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 (Artificial Intelligence and Machine Learning)

Programme Specific Outcomes:

The graduates in Computer Science and Engineering (Artificial Intelligence and Machine Learning) will be able to

PSO1: Inculcate the knowledge in the field of Data Structures, Machine Learning, Predictive Analytics, Reinforcement Learning, Deep Learning, Exploratory Data Analysis, Generative AI, Business Intelligence and Analytics to solve complex real-world problems across various domains.

PSO2: Design, develop, and apply machine learning algorithms and AI techniques for developing innovative solution to any applications addressing the needs of the society.

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*	*Credits*
First Semester									
Induction Program including Universal Human Values(Introduction)									
II	**Basic Sciences (BS)**								
	24BESM01	Mathematics-I (Algebra and Calculus)	3	1/0	3	50	50	100	4
III	**Core Courses Engineering Sciences (ES)**								
	24BEES01	Basic Electrical and Electronics Engineering	3	0/2	3	50	50	100	4
	24BEES02	Programming for Problem Solving using C	3	-	3	50	50	100	3
	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
	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 Ethical Human Conduct)	2	1/0	3	50	50	100	3
	24BEHS01	English for Technical Writing	2	0/2	3	50	50	100	3
II	**Basic Sciences (BS)**								
	24BESM03	Mathematics-II(Probability and Statistics)	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)**								
	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)								
	24BERC01	Data Structures and Algorithms - I	3	-	3	50	50	100	3
	24BERC02	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
	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)**								
	24BEMC03	Machine Learning – I	3	-	3	50	50	100	3
	24BEMC04	Data Structures and Algorithms - II	3	-	3	50	50	100	3
	24BEMC05	Database Management Systems	3	-	3	50	50	100	3
	24BEMC06	Software Engineering	3	-	3	50	50	100	3
	24BEMC07	Data Structures and Algorithms - II Laboratory	-	0/3	3	50	50	100	1
	24BEMC08	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	-	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)**								
	24BEMC09	Operating Systems	3	-	3	50	50	100	3
	24BEMC10	Artificial Intelligence	3	-	3	50	50	100	3
	24BEMC11	Computer Networks	3	0/2	3	50	50	100	4
	24BEMC12	Design and Analysis of Algorithms	3	-	3	50	50	100	3
	24BEMC13	Computer Vision	3	-	3	50	50	100	3
	24BEMC14	Operating Systems Laboratory	-	0/3	3	50	50	100	1
	24BEMC15	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)**								
	24BEMC16	Predictive Analytics	3	-	3	50	50	100	3
	24BEMC17	Web Programming for AI	3	-	3	50	50	100	3
	24BEMC18	Data Science	3	-	3	50	50	100	3
	24BEMC19	Theory of Computation	3	-	3	50	50	100	3
	24BEMC20	Reinforcement Learning	3	-	3	50	50	100	3
	24BEMC21	Web Programming for AI Laboratory	-	0/3	3	50	50	100	1
	24BEMC22	Data Science 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: 24BEME01Big Data Mining/ 24BEME02 Robotics and Drone Technology / 24BEME03 Cloud Computing and Virtualization/ 24BEME04Compiler Design			**PE2:** 24BEME21 Cryptography and Network Security/ 24BEME22 Linux programming/ 24BEME23 Artificial Neural Networks/ 24BEME24 Quantum Computing						
Sixth Semester									
III	**Core Courses** **Professional Core (PC)**								
	24BEMC23	R for Data Analytics	3	-	3	50	50	100	3
	24BEMC24	Machine Learning - II	3	-	3	50	50	100	3
	24BEMC25	Natural Language Processing	3	-	3	50	50	100	3
	24BEMC26	Regression Modelling	3	-	3	50	50	100	3
	24BEMC27	R for Data Analytics Laboratory	-	0/3	3	50	50	100	1
	24BEMC28	Machine Learning Laboratory	-	0/3	3	50	50	100	1
	24BEMC29	Mini Project	-	0/4	-	100	-	100	2
III	**Professional Electives (PE)**								
		Professional Elective – II (PE1or PE2)	3	-	2	50	50	100	3
	24BEME40- 24BEME59	Professional Elective – III (PE1 or PE2) TitleofMOOC (SWAYAM-NPTEL)##	3	-	-	-	100	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: 24BEME05 Business Intelligence / 24BEME06 Exploratory Data Analysis/ 24BEME07 Fog and Edge Computing/ 24BEME08 Image and Video Analytics			**PE2:** 24BEME25Block Chain Technology/ 24BEME26 Streaming Analytics/ 24BEME27 Internet of Things and Applications/ 24BEME28UI and UX Design						

Professional Elective-III

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

Part	CourseCode	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)**								
	24BEMC30	Deep Learning	3	-	3	50	50	100	3
	24BEMC31	Deep Learning Laboratory	-	0/3	3	50	50	100	1
	24BEMC32	Industrial Internship#	-	-	3	100	-	100	2
	24BEMC33	Project Work - Phase I	-	0/4	-	100	-	100	2
III	**Professional Electives (PE)**								
		Professional Elective – IV (PE1or PE2)	3	-	3	50	50	100	3
	24BEME60 - 24BEME79	Professional Elective – V (PE1or PE2) Title of MOOC (SWAYAM-NPTEL)##	3	-	-	-	100	100	3
	Open Elective (OE)								
	24BEBO01/ 24BEVO01/ 24BELO01/ 24BEFO01	Open Elective –I	3	-	3	50	50	100	3
IV	**Non-Credit Mandatory Courses (NCMC)**								
	24BEMC07	Disaster Management	3	-	2	100	-	100	Remark
	24BEMM01	Artificial Intelligence and Machine Learning–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:	PE 2:
24BEME09 Generative AI/ 24BEME10 Responsible AI/ 24BEME11 Cognitive Computing / 24BEME12 Social Media Analytics	24BEME29 Wearable Computing/ 24BEME30 Time Series Analysis and Forecasting/ 24BEME31 Virtual and Augmented Reality / 24BEME32 Principles of Programming Languages

