examine the Data Mining Methods and the process of Text Mining in Social Networks.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	3	-	-	-	1	1	1	3
CO2	2	2	2	3	3	-	-	-	3	2	3	2
CO3	2	2	3	2	2	-	-	-	3	1	1	2
CO4	3	2	1	2	3	-	-	-	2	1	3	1
CO5	3	2	2	1	3	-	-	-	2	2	3	1

Computer Vision

PE1

Hours of Instruction/week: 3T

Semester: V
Course Code: 24BEOE03 **No. of credits: 3**

Prerequisite: Linear Algebra and Calculus, Machine Learning

Course Learning Objectives (CLOs):

CLO1: To review image processing techniques for computer vision
CLO2: To analyse three-dimensional image analysis techniques

UNIT - I Introduction 9

Image Processing- Computer Vision - Low-level- Mid-level- High-level - Fundamentals of Image Formation- Transformation: Orthogonal- Euclidean- Affine- Projective - Fourier Transform- Convolution and Filtering- Image Enhancement- Restoration- Histogram Processing.

UNIT - II Feature Extraction and Feature Segmentation 9

Feature Extraction -Edges - Canny - LOG - DOG; Line detectors (Hough Transform) - Corners -Harris and Hessian Affine - Orientation Histogram - SIFT - SURF - HOG - GLOH - Scale-Space Analysis- Image Pyramids and Gaussian derivative filters - Gabor Filters and DWT- Image Segmentation - Region Growing - Edge Based approaches to segmentation - Graph-Cut - Mean-Shift - MRFs - Texture Segmentation.

UNIT - III Images, Histograms, Binary Vision 9

Simple pinhole camera model – Sampling – Quantisation – Colour images – Noise – Smoothing – 1D and 3D histograms - Histogram/Image Equalisation - Histogram Comparison - Back-projection - k-means Clustering – Thresholding - Threshold Detection Methods - Variations on Thresholding - Mathematical Morphology – Connectivity

UNIT - IV 3D Vision and Motion 9

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion–spline-based motion- optical flow – layered motion.

UNIT - V Applications 9

Overview of Diverse Computer Vision Applications: Document Image Analysis – Biometrics – Object Recognition – Tracking - Medical Image Analysis - Content-Based Image Retrieval - Video Data Processing - Virtual Reality and Augmented Reality.

Total Hours: **45**

References:

1 D. A. Forsyth& J. Ponce. (2003). *Computer Vision: A Modern Approach*. Pearson Education.

2 Richard Szeliski. (2011). *Computer Vision: Algorithms and Applications*. Springer Verlag London Limited.

3 Simon J. D. Prince. (2012). *Computer Vision: Models, Learning, and Inference*. Cambridge University Press.

Course Outcomes:

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

CO1: Explain the levels of image processing and transformation techniques.

CO2: Identify the feature extraction, segmentation and object recognition methods.

CO3: Apply Histogram and threshold detection methods for detection of geometric shapes.

CO4: Examine the 3D vision process and motion analysis techniques.

CO5: Apply computer vision techniques to various fields.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	-	-	-	2	1	-	-
CO2	2	2	2	1	2	2	-	-	2	2	-	-
CO3	3	3	3	1	2	-	-	-	3	1	-	-
CO4	3	3	2	1	-	-	-	-	2	2	-	-
CO5	3	-	2	-	-	-	-	-	2	2	-	-

Predictive Analytics

PE1

Semester: V **Hours of Instruction/week: 3T**

Course Code: 24BEOE04 **No. of credits: 3**

Prerequisite: Basics of Mathematics and Statistics

Course Learning Objectives (CLOs):

CLO1: To familiarize the concept of forecasting and develop analytical skill in fitting regression models.

CLO2: To provide the methodical approach for building time series models and impart the knowledge of assessing pattern of time series data plot.

UNIT - I Introduction to Predictive Analytics & Forecasting 9

Introduction to Analytics - Tools and Environment- Application of Modeling in Business - Data Modeling Techniques- Missing imputations - Forecasting: Nature and Uses – Forecasting Process – Time Series Plot – Plotting Smoothed Data Exploring Time Series Data Pattern – Auto-covariance and Auto-correlation Functions – Correlogram – General Approach to Time Series Modeling and Forecasting- Evaluating and Monitoring Forecasting Model Performance.

UNIT - II Forecasting Methodology 9

Forecasting techniques – Measuring Forecast Error – Applications – Moving averages and Smoothing Methods - Naïve Models – Simple and Moving Average Methods – Exponential Smoothing: First Order Exponential Smoothing – Holt - Winter Forecast Methods.

UNIT - III Regression Analysis 9

Linear Regression Models – Least Squares Estimation – Test for Significance of Regression – Confidence Interval on Regression Coefficients and Mean Response – Prediction of New Observation – Model Adequacy Checking: Residual Plots, Measures of Leverage and Influence – Regression Models for Time Series Data – Autocorrelation and Durbin-Watson Test.

UNIT - IV Time Series Analysis 9

Time Series – Components of Time Series: Trend, Seasonal Variation, Cyclical Variation and Irregular Variations – Additive and Multiplicative Models - Methods of Measuring Trend - Linear, Quadratic and Exponential Trends – Logistic Growth Model - Simple problems.

UNIT - V Box-Jenkins Methodology 9

Stationary and Nonstationary Time Series Data - Box-Jenkins Methodology: Autoregressive, Moving Average, Autoregressive Moving Average, Autoregressive Integrated Moving Average Models - Model Building Strategy - Model Selection Criteria – Diagnostic Checking.

Total Hours: **45**

References:

1 Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani. (2023). *An Introduction to Statistical Learning with Applications in R.* Springer.2nd Edition.

2 Hanke, J. E., & Wichern, D. (2014). *Business Forecasting.* Pearson New International Edition. 9th Edition.

3 Montgomery, D. C., Jennings, C. L., & Kulahci, M. (2015). *Introduction to Time Series Analysis and Forecasting*. Wiley. 2nd Edition.

4 Box, G.E.P., Jenkins, G.M., Reinsel, G. C., & Ljung, G.M. (2015). *Time Series Analysis: Forecasting and Control*. John-Wiley & Sons. 5th Edition.

5 Dean Abbott. (2014). *Applied Predictive Analytics Principles and Techniques for the Professional Data Analyst*. Wiley.

6 www.nptel.ac.in

Course Outcomes:

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

CO1: Acquire the knowledge on the fundamental concepts of Predictive analytics, forecasting and time series data patterns.

CO2: Explore future values by selecting the suitable time series models.

CO3: Analyze the linear regression models.

CO4: Apply the time series models to measure the linear trend in a time series plot.

CO5: Apply Box-Jenkins methodology to identify a suitable time series model.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	1	-	-	-	2	1	-	-
CO2	2	2	2	2	2	-	-	-	1	2	-	1
CO3	2	2	3	2	2	-	-	-	2	1	-	2
CO4	3	3	3	3	3	-	-	-	2	2	-	2
CO5	3	3	3	3	3	-	-	-	2	2	-	2

Quantum Computing

PE2

Semester: V **Hours of Instruction/week: 3T**

Course Code: 24BEOE21 **No. of credits: 3**

Prerequisite: Calculus, linear algebra

Course Learning Objectives (CLOs):

CLO1: To interpret working of a Quantum Computing program and understand the applications and limitations of quantum

CLO2: To apply quantum computing principles and algorithms to solve problems

UNIT - I Introduction 9

Fundamental Concepts: Global Perspectives - Quantum Bits - Quantum Computation - Quantum Algorithms - Quantum Information - Postulates of Quantum Mechanisms - Application: superdense coding - The density operator - Ensembles of quantum states

UNIT - II Quantum Computation and Search algorithms 9

Models for computation - analysis of computational problems - Quantum algorithms - Single qubit operations - Simulation of quantum systems - The quantum search algorithm - Quantum search as a quantum simulation - Quantum counting - Speeding up the solution of NP-complete problems - Quantum search of an unstructured database - Optimality of the search algorithm - Black box algorithm limits.

UNIT – III Quantum Information 9

Quantum noise and Quantum Operations – Classical Noise and Markov Processes - Quantum Operations - Examples of Quantum noise and Quantum Operations – Applications of Quantum operations - Limitations of the Quantum operations formalism - Distance Measures for Quantum information.