Professional Elective-V

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

Open Elective – I

24BEBO01 IoT for Personal Healthcare/
24BEVO01 VaastuShastra and Remedial Vaastu/
24BELO01 Sensors/
24BEFO01 Fundamentals of Food Process Engineering/
24BEPO013D Printing Techniques

Part	CourseCode	Name of Course/ component	Hours of Instruction / week		Scheme of Examination				
			Theory	Tutorial/ Practical	Duration of exam	CIA	CE	Total	Credits
Eighth Semester									
III	**Core Courses Professional Core (PC)**								
	24BEOC34	Project Work - Phase II	-	0/20	-	100	100	200	10
	Open Elective (OE)								
	24BEBO02/ 24BEVO02/ 24BELO02/ 24BEFO02	Open Elective-II	3	-	3	50	50	100	3
	24BEBO03/ 24BEVO03/ 24BELO03/ 24BEFO03	Open Elective-III	3	-	3	50	50	100	3

Open Elective- II	Open Elective- III
24BEBO02 Telehealth Technology/ 24BEVO02 Real Estate Practices / 24BELO02 Drone Technologies/ 24BEFO02 Principles of Nutrition/ 24BEPO02 Cross Media Publishing Techniques	24BEBO03 Diagnostic Instrumentation/ 24BEVO03 Green Building Concepts/ 24BELO03 IoT in Connected Cars/ 24BEFO03 Food Preservation Technology/ 24BEPO03Multimedia Development

Total Credits	**165**

Semester	*Course Code*	*Name of 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	24BVBAP1/ 24BVBGP1/ 24BVBWS1/ 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	24BEMM01	Artificial Intelligence and Machine Learning	-	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 3credit (12 weeks duration) MOOCs to be completed through SWAYAM–NPTEL as an alternative to two Professional Electives, ElectiveIII & 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 S*emester* Professional Elective I**	24BEME01	Big Data Mining
		24BEME02	Robotics and Drone Technology
		24BEME03	Cloud Computing and Virtualization
		24BEME04	Compiler Design
	VI *Semester* Professional Elective II	24BEME05	Business Intelligence
		24BEME06	Exploratory Data Analysis
		24BEME07	Fog and Edge Computing
		24BEME08	Image and Video Analytics
	VI *Semester* Professional Elective III	24BEME40/ 24BEME41/ - 24BEME49	**MOOC (12 Weeks Course in SWAYAM- NPTEL)**
	VII *Semester* Professional Elective IV	24BEME09	Generative AI
		24BEME10	Responsible AI
		24BEME11	Cognitive Computing
		24BEME12	Social Media Analytics
	VII *Semester* Professional Elective V	24BEME60/ 24BEME61/ - 24BEME69	**MOOC (12 Weeks Course in SWAYAM-NPTEL)**

LIST OF PROFESSIONAL ELECTIVES (PE2)Data Analysis, Security andIoT Domain

Part	*Semester*	*Course Code*	*Name of the Course*
III	**V S*emester* Professional Elective I**	24BEME21	Cryptography and Network Security
		24BEME22	Linux programming
		24BEME23	Artificial Neural Networks
		24BEME24	Quantum Computing
	VI *Semester* Professional Elective II	24BEME25	Block Chain Technology
		24BEME26	Streaming Analytics
		24BEME27	Internet of Things andApplications
		24BEME28	UI and UX Design
	VI *Semester* Professional Elective III	24BEME50/ 24BEME51/ - 24BEME59	**MOOC(12 Weeks Course in SWAYAM-NPTEL)**
	VII *Semester* Professional Elective IV	24BEME29	Wearable Computing
		24BEME30	Time Series Analysis and Forecasting
		24BEME31	Virtual and Augmented Reality
		24BEME32	Principles of Programming Languages
	VII *Semester* Professional Elective V	24BEME70/ 24BEME71/ - 24BEME79	**MOOC (12 Weeks Course in SWAYAM-NPTEL)**

Open Electives offered by the Department

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

Remarks for NCMC Courses

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

B.E. Honours (Cyber Security)(OPTIONAL)

Part	*Semester*	*Course Code*	*Name of Course/Component*
III	**V *Semester***	24BEMH01	Essentials of Cyber Security
		24BEMH02	Information Security
	VI*Semester*	24BEMH03	Ethical Hacking
		24BEMH04	Privacy and Security in Online Social Media
	To be completed between 5th to 7thsemesters	24BEMH51/ 24BEMH52/ - 24BEMH60	**MOOC (12 Weeks Course in SWAYAM – NPTEL)**
		24BEMH61/ 24BEMH62/ - 24BEMH70	**MOOC (12 Weeks Course in SWAYAM – NPTEL)**

Minor Specialization (Cloud Technologies)(OPTIONAL)

Part	*Semester*	*Course Code*	*Name of Course/Component*
III	**V *Semester***	24BEOM01	Principles of Cloud Computing
		24BEOM02	Cloud Architecture
	VI *Semester*	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)**

Program Educational Objectives:

The graduates in Computer Science and Engineering (Artificial Intelligence and Machine Learning) will be able to

PEO1: Effectively address a diverse array of computing challenges, meeting the demands of both industry and society.

PEO2: Design and develop advanced intelligent systems and applications by integrating state-of-the-art techniques in machine learning, analytics, and visualization.

PEO3: Recognize the importance of lifelong learning and professional development, continuously updating their skills and knowledge to adapt to emerging trends.

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.
6. ***Dr.B.S.Grewal(2014),Higher Engineering Mathematics***,43rdEdition,KhannaPublishers, New Delhi.
7. ***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

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"***, Dhanpat Rai 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. ***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: 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	PO 10	PO 11	PO 12
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

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 I **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****by* 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 I **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 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	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	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-PO MAPPING

	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

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 II **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

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, ANagaraj, JeevanVidyaPrakashan***, 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***–PanditSunderlal
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

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 II **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

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 – List View – Combo Box – Choice Box – Text Controls –Scroll Pane. Layouts – Flow Pane – HBox and VBox – Border Pane – Stack Pane – Grid Pane. Menus–Basics – Menu – Menu bars – Menu Item.

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, AssociateProfessor and Professor from employee class. Add Basic Pay (BP) as the member of all the inheritedclasses with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff clubfunds. 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 Schildt (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& Cornell (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

Machine Learning - I

Semester: III **Hours of Instruction/week: 3T**
Course Code: 24BEMC03 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To acquire theoretical Knowledge on setting hypothesis for pattern recognition
CLO2: To apply suitable machine learning techniques for data handling and to provide solution for various real world applications

UNIT - I Introduction to Machine Learning **9**

Introduction - Components of Learning - Learning Models - Geometric Models - Probabilistic Models - Logic Models - Grouping and Grading - Designing a Learning System - Types of Learning - Supervised - Unsupervised - Reinforcement - Perspectives and Issues - Version Spaces - PAC Learning - VC Dimension.

UNIT - II Supervised Learning Models: Classification **9**

K-Nearest Neighbor (K-NN) algorithm-Naïve Bayes classifier: Bayes theorem-Linear Discriminant Analysis (LDA)-Support Vector Machine (SVM)-Decision Tress(DT)-Random Forest-Bias -Variance trade-off-Cross validation methods: Leave One Out(LOO) cross validation-Folds cross validation.

UNIT - III Supervised Learning Models: Regression **9**

Regression: Linear regression-Single variable-Multi variable-Logistic regression-Polynomial regression-Lasso regression-Ridge regression-Boosting Algorithms: AdaBoost-Gradient Boosting-XG Boost-Neural Networks: Introduction-Representations-Problems for neural network learning-Perceptrons multilayer networks-Forward and Backpropagation algorithm.

UNIT - IV Unsupervised Learning: Clustering **9**

Introduction – types of unsupervised learning – Types of Clustering algorithms - K-means - K-Mediod– Hierarchical – DBSCAN – EM algorithm – Evaluation of clustering algorithms – Applications.

UNIT - V Dimensionality Reduction **9**

Introduction – Linear Techniques: Principal Component Analysis (PCA) – Linear Discriminant Analysis (LDA). Nonlinear Techniques: Uniform Manifold Approximation and Projection – Singular Value Decomposition – Evaluation of DR algorithms – Applications – Data Visualization – Feature Extraction – Noise reduction.

Total Hours: **45**

References:

1 Ethem Alpaydin, (2014).”Introduction to Machine Learning”, MIT Press, Prentice Hall of India, 3rd Edition.

2 Stephen Marsland, (2015). Machine Learning: An Algorithmic Perspective, Chapman and Hall / CRC Machine Learning andPattern Recognition Series, United States, 2nd Edition.

3 Ethem Alpaydin, (2014).Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press, Cambridge, United States, 3rd Edition.

Course Outcomes:

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

CO1: Discuss the characteristics and different learning systems in Machine Learning.

CO2: Understand the basic concepts of classification in supervised learning to solve appropriate methods.

CO3: Classify various supervised learning for real life applications.

CO4: Understand the basic concepts of clustering in unsupervised learning.

CO5: Design systems that use appropriate dimensionality reduction 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	1	2	-	-	2	1	2	3
CO2	3	3	2	2	2	2	-	-	2	2	3	2
CO3	3	2	3	2	2	2	-	-	3	1	3	3
CO4	3	2	2	2	1	1	-	-	1	1	2	2
CO5	3	2	2	2	-	2	-	-	2	2	3	2

Data Structures and Algorithms – II

Semester: III **Hours of Instruction/week: 3T**
Course Code: 24BEMC04 **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 Reema Thareja. (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: 24BEMC05 **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 RamezElamsri. Durvasul VLN Somayazul, Shamkant B Navathe, Shyam K Gupta. (2013).*Fundamentals of Database Systems.* PearsonEducation. 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	3	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: 24BEMC06 **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 Mc Graw-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: 24BEMC07 **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 Technique
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: 24BEMC08 **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, updating and retrieving.
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

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, unfairtrade 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 ConsumerProtection, 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*, 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: 24BEMC09 **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*. 9th Edition. Pearson Education.

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: Describe secondary storage structure and analyse the user problem.

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:24BEMC10 **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 AI foundation and explore 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 uncertaintyconditions.

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: 24BEMC11 **No. of credits: 4**

Course Learning Objectives (CLOs):

CLO1: To focus on the fundamental concept of computer networking, protocols, architectures and applications.
CLO2: To gain expertise in design, implement and analyse 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 ofdata 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; FlowControl and Error control protocols - Stop and Wait - Go-back–N ARQ - Selective Repeat ARQ - SlidingWindow - 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 andDHCP– 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 Bucketand 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 androuters.
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.