UNIT – IV Quantum Error Correction 9

Introduction - Shor code - Theory of Quantum Error – Correction - Constructing Quantum Codes - Stabilizer codes - Fault-Tolerant Quantum Computation – Entropy and information – Shannon Entropy - Basic properties of Entropy - Von Neumann - Strong Sub Additivity.

UNIT – V Quantum information theory **9**

Distinguishing quantum states and the accessible information - Data Compression - Classical information over noisy quantum channels - Quantum information over noisy quantum channels - Entanglement as a physical resource - Quantum cryptography

Total Hours: **45**

References:

1 Micheal A. Nielsen. & Issac L. Chiang. (2002). *Quantum Computation and Quantum Information.* Cambridge University Press, Fint South Asian Edition.

2 Eleanor G. Rieffel & Wolfgang H. Polak. (2014). *Quantum Computing: A Gentle Introduction (Scientific and Engineering Computation)*. MIT Press.

3 Noson S. Yanofsky & Mirco A. Mannucci (2008). *Quantum Computing for Computer Scientists*. Cambridge University Press. 1st Edition.

Course Outcomes:

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

CO1: Illustrate the fundamental concepts of quantum computing and explore the superdense coding and ensembles of quantum state

CO2: Identify computational problems, quantum algorithms and implement quantum search algorithms

CO3: Distinguish classical noise from Markov processes, apply quantum operations and evaluate distance measures for quantum information

CO4: Construct the quantum codes and explain the fault-tolerant quantum computation, entropy and information measures

CO5: Analyze different quantum states, compress data effectively, use entanglement in practical applications and explain quantum cryptography

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	-	-	-	1	1	1	2
CO2	3	2	2	1	2	-	-	-	1	2	1	2
CO3	3	2	2	1	2	-	-	-	1	2	1	2
CO4	3	2	3	2	2	-	-	-	1	2	1	2
CO5	3	3	3	2	2	-	-	-	1	2	1	2

High Performance Computing

PE2
Semester: V **Hours of Instruction/week: 3T**
Course Code: 24BEOE22 **No. of credits: 3**

Prerequisite: Computer Architecture, Operating Systems

Course Learning Objectives (CLOs):

CLO1: To understand High Performance Computing (HPC) system architectures and various computational models
CLO2: To implement intensive applications on HPC platform.

UNIT - I Introduction to Parallel Programming & Computing 9

Era of Computing - Parallel Computing - Multiprocessors and Multicomputer Architectures - Scalar VS Vector Processing - Multivector and Superscalar Machines - Pipelined Processors - SIMD Computers - Conditions of parallelism - Program flow mechanisms - Types of Parallelism – ILP - PLP - LLP - Program Partitioning and scheduling.

UNIT - II Introduction to High Performance Computing 9

Introduction - Scalable Parallel Computer Architectures - towards low-cost computing - Network of Workstations project by Berkeley - Cluster Computing Architecture - Components - Cluster Middleware and SSI - Need of Resource Management and Scheduling - Programming Environments.

UNIT - III High Speed Networks & Message Passing 9

Introduction to High-Speed Networks - Lightweight Messaging Systems - Xpress Transport Protocol - Software RAID and Parallel File systems - Load Balancing Over Networks – Algorithms and Applications - Job Scheduling approaches and Resource Management in Cluster.

UNIT - IV CUDA Programming 9

Introduction to CUDA architecture for parallel processing - CUDA Parallelism Model - Foundations of Shared Memory - Introduction to CUDA-C - Parallel programming in CUDA-C - Thread Cooperation and Execution Efficiency - Constants memory and events - memory management - CUDA C on multiple GPUs - Hashing and Natural Parallelism - Scheduling and Work Distribution - Atomics - Barriers and Progress - Transactional Memory.

UNIT - V Open CL and Shared-memory programming 9

Introduction to OpenCL - OpenCL Setup - Basic OpenCL - Advanced OpenCL - OpenMP: Introduction to OpenMP - Parallel Programming using OpenMP.

Total Hours: **45**

References:

1 Rajkumar Buyya. (2014). *High Performance Cluster Computing: Architectures and Systems*, Vol. 1. Pearson Education.

2 Georg Hager & Gerhard Wellein. (2011). *Introduction to High Performance Computing for Scientists and Engineers*. CRC Press.

3 Kai Hwang. (2003). *Advanced Computer Architecture: Parallelism, Scalability, Programmability*. Tata McGraw Hill Education.

4 Robert Robey & Yuliana Zamora (2021). *Parallel and High-Performance Computing.* Manning.

5 Barbara Chapman. Gabriele Jost & Ruud van der Pas. (2008). *Using OpenMP - Portable Shared Memory Parallel Programming*. MIT Press.

.

Course Outcomes:

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

CO1: Interpret the methodologies for parallel programming and computing.

CO2: Explain the fundamentals of High-Performance Computing system architectures and various computational models.

CO3: Apply high-speed networking, lightweight messaging systems in various applications.

CO4: Identify the CUDA architectural features and memory management in the parallel programming.

CO5: Implement intensive applications on HPC platform using OpenCL and OpenMP.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	-	-	-	2	3	2	2
CO2	2	2	3	2	2	-	-	-	2	1	1	2
CO3	2	3	3	3	2	-	-	-	2	2	1	2
CO4	3	3	2	2	3	-	-	-	2	2	1	2
CO5	3	3	2	2	3	-	-	-	2	2	1	2

Internet of Things and Applications

PE 2
Semester: V **Hours of Instruction/week: 3T**
Course Code:24BEOE23 **No. of credits: 3**

Prerequisite: Data Science, Computer Networks, Cloud Computing

Course Learning Objectives (CLOs):

CLO1: To gain knowledge on the fundamentals of Internet of Things.

CLO2: To apply the concept of Internet of Things in the real world scenario.

UNIT - I Fundamentals of IoT **9**

Genesis of IoT - Genesis of IoT - IoT and Digitization -IoT impact - IoT challenges - IoT Architecture: One M2M - IoT World Forum (IoTWF) - Additional IoT Reference Models- Simplified IoT Architecture – IoT functional stack – IoT data management and compute stack.

UNIT - II IoT Protocols **9**

IoT Access Technologies: Physical and MAC layers – topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN. Application Transport Methods: Supervisory Control and Data Acquisition (SCADA) - Application Layer Protocols: CoAP and MQTT.

UNIT - III IoT Design and Communication Technologies **9**

IoT Requirements; Hardware Software; Study of IOT Sensors; Tagging and Tracking; Embedded Products; IoT Design; IoT Connectivity and Management; IoT Security - IoT Communication - Cellular Machine-to-Machine (M2M) application networks; Software for M2M Applications - Hardware - IP Based Cellular Networks 3G - 4G.

UNIT - IV Data Analytics for IoT **9**

Data Analytics overview and challenges - Structured vs Unstructured Data - Data in Motion vs Data at Rest, Data Analytics Tools and Technology: NoSQL Databases Hadoop - Apache Kafka, Apache Spark - Edge Streaming Analytics - Network Analytics Chef - NETCONF-YANG.

UNIT - V IoT Applications **9**

Home Automation: Smart Lighting Home Intrusion Detection Smart Cities: Smart Parking - Smart Traffic Control Environment: Weather Monitoring System - Air Pollution Monitoring - Forest Fire Detection - Agriculture: Smart Irrigation - Manufacturing: Converged Plantwide Ethernet (CPwE) Reference Model - Power Utility Industry: Field Area Network (FAN) - GridBlock.

References:

1 David Hanes, Ganzalo Salgueiro, Patrick Grossetete, Rob Barton & Jerome Henry. (2015). *IoT Fundamentals: Networking Technologies, Protocols and Use cases for Internet of Things.* Cisco Press.

2 Adrain McEwen & Hakim Cassimally. (2014). *Designing the Internet of Things*. Wiley.

3 Arshdeep Bahga & Vijay Madisetti. (2015). *Internet of Things A hands on approach.* University Press.

Course Outcomes:

At the end of the course- student will be able to:

CO1: Explain the fundamentals and architecture of Internet of Things.

CO2: Use appropriate IoT protocols for various applications.

CO3: Identify various types of design and its communication technologies.

CO4: Apply the Data Analytics tools and technologies in IoT.