Total Hours**:30**

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: 24BEMC12 **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 DivideandConquer 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 AnanyLevitin, (2017). *Introduction to the Design and Analysis of Algorithms*. Pearson Education.3rd Edition.

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

4 SanjoyDasgupta, 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

Computer Vision

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

Course Code: 24BEMC13 **No. of credits: 3**

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 - ObjectRecognition – Tracking - Medical Image Analysis - Content-Based Image Retrieval - Video DataProcessing - 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 3D vision process and motion estimation techniques.

CO5: Apply vision techniques to real time applications.

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	-	-

Operating Systems Laboratory

Semester: IV **Hours of Instruction/week: 3P**
Course Code: 24BEMC14 **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: 24BEMC15 **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

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

Predictive Analytics

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

Course Code: 24BEMC16 **No. of credits: 3**

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

Web Programming for AI

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

Course Code: 24BEMC17 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To introduce the fundamentals of web programming through HTML and CSS.
CLO2: To establish the application of Javascript, NodeJS in designing interactive web pages.

UNIT - I Website Basics, HTML 5 **9**

World wide web and its evolution - E-mail, Telnet, FTP, E–commerce, Cloud Computing, Video conferencing - Internet service providers, IP Address, URL, Domain Name Servers - Web Browsers, Search Engine -Web Server vs Application Server.HTML Tags, Structure, HTML Coding Conventions - Block Elements, Text Elements, Code Related Elements, Character References - Lists, Images, section, article, aside Elements - nav Elements - header and footer Elements.

UNIT - II Cascading Style Sheets **9**

CSS Overview - CSS Rules, CSS Syntax and Style - Class Selectors, ID Selectors, span and div Elements - Cascading, style Attribute, style Container, External CSS Files - CSS Properties: Color Properties, Font Properties, Shadows – Text – Transformations – Transitions – Animations-line-height Property, Text Properties, Border Properties. Element Box, padding Property, margin Property - Hosting a Website and GIT.

UNIT - III JavaScript **9**

Hello World Web Page - Buttons, Functions, Variables, Identifiers - Assignment Statements and Objects - Document Object Model, Forms: form Element, Controls, Text Control Accessing a Form's Control Values, reset and focus Methods – Event Handler Attributes: onchange, onmouseover, onmouseout.

UNIT - IV 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.

UNIT - V AI Tools and Deployment **9**

AI Tools for Web Design-AI Tools for Content Creation-AI Technologies for Testing and Optimization Artificial Intelligence for Development and Deployment.

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*. 8th Edition, Addison-Wesley.8th Edition.

3 Brad Dayley. (2014).*Node.js, MongoDB, and AngularJS Web Development*. Addison-Wesley Professional.

4 Laura Lemay, Rafe Colburn and Jennifer Kyrnin.(2016). *Mastering HTML, CSS and Javascript Web Publishing*, BPB Publication, 1st Edition.

Course Outcomes:

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

CO1: Apply various elements of HTML.

CO2: Design interactive web pages using CSS.

CO3: Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.

CO4: Create Dynamic Web Applications using NodeJS and MongoDB.

CO5: Deploy AI tools in real world applications.

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

Data Science

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

Course Code: 24BEMC18 **No. of credits: 3**

Course Learning Objectives:

CLO1: To understand the skills in data preparatory and pre-processing steps.
CLO2: To acquire knowledge in data interpretation and visualization techniques.

UNIT - I Introduction **9**

Need for data science – benefits and uses – facets of data – data science process – setting their search goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

UNIT - II Describing Data I-Frequency distributions **9**

Frequency distributions - Outliers - interpreting distributions – graphs - averages – describing variability - interquartile range - variability for qualitative and ranked data - Normal distributions - z scores – correlation - scatter plots – regression - regression line - least squares regression line - standard error of estimate - interpretation of r2 - multiple regression equations - regression toward the mean.

UNIT - III Inferential Statistics **9**

Populations – samples - random sampling - Sampling distribution - standard error of the mean - Hypothesis testing - z-test - z-test procedure - decision rule – calculations - decisions - interpretations - one-tailed and two-tailed tests – Estimation - point estimate - confidence interval - level of confidence - effect of sample size.

UNIT - IV Analysis of Variance **9**

t-test for one sample - sampling distribution of t - t-test procedure - t-test for two independent samples - p-value - statistical significance - t-test for two related samples. Ftest – ANOVA – Two-factor experiments - three f-tests - two-factor ANOVA - Introduction to chi-square tests.

UNIT - V Predictive Analytics **9**

Linear least squares - implementation - goodness of fit - testing a linear model - weighted resampling. Regression using Stats Models - multiple regression - nonlinear relationships - logistic regression - estimating parameters - Time series analysis - moving averages - missing values - serial correlation - autocorrelation. Introduction to survival analysis.

Total Hours: **45**

References:

1 David Cielen, Arno D. B. Meysman, and Mohamed Ali. (2016). *Introducing Data Science*. Manning Publications.

2 Robert S. Witte and John S. Witte. (2017).*Statistics*. Wiley Publications, 11th Edition.

3 Jake VanderPlas. (2016). *Python Data Science Handbook*. O'Reilly

4 Allen B. Downey. (2014).*Think Stats: Exploratory Data Analysis in Python.* Green Tea Press.

Course Outcomes:

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

CO1: Explain the skills of data inspecting and cleansing.
CO2: Identify data using primary tools used for data science
CO3: Determine the relationship between data dependencies using statistics
CO4: Analyze the variance in the data
CO5: Build models for predictive analytics.