CO5: Analyze the applications of IoT in various domains.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	1	-	-	-	2	2	-	-
CO2	3	3	2	1	-	-	-	-	2	2	-	-
CO3	3	2	3	1	1	-	-	-	3	2	-	-
CO4	2	3	2	-	-	-	-	-	2	2	-	-
CO5	3	2	1	-	-	-	-	-	2	2	-	-

Software Testing

PE2

Semester: V **Hours of Instruction/week: 3T**

Course Code: 24BEOE24 **No. of credits: 3**

Prerequisite: Software Engineering

Course Learning Objectives (CLOs):

CLO1: To understand the basics of software testing and build test cases to execute them.
CLO2: To focus on wide aspects of test automation and use test automated tools
.

UNIT - I Basics of Software Testing **9**

Why do we test Software? - Black-Box Testing and White-Box Testing - Software Testing Life Cycle - V-model of Software Testing - Program Correctness and Verification - Reliability versus Safety - Failures - Errors and Faults (Defects) - Software Testing Principles - Program Inspections - Stages of Testing: Unit Testing - Integration Testing - System Testing

UNIT - II Test Planning **9**

The Goal of Test Planning - High Level Expectations - Intergroup Responsibilities - Test Phases - Test Strategy - Resource Requirements - Tester Assignments - Test Schedule - Test Cases - Bug Reporting - Metrics and Statistics

UNIT - III Test Design and Execution **9**

Test Objective Identification - Test Design Factors - Requirement identification - Testable Requirements - Modeling a Test Design Process - Modeling Test Results - Boundary Value Testing - Equivalence Class Testing - Path Testing - Data Flow Testing - Test Design Preparedness Metrics - Test Case Design Effectiveness - Model-Driven Test Design - Test Procedures - Test Case Organization and Tracking - Bug Reporting - Bug Life Cycle.

UNIT - IV Advanced Testing Concepts **9**

Performance Testing: Load Testing - Stress Testing - Volume Testing - Fail-Over Testing - Recovery Testing - Configuration Testing - Compatibility Testing - Usability Testing - Testing the Documentation - Security testing - Testing in the Agile Environment - Testing Web and Mobile Applications.

UNIT - V Test Automation and Tools **9**

Automated Software Testing - Automate Testing of Web Applications - Selenium: Introducing Web Driver and Web Elements - Locating Web Elements - Actions on Web Elements - Different Web

Drivers - Understanding Web Driver Events - Testing: Understanding Testing.xml - Adding Classes - Packages - Methods to Test - Test Reports.

Total Hours: **45**

References:

1 Yogesh Singh (2012). *Software Testing*. Cambridge University Press India Private Ltd.

2 Paul C. Jorgensen. (2014). *Software Testing: A Craftsman's Approach*. Taylor & Francis Group. 4th Edition.

3 Limaye. M.G. (2017). *Software Testing - Principles, Techniques and Tools.* McGraw Hill Education India.

4 Naresh Chauhan. (2016). *Software Testing*. Oxford University Press. 2nd Edition

5 Elfriede Dustin. Thom Garrett, Bernie Gaurf. (2009). *Implementing Automated Software Testing*. Pearson Education, Inc.

6 Unmesh Gundecha & Satya Avasarala. (2018). *Selenium WebDriver 3 Practical Guide*. 2nd Edition

Course Outcomes:

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

CO1: Explain the basic concepts of software testing and the need for software testing

CO2: Design Test planning and different activities involved in test planning

CO3: Design effective test cases that can uncover critical defects in the application

CO4: Apply advanced types of testing for a given application.

CO5: Apply automated software tools to test software for performance measures

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	-	-	-	2	2	3	2
CO2	2	3	1	1	2	-	-	-	2	2	1	2
CO3	2	2	1	3	2	-	-	-	3	2	1	2
CO4	2	1	3	2	3	-	-	-	2	2	2	2
CO5	2	2	1	3	3	-	-	-	2	2	2	1

Data Visualization

PE1
Semester: VI

Hours of Instruction/week: 3T

No. of credits: 3

Course Code: 24BEOE05

Prerequisite: Data Science

Course Learning Objectives (CLOs):

CLO1: To know the working principles of various information visualization tools.
CLO2: To gain skill in designing real time interactive information visualization system.

UNIT - I Introduction **9**

Context of data visualization – Definition, Methodology, Visualization design objectives - Key Factors – Purpose, visualization function and tone, visualization design options - Data representation, Seven stages of data visualization, widgets, data visualization tools - Mapping - Time Series - Connections and Correlations - Scatterplot Maps - Trees, Hierarchies, and Recursion - Networks and Graphs.

UNIT - II Visualization Techniques **9**

Mapping - Time series - Connections and correlations – Indicator-Area Chart-Pivot table - Scatter charts, Scatter maps - Tree maps, Space filling and non-space filling methods - Hierarchies and Recursion - Networks and Graphs-Displaying Arbitrary Graphs-node link graph-Matrix representation for graphs- Info graphics

UNIT - III Text and Document Visualization **9**

Acquiring data - Where to Find Data, Tools for Acquiring Data from the Internet - Locating Files for Use with Processing - Loading Text Data, Dealing with Files and Folders - Listing Files in a Folder - Asynchronous Image Downloads - Web Techniques - Parsing data - Levels of Effort - Tools for Gathering Clues - Text Markup Languages - Regular Expressions - Grammars and BNF Notation - Compressed Data - Vectors and Geometry - Binary Data Formats - Advanced Detective Work.

UNIT - IV Interactive Data Visualization **9**

Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geomapping – Exporting - Framework – D3.js - Tableau Dashboards.

UNIT - V Security in Data Visualization **9**

Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems – Creating secured visualization system.

Total Hours: **45**

References:

1 Robert Spence. (2014). *Information Visualization An Introduction*. Pearson Education. 3rd Edition.

2 Colin Ware. (2012). *Information Visualization Perception for Design*. Margon Kaufmann Publishers. 3rd Edition.

3 Robert Spence. (2006). *Information Visualization Design for Interaction*. Pearson Education. 2ndEdition.

4 Benjamin B. Bederson & Ben Shneiderman. (2003). *The Craft of Information Visualization*. Morgan Kaufmann Publishers.

5 Matthew O. Ward, George Grinstein& Daniel Keim. (2015). *Interactive Data Visualization: Foundation, Techniques and Applications.* A. K. Peters/CRC Press. 2nd Edition.

Course Outcomes:

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

CO1: Acquire basic knowledge for designing information visualizing System.

CO2: Identify the techniques for interactive information visualization.

CO3: Identify the tools and techniques used for Text and Document Visualization.

CO4: Apply various modern visualization tools for interactive data visualization.

CO5: Apply the security concepts in data visualization and create a secured visualization system.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	-	-	-	2	2	3	2
CO2	2	2	2	3	3	-	-	-	3	2	2	2
CO3	2	3	2	2	3	-	-	-	2	2	1	1
CO4	2	2	2	2	3	-	-	-	3	2	1	1
CO5	2	2	3	2	1	-	-	-	1	2	1	2

Image and Video Analytics

PE1

Semester: VI **Hours of Instruction/week: 3T**

Course Code: 24BEOE06 **No. of credits: 3**

Prerequisite: Python, Machine Learning

Course Learning Objectives (CLOs):

CLO1: To understand the basics of image processing techniques for computer vision and various object detection techniques.

CLO2: To gain knowledge on various Object recognition mechanisms and video analytics techniques.

UNIT - I Introduction **9**

Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.

UNIT - II Image Pre-Processing **9**

Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models - Edges in multi-speralct images - Local pre-processing in the frequency domain - Line detection by local preprocessing operators - Image restoration.

UNIT - III Object Detection Using Machine Learning **9**

Object detection– Object detection methods – Deep Learning framework for Object detection– bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once (YOLO)-Salient features-Loss Functions-YOLO architectures.

UNIT - IV Face Recognition and Gesture Recognition **9**

Introduction to Face Recognition – Applications of Face Recognition-Process of Face Recognition-DeepFace solution by Facebook - FaceNet for Face Recognition- Implementation using FaceNet-Gesture Recognition.

UNIT - V Video Analytics **9**

Video Processing – use cases of video analytics – Vanishing Gradient and exploding gradient problem – RestNet architecture – RestNet and skip connections – Inception Network – GoogleNet architecture – Improvement in Inception v2 -Video analytics – RestNet and Inception v3.

Total Hours: **45**

References:

1. Milan Sonka, Vaclav Hlavac & Roger Boyle.(2013).*Image Processing, Analysis, and Machine Vision.* Thomson Learning.4th Edition.
2. Vaibhav Verdhan. (2021). *Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras.* Apress.
3. Richard Szeliski. (2011). *Computer Vision: Algorithms and Applications.* Springer Verlag London.
4. D. A. Forsyth& J. Ponce. (2003). *Computer Vision: A Modern Approach,* Pearson Education.
5. E. R. Davies. (2012). *Computer & Machine Vision.* Academic Press. 4th Edition.

Course Outcomes:

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

CO1: Acquire the knowledge on basics of image processing techniques for computer vision and video analysis.

CO2: Explain the techniques used for image pre-processing.

CO3: Identify various object detection techniques.

CO4: Examine the various face recognition and gesture recognition methods.

CO5: Interpret the various deep learning-based architectures in video analytics.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	2	1	-	-	-	2	2	1	-
CO2	3	2	3	3	2	-	-	-	1	2	2	1
CO3	1	2	2	3	2	-	-	-	3	2	-	-
CO4	1	2	3	3	2	-	-	-	2	2	-	1
CO5	3	2	1	2	2	-	-	-	2	2	-	-

Natural Language Processing

PE1
Semester: VI

Hours of Instruction/week: 3T

Course Code: 24BEOE07

No. of credits: 3

Prerequisite: Basic knowledge of probability

Course Learning Objectives (CLOs):

CLO1: To learn the fundamentals of natural language processing.
CLO2: To apply various practical skills for the design and implementation of NLP systems.

UNIT - I Introduction 9

Speech and Language Processing – Ambiguity – Models and algorithms – Language – Thought – Understanding Regular Expressions – Basic Regular Expression Patterns –Words – Text Normalization – Minimum Edit Distance – Automata – Words and Transducers – Morphology – Finite-State Morphological Parsing – Building A Finite-State Lexicon– Finite State Transducers – FSTS for Morphological Parsing – Combining FST Lexicon and Rules – The Porter Stemmer.

UNIT - II Word Level Analysis 9

N-grams Language – N-grams – Evaluating Language Models – Generalization and Zeros – Smoothing – Kneser-Ney Smoothing –The Web and Stupid Backoff – Perplexity's Relation to Entropy – English Word Classes –The Penn Treebank Part-of-Speech Tagset – Part-of-Speech Tagging – HMM Part-of-Speech Tagging – Maximum Entropy Markov Models.

UNIT - III Syntax Analysis 9

Constituency – Context Free Grammars – Grammar Rules for English – Treebanks – Grammar Equivalence and Normal Form – Lexicalized Grammars –Ambiguity – CKY Parsing: A Dynamic Programming Approach – Partial Parsing – Probabilistic ContextFreeGrammars - Dependency Parsing.

UNIT - IV Semantic Analysis and Coreference Resolution 9

Semantic Augmentations to Context Free Grammar Rules – Word Senses and WordNet – Word Sense Disambiguation – Word Sense Induction – Semantic Roles – FrameNet – Semantic Role Labeling– Coreference Phenomena: Linguistic Background – Coreference Tasks and Datasets – Mention Detection –Architectures for Coreference Algorithms.

UNIT - V Discourse Analysis and Speech Processing 9

Discourse Coherence – Discourse Structure Parsing – Centering and Entity Based Coherence – Question Answering –Factoid Question Answering – Classical QA Models – Chatbots and Dialogue systems – Frame-based Dialogue Systems – Dialogue–State Architecture.

Total Hours: **45**

References:

1 Daniel Jurafsky, James H. Martin. (2019). *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech*. Pearson Publication.

2 Breck Baldwin. (2015). *Language Processing with Java and Ling Pipe Cookbook*. Atlantic Publisher.

3 Richard M Reese. (2015). *Natural Language Processing with Java.* O'Reilly Media.

4 Nitin Indurkhya & Fred J. Damerau. (2010). *Handbook of Natural Language Processing.* Chapman and Hall/CRC Press. 2nd Edition.

Course Outcomes:

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

CO1: Interpret the basics of linguistics, Morphology and Rules associated with NLP.

CO2: Explain the types of N-grams models and PoS Tag.

CO3: Identify the use of context free grammar and parsing in syntax analysis.

CO4: Analyze the semantic processing and Coreference tasks.

CO5: Analyze the discourse coherence, structure parsing, QA models and develop dialogue systems.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	2	-	1	-	3	2	2	2
CO2	3	2	3	2	2	-	1	-	2	1	2	3
CO3	2	2	3	2	3	-	-	-	2	2	1	2
CO4	2	2	2	2	2	-	-	-	2	2	2	2
CO5	3	3	2	2	2	-	-	-	3	2	3	2

Business Analytics

PE1

Semester: VI **Hours of Instruction/week: 3T**

Course Code: 24BEOE08 **No. of credits: 3**

Prerequisite: Data Mining and Warehousing, Machine Learning

Course Learning Objectives (CLOs):

CLO1: To comprehend the process of acquiring Business Intelligence and understand various types of analytics for Business Forecasting.

CLO2: To apply analytics for different functions of a business.

UNIT - I Introduction **9**

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration.

UNIT - II Business Intelligence **9**

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions.

UNIT - III Business Forecasting **9**

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modeling –Machine Learning for Predictive analytics.

UNIT - IV Human Resources & Supply Chain Analytics **9**

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain. Apply HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT - V Marketing & Sales Analytics **9**

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales.

Total Hours: **45**

References:

1 R. Evans James. (2017). *Business Analytics*. Pearson Education. 2nd Edition.

2 R. N. Prasad& Seema Acharya. (2016). *Fundamentals of Business Analytics*, John Wiley & Sons. Reprint Edition.

3 Philip Kotler & Kevin Keller. (2016). *Marketing Management.* Prentice Hall of India. 15th Edition.

4 VSP. RAO. (2010). *Human Resource Management*. Excel Books. 3rd Edition.

5 Mahadevan B. (2018). *Operations Management - Theory and Practice.* Pearson Education. 3rd Edition.

Course Outcomes:

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

CO1: Infer the real-world business problems and model with analytical solutions.

CO2: Interpret the business processes for extracting Business Intelligence.

CO3: Use predictive analytics for business forecasting.

CO4: Apply analytics for supply chain and logistics management.

CO5: Apply analytics for marketing and sales.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	3	2	-	-	-	-	-	-	-
CO2	2	2	1	2	2	-	-	-	-	-	-	-
CO3	3	3	2	3	3	-	-	-	-	-	-	-
CO4	3	3	2	3	3	-	-	-	-	-	-	-
CO5	3	3	2	3	3	-	-	-	-	-	-	-

Security and Privacy in Cloud

PE2

Semester: VI **Hours of Instruction/week: 3T**

Course Code: 24BEOE25 **No. of credits: 3**

Prerequisite: Cryptography, Cloud Computing

Course Learning Objectives (CLOs):

CLO1: To understand the security design and architectural considerations for Cloud.
CLO2: To learn the various design patterns and audit cloud applications for security.

UNIT - I Fundamentals of Cloud Security **9**

Overview of cloud security - Security Services - Confidentiality, Integrity, Authentication, Non-repudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT - II Security Design for Cloud **9**

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention - deletion and archiving procedures for tenant data - Encryption - Data Redaction - Tokenization - Obfuscation - PKI and Key.

UNIT - III Access Control and Identity Management **9**

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder detection and prevention.

UNIT - IV Cloud Security Design Patterns **9**

Introduction to Design Patterns - Cloud bursting - Geo-tagging - Secure Cloud Interfaces - Cloud Resource Access Control - Secure On-Premise Internet Access - Secure External Cloud.

UNIT - V Monitoring, Auditing and Management **9**

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management.

Total Hours: **45**

References:

1 Raj Kumar Buyya, James Broberg & Andrzej Goscinski. (2013). *Cloud Computing - Principles and Paradigms.* Wiley.

2 Mather, Kumaraswamy & Latif. (2011). *Cloud Security and Privacy.* O'Reilly Media.

3 Dave Shackleford. (2012). *Virtualization Security: Protecting Virtualized Environments.* Wiley.

Course Outcomes:

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

CO1: Explain the fundamental concepts of cloud security.

CO2: Interpret the security design principles and data protection strategies in the cloud.

CO3: Identify the access control requirements and identity management for cloud infrastructure.

CO4: Analyze the design considerations for security in the cloud.