CO - PO MAPPING

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

Theory of Computation

Semester :V **Hours of Instruction /week: 3T**
Course Code: 24BEMC19 **No. of credits: 3**

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 (Rijk 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

Reinforcement Learning

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

Course Code: 24BEMC20 **No. of credits: 3**

Course Learning Objectives:

CLO1: Illustrate the fundamentals of Reinforcement learning and model-based prediction control using dynamic programming.

CLO2: 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 and Andrew G. Barto.(2015).*Reinforcement Learning: An introduction*. The MIT Press. 2nd Edition

2 Stuart J. Russell and 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:

At the end of the 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	2	1
CO3	3	2	2	2	1	2	-	-	1	1	1	2
CO4	3	2	1	3	-	1	-	-	1	1	1	2
CO5	2	3	3	2	2	1	-	-	3	1	2	3

Web Programming for AI Laboratory

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

Course Code: 24BEMC21 **No. of credits: 1**

Course Learning Objective (CLO):

- **CLO1:** Design and implement applications using the concepts of Web programming.

List of Experiments:

1. Experiment the use of basic HTML elements.
2. Demonstrate the applications of Lists, Tables, Images, Section, article and aside elements.
3. Develop web pages using HTML and various elements of CSS.
4. Build web pages using While Loop, External JavaScript Files, do Loop, Radio Buttons, Checkboxes, for Loop - fieldset and legend Elements.
5. Manipulating CSS with JavaScript- Using z-index to Stack Elements-Text area Controls
6. Create a simple application using node.js
7. Build http services in node.js
8. Create a simple application using Angular.js
9. Implement Angular.js services in web application
10. Simple application to demonstrate Database Connectivity using MongoDB.
11. Create a UI web design using uizard AI tool
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 Laura Lemay, Rafe Colburn and Jennifer Kyrnin.(2016). *Mastering HTML, CSS and Javascript Web Publishing*, BPB Publication, 1st Edition.

Course Outcomes:

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

CO1: Learn, apply and Design applications using DHTML and Java Script.

CO2: Demonstrate the PERL programming language for designing dynamic web pages.

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

Data Science Laboratory

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

Course Code: 24BEMC22 **No. of credits: 1**

Course Learning Objective (CLO):

- **CLO1:** To Learn big data tools and techniques for working with large datasets.

List of Experiments:

1. Working with Numpy arrays
2. Working with Pandas data frames
3. Basic plots using Matplotlib
4. Frequency distributions, Averages, Variability
5. Normal curves, Correlation and scatter plots, Correlation coefficient
6. Regression
7. Z-test and T-test
8. ANOVA
9. Building and validating linear models
10. Building and validating logistic models
11. Time series analysis
12. Mini Project

Total Hours: **45**

Software Requirements:

Python

References:

1 David Cielen, Arno D. B. Meysman, and Mohamed Ali. (2016).*Introducing Data Science*. Manning Publications.

2 Robert S. Witte and John S. Witte. (2017).*Statistics*. Wiley Publications, 11th Edition.

3 Jake VanderPlas. (2016). *Python Data Science Handbook*. O'Reilly

4 Allen B. Downey. (2014).*Think Stats: Exploratory Data Analysis in Python.* Green Tea Press.

Course Outcomes:

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

CO1: Write python programs to handle data using Numpy and Pandas

CO2: Perform data exploration using Matplotlib

CO3: Build models of predictive analytics

CO - PO MAPPING

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

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

R for Data Analytics

Semester: VI **Hours of Instruction/week: 3T**
Course Code: 24BEMC23 **No. of credits: 3**

Course Learning Objectives:

CLO1: To explore the fundamental concept of data analytics and use R programming language to identify suitable data sources to agree the methodological approach
CLO2: To gain knowledge to apply R programming for Text processing.

UNIT - I Introduction **9**

Introducing to R – Installation of Libraries; Constants and Variables; Numbers; R Data Structures – Help functions in R – Vectors: Numeric Vectors - Scalars – Declarations – recycling – Vectorized operation: Using all and any, NA and NULL values, Filtering, Vectorized if-then else, Vector Equality, Vector Element names – Arithmetic and Boolean operations – conditional and loop statement in R – Functions and Recursions in R – Packages in R.

UNIT - II Matrices, Arrays and Lists **9**

Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns: Adding and deleting rows and columns – Higher Dimensional arrays - Vector/Matrix Distinction – Avoiding Dimension Reduction - Characters and Strings - String vector - String operations and functions – List – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists – Different R operations using a List, matrix, Array.

UNIT - III Data Frames **9**

Overview on Data Frames – Create it in scratch - Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Math and Simulations in R - Reading a datafile directly into a dataframe - EDA using R - Reading different file formats.

UNIT - IV OOPS and Statistical Models **9**

S3 Classes – S4 Classes – managing your objects – Input/Output – Accessing keyboard and monitor – Reading and writing files – Accessing the internet – String Manipulation – Graphics – Creating Graphs – Customizing Graphs – saving graphs to files – Creating three-dimensional plots.

UNIT - V Visualization and Learning Techniques **9**

Introduction to GGPlot2 – Library - Factors – Aesthetics – Plotting with Layers – Overriding Aesthetics – Mapping vs Setting – Histograms – Density Charts – Statistical Transformation – Facets – Coordinates – Themes. Learning Techniques - Supervised Learning: Linear Regression; Logistic

Regression; Decision Trees; Random Forests; K-Nearest Neighbours (k-NN); Support Vector Machine. Unsupervised Learning: K-Means Clustering; Hierarchical clustering.

Total Hours: **45**

References:

1 Norman Matloff. (2011). *The Art of R Programming: A Tour of Statistical Software Design*. No Starch Press.

2 Mark Gardener. (2013). *Beginning R – The Statistical Programming Language*. Wiley.

3 Robert Knell. (2013). *Introductory R: A Beginner's Guide to Data Visualization. Statistical Analysis and programming in R.* Amazon Digital South Asia Services Inc.

4 Jared P. Lander. (2013). *R for Everyone: Advanced Analytics and Graphics*. Addison-Wesley Data & Analytics Series.

Course Outcomes:

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

CO1: Acquire the programming fundamentals of R.

CO2: Interpret R script to handle the data frames and perform matrix like operations.

CO3: Implement logical operations, statistical operations, and many more for complex problems.

CO4: Apply object-oriented concepts and demonstrate the mathematical, statistical, and linear operations in R programming.

CO5: Analyze the R graphics features for the given real-world application

CO - PO MAPPING

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

Machine Learning – II

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

Course Code: 24BEMC24 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To acquire Knowledge on various types of learning, algorithms and techniques.

CLO2: To solve real world problems using machine learning techniques and understand the challenges and limitations

UNIT - I Data Pre-processing Techniques 9

Introduction – Four Steps – Data cleaning – Data Integration - Data Transformation/Normalization – Data Reduction – Feature Selection Techniques – Hyper parameter Tuning.

UNIT - II Machine Learning Frameworks 9

Tensor Flow Introduction – Installation – Eager Execution – Tensor Flow for object detection and recommender systems – Introduction to Pytorch - Installation and deployment – Packages: Torch Audio – Torch Text – Torch Vision – Torch Arrow – Torch Serve- Pytorch for Image Segmentation.

UNIT - III Ensemble and Probabilistic Learning 9

Model Combination Schemes - Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost - Stacking.Gaussian mixture models - The Expectation-Maximization (EM) Algorithm - Information Criteria - Nearest neighbour methods - Nearest Neighbour Smoothing - Efficient Distance Computations: the KD-Tree - Distance Measures.

UNIT - IV Reinforcement Learning and Evaluating Hypotheses 9

Introduction - Learning Task - Q Learning - Non deterministic Rewards and actions - temporal-difference learning - Relationship to Dynamic Programming - Active reinforcement learning - Generalization in reinforcement learning.Motivation - Basics of Sampling Theory: Error Estimation and Estimating Binomial Proportions - The Binomial Distribution - Estimators - Bias - Variance

UNIT - V Graphical Models 9

Graphical model: Canonical cases for conditional independence -Bayesian Networks – Markov Random Fields – HiddenMarkov Model (HMMS) – Markov Chain Monte Carlo (MCMC) Methods – Deep Belief Networks (DBN).

Total Hours: **45**

References:

1 Ankur A.Patel (2022).*Hands-On Unsupervised Learning Using Python: How to Build Applied Machine Learning Solutions from Unlabeled Data.*

2 Sebastian Raschka ,Yuxi (Hayden) Liu , Vahid Mirjalili. (2022). *Machine Learning with PyTorch and Scikit-Learn.* United Kingdom. Packt Publishing.

3 Nimish Sanghi (2021). *Deep Reinforcement Learning with Python: With PyTorch, TensorFlow and OpenAIGy.* Apress

Course Outcomes:

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

CO1: Apply data preprocessing techniques for various types of data.

CO2: Design the various ML models using pytorch and Tensorflow frameworks.

CO3: Outlinevarious techniques to enhance the performance of learning.

CO4: Identify the reinforcement learning models for handling unknown pattern.

CO5: Design systems that use theappropriate graph models of machinelearning.

CO - PO MAPPING

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

Natural Language Processing

Semester: VI **Hours of Instruction/week: 3T**
Course Code: 24BEMC25 **No. of credits: 3**

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 NLPsystems.

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 Context-Free Grammars 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 NitinIndurkhya and 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 basics of linguistics, Morphology and Rules associated with NLP

CO2: Explain the types of N-grams models and PoS Tag

CO3: Identify the sequence labeling problem for a given domain

CO4: semantic processing tasks, simple document indexing and searching system using the concepts of NLP

CO5: Implement a simple chatbot using dialogue system concepts

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

Regression Modelling

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

Course Code: 24BEMC26 **No. of credits: 3**

Course Learning Objectives:

CLO1: Assess the relationship between variables in a data set and a continuous response variable.

CLO2: Learn to fit simple and multiple linear regression models using the R program.

UNIT - I Introduction **9**

Introduction to regression: regression through the origin- linear least squares- regression to the mean- basic definitions: notation for data - the empirical mean - the empirical standard deviation and variance - normalization - empirical covariance - some facts about correlation.

UNIT - II Simple Linear Regression Model **9**

Simple linear model with normal errors- regression parameters: interpretation- properties- estimation and testing of hypotheses- prediction using the regression model. R- Squared.

UNIT - III Multivariable Regression Analysis **9**

Multivariable linear regression model- estimation- example with two variables- simple linear regression: the general case- interpretation of the coefficients- fitted values- residuals and residual variation.

UNIT - IV Residuals, Variation, Diagnostics and Model Selection **9**

Residuals - influential - high leverage and outlying points - residuals - leverage and influence measures - model selection: the Rumsfeldian triplet - general rules - R squared and adjusted R squared - variance inflation factor - the impact of over- and under-fitting on residual variance estimation, covariate model selection

UNIT - V Generalized Linear Models **9**

Logistic regression: modelling binary response - estimation - odds - modelling the odds - interpreting logistic regression - Poisson distribution and Poisson regression: modelling count data - estimation - Poisson distribution - linear regression - Poisson regression - mean-variance relationship - rates.

References:

1 Fox, J., & Weisberg, S (2018). *An R companion to applied regression*, Sage publications.

2 Ciaburro, G.*(2018). Regression Analysis with R: Design and develop statistical nodes to identifyunique relationships within data* at scale, Packt Publishing Ltd.