CO5: Use various risks, audit and monitoring mechanisms in the cloud.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	2	-	-	-	1	1	1	3
CO2	1	3	2	3	1	-	-	-	2	2	3	2
CO3	3	2	2	3	2	-	-	-	3	1	1	2
CO4	2	1	2	3	3	-	-	-	3	2	3	3
CO5	1	3	3	1	1	-	-	-	2	3	3	2

UI and UX Design

PE2

Semester: VI **Hours of Instruction/week: 3T**

Course Code: 24BEOE26 **No. of credits: 3**

Prerequisite: Web Technology

Course Learning Objectives (CLOs):

CLO1: To understand the concepts of UI and UX design and UX design process.
CLO2: To learn the importance and scope of Interaction design and User centered design.

UNIT - I User-Centered Design Process 9

Overview of UI & UX Design - Overview of the UX Design Process - Difference between User Interface(UI) vs User Experience (UX) - Defining problem and vision statement - Persona creation - Primary and Secondary persona - Requirement definition - Creative ideation - brainstorming and ideation techniques - Scenarios and functionality extraction - Information Architecture - Task flows - Wireframe design.

UNIT - II UI, Heuristics and Interaction Design 9

Design Principles for UX and UI Design - UI Elements-Patterns - Material Design (Google) and Human Interface Design (Apple) guidelines - Interaction Principles & Interaction Behaviour - Master the Brand Platforms & Style Guides - comments and current UI patterns - Understand problems and design solutions for e-commerce, social media, message, data, and dashboard design.

UNIT - III Elementary Sketching 9

Principles of Sketching - Core Responsive Design - Wireframing vs Wireflows - Click through Wireframing Prototyping - Wireflow Creation - Work with different tools - Figma - Low-High Fidelity Design: Inclusive Design and Designing for Accessibility - Building High-Fidelity Mockups– Designing Efficiently with Tools - Interaction Patterns - Designing animations and interactions.

UNIT - IV Understand Style Guides, Elements, Prototyping 9

Building a Design System - Style guides, color palette, fonts, grid, iconography, UI elements, photography or imagery, and illustration - Use of grids in UI design - Design animations and interaction patterns for key UI elements.

UNIT - V Usability Evaluation and Product Design 9

Type of usability evaluation - Qualitative & Quantitative evaluation - Guerilla testing, A/B Testing, Unmoderated remote usability testing, Card sorting, Session recording, think aloud - Designing evaluation protocol - Conducting usability evaluation study -Conduct Usability Test explicit -

Synthesize Test Findings - practices in corporate World - Product Design: Types of products & solutions - Design Psychology for e-commerce sites, CMS - Design Thinking Life Cycle.

Total Hours: **45**

References:

1 Norman, Donald A.(2002). *The Design of Everyday Things.* Basic Books.

2 Wilbent. O. Galitz. (2001). *The Essential Guide to User Interface Design*, John Wiley & Sons.

3 Alan Cooper. (2002). *The Essential of User Interface Design.* Wiley-Dream Tech Ltd.

4 Pamala B. Deacon. (2020). *UX and UI Strategy*: *A Step by Step Guide on UX and UI Design*. CRC Press.

5 Kevin P. Nichols, Donald Chesnut. (2014). *UX For Dummies*. For Dummies.1st Edition.

6 Russ Unger & Carolyn Chandler. (2012). *A Project Guide to UX Design: For user experience designers in the field or in the making*. New Riders Publishing. 2nd Edition.

Course Outcomes:

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

CO1: Explain the fundamentals of User Interface, User Experience, persona mapping and design process

CO2: Interpret the design principles for UX and UI, interactive products and design solutions for interaction design.

CO3: Design digital wireframes and create animations and interactive patterns using tools.

CO4: Apply the techniques involved in designing digital wireframes using various UI elements.

CO5: Evaluate the process of usability tests and product design.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	3	2	-	-	-	2	1	1	2
CO2	2	2	2	2	2	-	-	-	2	1	1	2
CO3	1	3	3	3	3	-	-	-	2	2	1	2
CO4	1	2	2	3	3	-	-	-	2	2	1	2
CO5	1	2	2	3	2	-	-	-	2	2	1	2

Security in IoT

PE2

Semester: VI **Hours of Instruction/week: 3T**

Course Code: 24BEOE27 **No. of credits: 3**

UNIT - I Introduction **9**

Security Requirements in IoT Architecture - Security in Enabling Technologies - Security Concerns in IoT Applications. Security Architecture in the Internet of Things - Security Requirements in IoT – Insufficient Authentication/Authorization - Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT. Vulnerabilities – Secrecy and Secret-Key Capacity - Authentication/Authorization for Smart Devices - Transport Encryption – Attack & Fault trees

UNIT - II Cryptographic Fundamentals for IoT **9**

Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes – Digital Signatures – Random number generation – Cipher suites – key management fundamentals – cryptographic controls built into IoT messaging and communication protocols – IoT Node Authentication.

UNIT - III Identity & Access Management Solutions for IoT **9**

Identity lifecycle – authentication credentials – IoT IAM infrastructure – Authorization with Publish / Subscribe schemes – access control.

UNIT - IV Privacy Preservation and Trust Models for IoT **9**

Concerns in data dissemination – Lightweight and robust schemes for Privacy protection – Trust and Trust models for IoT – self-organizing Things - Preventing unauthorized access

UNIT - V Cloud Security for IoT **9**

Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud IoT security controls – An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing.

Total Hours: **45**

References:

1 Brian Russell & Drew Van Duren. (2016). *Practical Internet of Things Security*. Packt Publishing. Kindle Edition.

2 Fei Hu. (2020). *Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations.* CRC Press.

3 Shancang Li & Li Da Xu. (2017). *Securing the Internet of Things*. Elsevier. 1st Edition.

Course Outcomes:

Upon completion of this course, students will be able to:

CO1: Explain the Security architecture in the Internet of Things and types of Vulnerabilities.

CO2: Identify the Encryption and Decryption algorithms.

CO3: Explore the authentication credentials and access management solutions for IoT.

CO4: Examine the schemes for privacy protection and trust models for IoT.

CO5: Apply the cloud security concepts in IoT.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	-	1	1	-	1
CO2	3	3	3	2	1	1	-	-	2	2	-	2
CO3	3	2	2	2	1	1	-	-	2	2	-	2
CO4	3	3	3	2	1	1	-	-	2	2	-	2
CO5	3	3	3	2	1	1	-	-	2	2	-	2

Edge Computing

PE2
Semester: VI
Hours of Instruction/week: 3T
Course Code: 24BEOE28
No. of credits: 3

Prerequisite: Data Science, Cryptography, Cloud Computing

Course Learning Objectives (CLOs):

CLO1: To understand the edge computing, purpose and architecture
CLO2: To explore research, frameworks, and applications in Edge Computing.

UNIT - I Computing Paradigms 9

Introduction - Major Impacts of Computing - Parallel Computing - Distributed Computing - Cluster Computing - Utility Computing - Grid Computing - Cloud Computing – Other Computing Paradigms: Ubiquitous Computing - Jungle Computing - Fog Computing - Osmotic Computing - Data Centre Technology - Edge Data Centres.

UNIT - II Edge Computing Architecture 9

IoT Architecture and Core IoT Modules - A connected ecosystem, IoT versus machine – to -machine versus – SCADA - The value of a network and Metcalfe's and Beckstrom's laws IoT and edge architecture - Role of an architect - Understanding Implementations with examples - Example use case and deployment - Case study – Telemedicine palliative care Requirements – Implementation - Use case retrospective.

UNIT - III Edge Analytics and Edge Data Storage Security 9

Edge Data Analytics - Potential of Edge Analytics - Architecture of Edge Analytics - Machine Learning for Edge Devices - Data Security - Data Confidentiality – Authentication- Privacy-Preserving Schemes - Edge-Based Attack Detection and Prevention.

UNIT - IV Edge Computing Technologies 9

Edge computing: ecosystem and players - Computing and networking collaborations for edge computing - Collaboration between edge computing and networks - Edge computing and PON - Edge computing and software-defined technology.

UNIT - V Applications 9

Edge Computing with Blockchain - Edge Computing in Healthcare - Edge Computing/Analytics in Industrial IOT - Edge Computing High-Potential Use Cases: Autonomous Vehicles - Smart Cities. - Industrial Automation.

Total Hours: **45**

References:

1 K. AnithaKumari, G. Sudha Sadasivam, D. Dharani & M. Niranjanamurthy. (2021). *Edge Computing Fundamentals, Advances and Applications*. CRC Press.

2 Javid Taheri & Shuiguang Deng. (2020). *Edge Computing: Models, technologies and applications.* Institution of Engineering & Technology.

3 Alex Marcham. (2021). *Understanding Infrastructure Edge Computing: Concepts, Technologies, and Considerations*. John Wiley.

Course Outcomes:

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

CO1: Explain the different types of computing methods.

CO2: Interpret the architecture and use cases in IoT with edge computing.

CO3: Identify the use of Edge Analytics and the methods of data storage security in edge computing.

CO4: Explore the technologies of edge computing.

CO5: Examine the applications of edge computing in different domains.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	3	3	-	-	-	1	1	-	3
CO2	2	2	1	2	3	-	-	-	2	1	-	3
CO3	2	3	3	3	3	-	-	-	2	1	-	3
CO4	2	3	2	3	3	-	-	-	2	1	-	3
CO5	2	3	2	3	3	-	-	-	2	1	-	3

Reinforcement Learning

PE1

Semester: VII **Hours of Instruction/week: 3T**

Course Code: 24BEOE09 **No. of credits: 3**

Prerequisite: Linear Algebra, calculus, Machine Learning

Course Learning Objectives (CLOs):

CLO1: To familiarize the fundamentals of Reinforcement learning and model-based prediction control using dynamic programming.

CLO2: To explore the planning and learning with tabular methods.

UNIT - I Introduction **9**

Introduction to Reinforcement learning, examples - Elements of reinforcement learning - Limitations and Scope- An extended example - multi-armed bandits - k-armed bandit problem - action-value methods - the 10-armed testbed - incremental implementation - tracking a non-stationary problem - optimistic initial values - upper-confidence-bound action selection - associative search.

UNIT - II Markov Decision Process and Model-Based Prediction and Control **9**

Finite Markov Decision Process - The Agent–Environment Interface - Goals and Rewards - Returns and Episodes - Unified Notation for Episodic and Continuing Tasks - Policies and Value Functions - Optimal Policies and Optimal Value Functions - Optimality and Approximation - Dynamic Programming - Policy Evaluation (Prediction) - Policy Improvement - Policy Iteration - Value Iteration - Generalized Policy Iteration - Efficiency of Dynamic Programming - Asynchronous Dynamic Programming.

UNIT - III Model-Free Prediction and Control **9**

Model-free learning - Model-free prediction - Monte Carlo methods - Monte Carlo Prediction - Monte Carlo Estimation of Action Values - Temporal-Difference Learning - TD Prediction - Advantages of TD Prediction Methods - Optimality of TD(0) - n-step Bootstrapping - n-step TD Prediction - n-step Sarsa - Model-free control - Monte Carlo Control - Monte Carlo Control without Exploring Starts - Off policy learning - Importance sampling - Off-policy Monte Carlo Control - Sarsa: On-policy TD Control - Q-learning: Off-policy TD control.

UNIT - IV Planning and Learning with Tabular Methods **9**

Models and planning - Dyna: Integrated Planning, Acting and Learning - When the model is wrong? - Prioritized Sweeping - Real-time Dynamic Programming - Monte Carlo Tree Search.

UNIT - V Value Function Approximation **9**

On-policy Prediction with Approximation - Value Function Approximation - The Prediction Objective (VE) - Stochastic-gradient and Semi-gradient Methods - Linear Methods - Least-Squares TD.

Total Hours: **45**

References:

1 Richard S. Sutton & Andrew G. Barto. (2015). *Reinforcement Learning: An introduction.* The MIT Press. 2nd Edition

2 Stuart J. Russell & Peter Norvig. (2015) *Artificial Intelligence: A Modern Approach.* Pearson. 3rd Edition

3 Martijn van Otterlo & Marco Wiering. (2012). *Reinforcement Learning: State-of-the-Art*. Springer-Verlag Berlin Heidelberg.

4 Reinforcement Learning with MATLAB. (2020). MathWorks Inc.

Course Outcomes:

Upon completion of this course, students will be able to:

CO1: Explain the basic concepts of reinforcement learning.

CO2: Infer model-based prediction and control using dynamic programming.

CO3: Identify model-free prediction and control methods.

CO4: Examine the Planning and Learning with Tabular Methods.

CO5: Interpret the value function approximation methods.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	2	2	-	-	2	1	1	2
CO2	2	2	1	2	1	2	-	1	1	1	2	1
CO3	3	2	2	2	1	2	-	-	1	1	1	2
CO4	3	2	1	3	-	1	-	1	1	1	1	2
CO5	2	3	3	2	2	1	3	1	3	1	2	3

Text and Speech Analysis

PE1
Semester: VII **Hours of Instruction/week: 3T**

Course Code: 24BEOE10 **No. of credits: 3**

Prerequisite: NLP, Machine learning, Python

Course Learning Objectives (CLOs):
CLO1: To familiarize the basics of natural language processing
CLO2: To gain knowledge on classification algorithms to text documents, build question-answering and dialogue systems and develop speech recognition system and synthesizer

UNIT - I Natural Language Basics 9

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model.

UNIT - II Text Classification 9

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models.

UNIT - III Question Answering And Dialogue Systems 9

Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -evaluating dialogue systems.

UNIT - IV Text-To-Speech Synthesis 9

Overview - Text normalization - Letter-to-sound – Prosod – Evaluation - Signal processing - Concatenative and parametric approaches - WaveNet and other deep learning-based TTS systems.

UNIT - V Automatic Speech Recognition 9

Speech Recognition: Acoustic modelling – Feature Extraction – HMM, HMM-DNN systems.

Total Hours: **45**

References:

1 Daniel Jurafsky & James H. Martin.(2022). *Speech and Language Processing: An Introduction to Natural Language Processing. Computational Linguistics, and Speech Recognition*, 3rd Edition.

2 Dipanjan Sarkar. (2018). *Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data.* APress.

3 Tanveer Siddiqui & Tiwary U S. (2008). *Natural Language Processing and Information Retrieval.* Oxford University Press.

4 Lawrence Rabiner, Biing-Hwang Juang & B. Yegnanarayana. (2009). *Fundamentals of Speech Recognition.* Pearson. 1st Edition,

5 Steven Bird, Ewan Klein & Edward Loper. *Natural language processing with Python.* O'Reilly Media.

Course Outcomes:

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

CO1: Explain existing and emerging deep learning architectures for text and speech processing

CO2: Apply deep learning techniques for NLP tasks, language modelling and machine translation

CO3: Explain coreference and coherence for text processing

CO4: Build question-answering systems, chatbots and dialogue systems

CO5: Apply deep learning models for building speech recognition and text-to-speech systems

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	1	3	-	-	-	1	2	1	2
CO2	3	1	2	1	3	-	-	-	2	2	1	3
CO3	2	2	1	3	1	-	-	-	3	3	1	2
CO4	2	1	1	1	2	-	-	-	2	1	2	2
CO5	1	3	2	2	1	-	-	-	3	2	1	1

Cognitive Computing

PE I

Semester: VII **Hours of Instruction/week: 3T**

Course Code: 24BEOE11 **No. of credits: 3**

Prerequisite: Artificial Intelligence, NLP, Bigdata

Course Learning Objectives (CLOs):

CLO1: To understand how Natural Language Processing and Big Data play vital role in Cognitive Computing.

CLO2: To know about the business applications of Cognitive Computing.

UNIT - I Foundations of Cognitive Computing 9

Foundation of Cognitive Computing: cognitive computing as a new generation - the uses of cognitive systems - system cognitive- gaining insights from data - Artificial Intelligence as the foundation of cognitive computing - understanding cognition - Design Principles for Cognitive Systems: Components of a cognitive system - building the corpus - bringing data into cognitive system - machine learning - hypotheses generation and scoring- presentation- and visualization services.

UNIT - II Natural Language Processing in Cognitive Systems 9

Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system - semantic web - Applying Natural language technologies to Business problems Representing knowledge in Taxonomies and Ontologies: Representing knowledge - Defining Taxonomies and Ontologies - knowledge representation - models for knowledge representation - implementation considerations.