3 Lilja, D. J.*(2016).Linear Regression Using R: An Introduction to Data Modeling*, University ofMinnesota Libraries Publishing.

Course Outcomes:

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

CO1: Explain simple and multiple linear regression models.

CO2: Identify relationships between multiple variables

CO3: Build linear models and predict the study variable using the R program

CO4: Validate regression models

CO5: Analyze and model categorical and count data

CO - PO MAPPING

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

R for Data Analytics Laboratory

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

Course Code: 24BEMC27 **No. of credits: 1**

Course Learning Objective (CLO):

- **CLO1:** To acquire knowledge on R system and to perform statistical and regression model.

List of Experiments:

1. Understanding of R System, R-Studio, R Packages, installation and configuration of R-Environment.
2. Creating and displaying Data
3. Conditional executions and loops, data management with sequences
4. Creating and manipulating a List and Array.
5. Creating and manipulating Strings - Data management with display paste, split, find and replacement, manipulations with alphabets, evaluation of strings, data frames.
6. Creating a Data Frame and Matrix-like Operations on a Data Frame, Merging two Data Frames.
7. Applying functions to Data Frames, import of external data in various file formats, statistical functions, compilation of data.
8. Simple Linear Regression – Fitting, Evaluation and Visualization
9. Multiple Linear Regression, Lasso and Ridge Regression
10. Use the following scenarios:
    a. Use the Diabetes data set from UCI and Pima Indians Diabetes data set for per forming the following: i. Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis. ii. Bivariate Analysis: Linear and logistic regression modeling. iii. Multiple Regression Analysis iv. Also Compare the results of the above analysis for the two data sets.
11. Use the following scenarios:
    a. Data Modelling i. Apply Bayesian and SVM techniques on Iris and Diabetes data set. ii. Apply and explore various plotting functions on UCI data sets.
12. Mini Project

Total Hours: **45**

Software Requirements:

R Studio

References:

1 Norman Matloff.(2011). *The Art of R Programming: A Tour of Statistical Software Design*. No Starch Press.

2 Mark Gardener.(2013). *Beginning R – The Statistical Programming Language*.Wiley.

3 Robert Knell. (2013). *Introductory R: A Beginner's Guide to Data Visualization. Statistical Analysis and programming in R.* Amazon Digital South Asia Services Inc.

4 Jared P. Lander. (2013). *R for Everyone: Advanced Analytics and Graphics*. Addison-Wesley Data & Analytics Series.

Course Outcomes:

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

CO1: Use R programming language

CO2: Perform various operation in data preparation

CO3: Identify the statistical methods applied in R

CO - PO MAPPING

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

Machine Learning Laboratory

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

Course Code: 24BEMC28 **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 Ethem Alpaydin (2014). *Introduction to Machine Learning.* MIT Press, Prentice Hall of India, 3rd Edition.

2 Stephen Marsland (2015).*Machine Learning: An Algorithmic Perspective, Chapman and Hall / CRC Machine Learning andPattern Recognition Series,* United States, 2nd Edition.

3 Sebastian Raschka ,Yuxi (Hayden) Liu , VahidMirjalili. (2022). *Machine Learning with PyTorch and Scikit-Learn.* United Kingdom. Packt Publishing.

Course Outcomes:

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

CO1: Identify the implementation procedures for the machine learning algorithms.

CO2: Evaluate data exploration using Matplotlib

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

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 ethicsin 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: 24BEMC30 **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 recurrentnetworks – 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 Good fellow, 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*. O'Reilly.

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*. O'Reilly.

7 Giancarlo Zaccone, Md. Rezaul Karim & Ahmed Menshawy. (2017). *Deep Learning with Tensor Flow: Explore neural networks with Python*. Packet Publisher.

Course Outcomes:

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

CO1: Acquire knowledge in 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: 24BEMC31 **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 Ian Good 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 auto encoders 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

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

Big Data Mining

PE 1
Semester: V **Hours of Instruction/week: 3T**
Course Code: 24BEME01 **No. of credits: 3**
Prerequisite: Machine Learning
Course Learning Objectives (CLOs):

CLO1: To learn the basic concepts of computational approaches to Modeling, Feature Extraction.

CLO2: To learn the various clustering techniques applicable to Big Data.

UNIT - I Data mining and Large Scale Files 9

Introduction to Statistical modeling - Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining – Distributed File Systems– Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.

UNIT - II Similar Items 9

Nearest Neighbor Search – Shingling of Documents – Similarity preserving summaries – Locality sensitive hashing for documents – Distance Measures – Theory of Locality Sensitive Functions – LSH Families – Methods for High Degree of Similarities.

UNIT - III Mining Data Streams 9

Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows

UNIT - IV Link Analysis and Frequent Itemsets 9

Page Rank –Efficient Computation – Topic Sensitive Page Rank – Link Spam – Market Basket Model – Apriori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.

UNIT - V Clustering 9

Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non – Euclidean Spaces – Streams and Parallelism – Case Study: Advertising on the Web – Recommendation Systems

Total Hours: **45**

References:

1 Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman(2014).*Mining of Massive Datasets.* Cambridge University Press, 2nd Edition.

2 Jiawei Han, Micheline Kamber, Jian Pei(2011).*Data Mining Concepts and Techniques.* Morgan Kaufman Publications, 3rdEdition.

3 Ian H.Witten, Eibe Frank (2011).*Data Mining – Practical Machine Learning Tools and Techniques.* Morgan Kaufman Publications, 3rd Edition,

4 David Hand, Heikki Mannila and Padhraic Smyth(2001). *Principles of Data Mining.* MIT Press.

Course Outcomes:

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

CO1: Design algorithms by employing Map Reduce technique for solving Big Data problems.