UNIT - III Big Data and Cognitive Computing 9

Relationship between Big Data and Cognitive Computing: Dealing with human-generated data - defining big data - architectural foundation - analytical data warehouses - Hadoop - data in motion and streaming data - integration of big data with traditional data - Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing - Key capabilities in advanced analytics - using advanced analytics to create value - Impact of open source tools on advanced analytics

UNIT - IV Business Implications of Cognitive Computing 9

Preparing for change - advantages of new disruptive models - knowledge meaning to business - difference with a cognitive systems approach - meshing data together differently - using business knowledge to plan for the future - answering business questions in new ways - building business specific solutions - making cognitive computing a reality - cognitive application changing the market - The process of building a cognitive application: Emerging cognitive platform - defining the objective

- defining the domain - understanding the intended users and their attributes - questions and exploring insights - training and testing

UNIT - V Application of Cognitive Computing **9**

Building a cognitive health care application: Foundations of cognitive computing for healthcare - constituents in healthcare ecosystem - learning from patterns in healthcare Data - Building on a foundation of big data analytics - cognitive applications across the health care eco system - starting with a cognitive application for healthcare - using cognitive applications to improve health and wellness - using a cognitive application to enhance the electronic medical record - Using cognitive application to improve clinical teaching.

Total Hours: **45**

References:

1 Judith Hurwitz, Marcia Kaufman, Adrian Bowles. (2015). *Cognitive Computing and Big Data* Analytics. Wiley.

2 Hurwitz, Kaufman, and Bowles, *Cognitive Computing and Big Data Analytics*. Wiley,Indianapolis.

3 Noah D. Goodman, Joshua B. Tenenbaum. (2016). Probabilistic Models of Cognition. 2nd Edition.

Course Outcomes:

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

CO1: Explain the fundamental concepts and design principles of cognitive computing.

CO2: Interpret the role of Natural language processor in Cognitive computing.

CO3: Analyze the relationship between Big Data and Cognitive Computing

CO4: Analyze the process of building a cognitive application and business implications.

CO5: Apply the concepts of cognitive computing in health care.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	-	-	-	1	1	1
CO2	3	3	3	2	3	-	-	-	1	1	-	-
CO3	3	3	3	2	3	-	-	-	3	2	-	-
CO4	3	3	3	2	3	-	-	-	2	2	-	-
CO5	3	3	3	3	3	-	-	-	2	2	-	-

Generative AI

PE I
Semester: VII **Hours of Instruction/week: 3T**

Course Code: 24BEOE12 **No. of credits: 3**

Prerequisite: Probability, Deep Learning

Course Learning Objectives (CLOs):
CLO1: To gain a thorough understanding of generative models and their role in artificial intelligence.
CLO2: To understand the challenges and limitations of evaluating generative models.

UNIT - I Introduction to Generative AI 9

Capabilities - History and Evolution -Benefits- Challenges - Applications of Generative AI Tools for Text- Image Code- Audio and Video generation– Economic Potential of Generative AI - Use cases.

UNIT - II Prompt Engineering Techniques and Approaches 9

Prompt Creation -Writing effective prompts -Techniques for using text prompts: Zero shotand few-shot prompt techniques – Prompt engineering approaches: Interview pattern, Chain-of Thought, Tree-of Thought - Benefits of using text prompts - Challenges in generating meaningful and coherent prompts.

UNIT - III Models for Generative AI 9

Basics of Sequential data processing – Building blocks of Generative AI - Discriminative modelling – Generative modelling –Recurrent Neural Networks – Long Short-Term Memory (LSTM) Networks - Generative Adversarial Networks (GANs) – Variational Autoencoders (VAEs) – Transformer–based Models - Diffusion models Applications.

UNIT - IV Platforms for Generative AI 9

Introduction to Platforms – Features of platforms – Capabilities -Applications - Pre-trained Models - Challenges – Generation of Text to Text – Generation of Text to Image – Text to Code Generation – Explainable AI – Benefits – Use cases.

UNIT - V Ethical Issues and Limitations of Generative AI 9

Limitations of Generative AI – Issues and concerns – Considerations for Responsible Generative AI – Economic Implications – Social Implications – Future and professional Growth of Generative AI.

Total Hours: **45**

References:

1 David Foster. (2023). *Deep Learning: Teaching Machines to Paint, Write, Compose and Play*. O'Reilly Media. 2nd edition.

2 Ian Goodfellow, Yoshua Bengio & Aaron Courville. (2016). *Deep Learning*. MIT Press.

3 Rafael Valle. (2019). *Hands-on Generative Adversarial Networks with Keras*. Packet Publisher.

Course Outcomes:

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

CO1: Explain the basic concepts of Generative AI and their roles.

CO2: Identify effective prompt engineering techniques and its approaches.

CO3: Apply a range of sequential data processing techniques and Generative AI models across various domains.

CO4: Apply the platforms for building generative AI models.

CO5: Comprehend ethical issues and limitations of generative AI models.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	1	-	3	2	2	2
CO2	2	2	2	3	2	-	2	-	1	1	2	3
CO3	3	3	3	2	3	-	-	-	2	1	1	2
CO4	2	2	2	1	2	-	-	-	2	1	2	2
CO5	2	2	2	2	2	-	-	-	3	2	3	2

IoT Analytics

PE2
Semester: VII
Hours of Instruction/week: 3T
Course Code: 24BEOE29
No. of credits: 3

Prerequisite: Data Science, IoT

Course Learning Objectives (CLOs):

CLO1: To understand IoT analytics, challenges, and connectivity protocols.
CLO2: To introduce IoT cloud and big data integration techniques and services.

UNIT - I Introduction **9**

Introduction– IoT Devices - IoT Networking Connectivity Protocols – IoT Data Messaging Protocols – MQTT, CoAP. IoT Analytics: Data vs big data- Challenges of IoT Analytics Applications - IoT Analytics Lifecycle and Techniques.

UNIT - II IoT Cloud and Big Data Integration **9**

IoT Cloud and Big Data Integration: Cloud based IoT platform – Data Analytics for IoT – Data Collection – WAZIUP software Platform – Ikaas Software Platform - Elastic analytics concepts – designing for scale – Cloud security and analytics – AWS overview - AWS key services for IoT analytics.

UNIT - III Strategies and Techniques in Data Collection **9**

Strategies and Techniques in Data collection: Designing Data Processing for Analytics – Applying Big Data to Storage – Apache Spark for IoT Data Processing - Solving Industry Specific Problems.

UNIT - IV Geospatial Analytics to IoT Data **9**

Geospatial Analytics to IoT Data: Basics – Vector and Raster Based Methods – Processing Geospatial Data. Data Science for IoT Analytics – Machine Learning Basic – Forecasting IoT data using ARIMA – Deep learning with IoT data.

UNIT - V Applications & Case Studies **9**

Applications & Case Studies: Data Analysis in Smart Building – Internet of Things Analytics for Smart Cities – IoT Analytics: From Data Collection to Deployment and Operationalization.

Total Hours: **45**

References:

1 Andrew Minteer. (2017). *Analytics for the Internet of things*. Packt Publishing,

2 John Soldatos. (2016). *Building Blocks for IoT Analytics*. River Publishers.

3 Rajkumar Buyya & Amir Vahid Dastjerdi (2016). *Internet of Things: Principles and Paradigms*. Elsevier.

4 R. Chandrasekaran (2015). *Essentials of Cloud computing*. Chapman and Hall/CRC. 2nd Edition.

Course Outcomes:

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

CO1: Interpret the concepts and techniques of IoT Data Analytics Lifecycle and Machine Learning Application in IoT.

CO2: Examine the cloud based IoT, big data and IoT in various domains.

CO3: Apply the new strategies and techniques in Data Collection.

CO4: Explore the Geospatial Analytics to IoT Data and Data Science for IoT Analytics.

CO5: Examine the applications of IoT Analytics.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	1	1	-	-	1	1	-	3
CO2	3	3	3	2	2	2	-	-	1	2	-	3
CO3	3	3	3	1	2	2	-	1	2	2	1	3
CO4	3	3	3	1	2	2	-	1	2	2	1	3
CO5	3	3	3	-	2	2	-	1	2	2	1	3

Blockchain Technology

PE 2 **Hours of Instruction/week: 3T**

Course Code: 24BEOE30 **No. of credits: 3**

Prerequisite**:** Cryptography, Distributed Computing

Course Learning Objectives (CLOs):

CLO1: To familiarize the types and applications of Blockchain
CLO2: To analyse various blockchain based application.

UNIT - I Introduction to Blockchain 9

Introduction to Blockchain – History - Definition - Blockchain Categories – Public - Private - Consortium - Blockchain Network and Nodes - Peer-to-Peer Network - Mining Mechanism - Generic elements of Blockchain - Features of Blockchain and Types of Blockchain.

UNIT - II Block chain Architecture 9

Bitcoin Blockchain - Blockchain Architecture – Block - Hash - Distributer P2P - Structure of Blockchain - Consensus mechanism: Proof of Work (PoW) - Proof of Stake (PoS) - Byzantine Fault Tolerance (BFT) - Proof of Authority (PoA) and Proof of Elapsed Time (PoET).

UNIT - III Block chain-Based Futures System 9

Project presentation - Futures smart contract: Blockchain oracles- Web3j: Setting up the Web3j- Installing Web3j- Wallet creation - Java client: The wrapper generator- Initializing Web3j - Setting up Ethereum accounts - Deploying the contract.

UNIT - IV Blockchain Business and Creating ICO 9

Public versus private and permissioned versus permission less blockchains - Privacy and anonymity in Ethereum - Why are privacy and anonymity important? - The Ethereum Enterprise Alliance- Blockchain as-a-Service - Initial Coin Offering (ICO): Project setup for ICO implementation - Token contracts - Token sale contracts - Contract security and testing the code.

UNIT - V Distributed Storage IPFS and Swarm 9

Ethereum Virtual Machine- Swarm and IPFS: Installing IPFS - Hosting our frontend: Serving your frontend using IFPS - Serving your frontend using Swarm - IPFS file uploader project: Project setup the web page.

Total Hours: **45**

References:

1 Imran Bashir. (2018). *Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained*. Packt Publishing Ltd. 2nd Edition

2 BellajBadr, Richard Horrocks & Xun (Brian) Wu. (2018). *Blockchain By Example: A developer's guide to creating decentralized applications using Bitcoin, Ethereum, and Hyperledger*. Packt Publishing Limited.

3 Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller & Steven Goldfeder. (2016). *Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction*. Princeton University Press.

Course Outcomes:

At the end of the course- student will be able to:

CO1: Explain the fundamental concepts of blockchain.

CO2: Explore the architecture of blockchain and Consensus mechanisms.

CO3: Develop and deploy the projects using Web3j in blockchain.

CO4: Compare Public vs private and permissioned vs permission less blockchains and explain Ethereum and ICO.

CO5: Design blockchain based applications with Swarm and IPFS.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	-	1	1	-	-	1	1	-	3
CO2	3	3	3	2	2	2	-	-	1	2	-	3
CO3	3	3	3	1	2	2	-	1	2	2	1	3
CO4	3	3	3	1	2	2	-	1	2	2	1	3
CO5	3	3	3	-	2	2	-	1	2	2	1	3

Information Security

PE2
Semester: VII **Hours of Instruction/week: 3T**
Course Code: 24BEOE31 **No. of credits: 3**

Prerequisite: Basic knowledge of Cryptography

Course Learning Objectives (CLOs):

CLO1: To gain knowledge on information security principles and risk management.
CLO2: To inculcate the protection mechanisms in physical security control & operations security.

UNIT - I Introduction **9**

Growing IT Security Importance and New Career Opportunities – Becoming an Information Security Specialist – Conceptualizing Information Security – Information Security Principles of Success.

UNIT - II Governance and Risk Management **9**

Introduction – Security Policies Set the stage for Success – Four Types of Policies – Developing and Managing Security Policies –Providing Policy Support Documents – Suggested Standards Taxonomy – Security Architecture and Design: Introduction – Defining the Trust Computing Base – Protection Mechanisms in a Trusted Computing- Base – System Security Assurance Concepts.

UNIT - III Business Continuity Planning and Disaster Recovery Planning & Laws **9**

Overview of the Business Continuity Planning - Disaster Recovery Planning– Introduction to Laws , Investigations and Ethics – Types of Computer Crimes – How Cyber Criminals Commit Crimes – The Computer and the Law – Intellectual Property Law – Privacy and the Law – Computer Forensics – The Information Security Professionals Code of Ethics – Other Ethics Standards.

UNIT - IV Physical Security Control & Operations Security **9**

Introduction – Understanding the Physical Security Domain – Physical Security Threats – Providing Physical Security – Introduction to Operations Security – Operations Security Principles – Operations Security Process Controls – Operations Security Controls in Action.

UNIT - V Access Control Systems & Cryptography **9**

Introduction – Terms and Concepts – Principles of Authentication – Biometrics – Single SignOn – Remote User Access and Authentication – Introduction to Cryptography – Applying Cryptography to Information Systems – Basic Terms and Concepts – Strength of Cryptosystems – Putting the Pieces to Work – Examining Digital Cryptography.

Total Hours: **45**

References:

1 Mark Merkow & Jim Breithaupt. (2007). *Information Security: Principles and Practices*. Pearson Education.

2 Matt Bishop. (2006). *Computer Security: Art and Science*. Pearson Education

3 Mark Rhodes-Ousley. (2013). *The Complete Reference - Information Security*. McGraw Hill Education. 2nd Edition.

4 Michael E. Whitman & Herbert J. Mattord. (2012). *Principles of Information Security.* Cengage Learning. 4th Edition.

Course Outcomes:

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

CO1: Explain the importance of IT Security and its principles.

CO2: Identify the security policies within organizational contexts and system security assurance concepts.

CO3: Explore the Business continuity planning and disaster recovery planning & laws.

CO4: Analyze the physical security threats and manage physical and operational security measures to mitigate risks.

CO5: Examine the access control mechanisms and apply Cryptography to Information System.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	-	-	-	2	2	3	2
CO2	2	2	2	3	3	-	-	-	3	2	2	2
CO3	2	3	2	2	3	-	-	-	2	2	1	1
CO4	2	2	2	2	3	-	-	-	3	2	1	1
CO5	2	2	3	2	1	-	-	-	1	2	1	2

Full Stack Software Development

PE2

Semester: VII **Hours of Instruction/week: 3T**

Course Code: 24BEOE32 **No. of credits: 3**

Prerequisite: Python, Web technology

Course Learning Objectives (CLOs):

CLO1: To apply the concepts of python in web development.
CLO2 : To gain knowledge on the construction of client and server side applications and learn the concepts of both front end and back end programming.

UNIT - I Object Oriented Approach in Python 9

Classes – Class Coding Basics: Instances – Behavior Methods – Operator Overloading –Customizing Behavior Methods – Constructors – Polymorphism – Inheritance.

UNIT - II User Interface Applications in Python and Version Control System 9

Wxpython installation – Menus and Toolbars – Layout Management – Wxpython Events – Wxpython Dialogs – Widgets – Graphics – Collaborative Version Control Systems – GitCommands – Real Time Usage of Git Commands.

UNIT - III Flask Framework for Web Development 9

Flask Basics – Routes – Templates – Control Flow – Inheritance – Forms – Modules –Connection with Databases – Relational Database versus NoSQL – Modeling – Mapping Classes to Mongodb – Building Data Layer with Mongo Engine.

UNIT - IV Real Time Deployment of Web Application 9

Deploy Web Applications with Flask and MongoDB – Example Applications – Blogs –Forums – Auto Evaluation of Student Assignments – Deployment Using AWS or GoogleCloud or Heroku.

UNIT - V Deployment of Software in Linux and Windows Platform 9

Deployment in Ubuntu Distribution – Creation of .Deb Executable File – Deployment in Windows – Creation of Standalone Executable – Test Cases.

Total Hours: **45**

References:

1. Mark Lutz. (2013). *Learning Python*. O' Reilly. 5th Edition.
2. Scott Chacon & Ben Straub. (2016). *Pro Git. Free e-book under Creative commons.* Apress. 2nd Edition.
3. Miguel Grinberg. (2014). *Flask Web Development Developing Web Applications with Python*. O'Reilly Media.
4. http://zetcode.com/wxpython/

Course Outcomes:

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

CO1: Explain the object-oriented approach and GUI applications in Python.

CO2: Interpret the User Interface Applications in Python and Version Control System.

CO3: Apply Flask framework to develop web applications.

CO4: Develop and deploy web applications using Flask and MongoDB using various cloud based platforms.

CO5: Examine the deployment of Software in Linux and Windows Platform.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	1	3	1	3	2	2	1	-
CO2	3	2	1	3	2	3	1	2	1	2	2	1
CO3	2	3	2	1	2	2	2	-	3	2	-	-
CO4	3	2	1	3	2	1	3	-	2	2	-	1
CO5	3	2	1	3	2	3	2	2	2	2	-	-