CO2: Identify similarities using appropriate measures.

CO3: Point out problems associated with streaming data and handle them.

CO4: Discuss algorithms for link analysis and frequent itemset mining.

CO5: Design solutions for problems in Big Data by suggesting appropriate clustering techniques

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

Robotics and Drone Technology

PE 1
Semester: V **Hours of Instruction/week: 3T**
Course Code: 24BEME02 **No. of credits: 3**
Prerequisite: Artificial Intelligence

Course Learning Objectives (CLOs):
CLO1: To learn the concepts of robotics and its design process.
CLO2: To familiarize the concepts of drone and its types and application.

UNIT - I Introduction to Robotics **9**

Principle of robotics and AI – Advanced robotics techniques – Development environment – System and decision making framework – The robot control system.

UNIT - II Robot Design Process **9**

Image recognition process – Neural network – Picking up the toys: Task Analysis –Teaching the robot arm – Other robot arm machine learning approaches – Teaching a Robot to listen: Robot Speech recognition.

UNIT - III Introduction to Drones **9**

Definition and history of drones- Types of drones and their applications-Drone components and terminology-Regulations and Guidelines for drone usage.

UNIT - IV Drone Design and Assembly **9**

Design considerations for drone airframe and propulsion systems- Selecting and assembling drone components such as motors- batteries-flight controllers- and cameras- Basic wiring and soldering techniques.

UNIT - V Applications of Drone **9**

Overview of commercial and industrial drone applications- Case studies and examples of successful drone deployments- GPS based navigation system- Drone Camera Systems- Agro application-Drone Delivery-Future trends and developments in the drone industry.

Total Hours: **45**

References:

1 John J. Craig (2014) *Introduction to Robotics Mechanics and Control*, 2nd Edition, Addison Wesley.

2 D. Saxby (2018), *Drone Aerial Photography and Video: Techniques and Stories from the Field*. Cengage Learning.

3 D. McLeod (2019), *Getting Started with Drone: How to Build, Fly, and Program Your Own Drone*, Apress.

4 G. C. Camara Leal (2017), *Flying Robots: An Introduction to Autonomous Aerospace Systems, Springer.*

Course Outcomes:

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

CO1: Learn about the concepts of robotics and its control system.

CO2: Analyze the various Robot design process and path planning techniques.

CO3: Learn about the various types of Drones and its applications.

CO4: Learn about the various components of drone design.

CO5: Acquire knowledge in various applications of drone.

CO - PO MAPPING

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

Cloud Computing and Virtualization

PE 1
Semester: V **Hours of Instruction/week: 3T**
Course Code: 24BEME03 **No. of credits: 3**
Prerequisite: Computer Networks

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: Employ the concepts of storage virtualization, network virtualization and its management

CO2: Apply the concept of virtualization in the cloud computing

CO3: Identify the architecture, infrastructure and delivery models of cloud computing

CO4: Develop services using Cloud computing

CO5: Apply the security models in the cloud 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

Compiler Design

PE 1
Semester: V **Hours of Instruction/week: 3T**
Course Code: 24BEME04 **No. of credits: 3**
Prerequisite: Theory of Computation

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	3	2	2	2	1	1	-	1	2	1	3
CO2	2	3	3	2	2	-	-	-	1	1	1	2
CO3	2	3	3	2	2	-	-	-	1	1	1	2
CO4	2	3	3	2	2	-	-	-	2	1	1	2
CO5	2	3	3	2	2	1	1	-	2	2	1	3

Cryptography and Network Security

PE 2

Semester: V **Hours of Instruction/week: 3T**
Course Code: 24BEME21 **No. of credits: 3**
Prerequisite: Computer Networks

Course Learning Objectives (CLOs):

CLO1: To know the methods of conventional encryption.

CLO2: To know the knowledge about authentication, hash functions and application level security mechanisms.

UNIT – I Introduction **9**

OSI Security Architecture – Classical Encryption techniques – Cipher Principles – Data Encryption Standard – Block Cipher Design Principles and Modes of Operation – Evaluation criteria for AES – AES Cipher – Triple DES – Placement of Encryption Function – Traffic Confidentiality.

UNIT - II Public Key Cryptography **9**

Key Management – Diffie-Hellman key Exchange – Elliptic Curve Architecture and Cryptography – Introduction to Number Theory – Confidentiality using Symmetric Encryption – Public Key Cryptography and RSA.

UNIT - III Message Authentication and Hash Functions **9**

Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm – Secure Hash Algorithm – RIPEMD – HMAC Digital Signatures – Authentication Protocols – Digital Signature Standards

UNIT - IV Network Security **9**

Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security – PGP – S/MIME –IP Security – Web Security.

UNIT - V System Level Security **9**

Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems.

Total Hours: **45**

References:

1 William Stallings. (2015). *Cryptography and Network Security*. 6th Edition. Pearson Education.

2 Behrouz A. Foruzan.(2007). *Cryptography and Network Security*. Tata McGraw-Hill.

3 AtulKahate.(2003). *Cryptography and Network Security.* Tata McGraw-Hill.

Course Outcomes:

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

CO1: Describe network security fundamental concepts and principles

CO2: Compare various Public key cryptographic techniques.

CO3: Analyze key agreement algorithms to identify their weaknesses

CO4: Discuss Network security and authentication applications.

CO5: Identify and assess different types of threats, malware, spyware, viruses, vulnerabilities.

CO - PO MAPPING

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

Linux Programming

PE 2 **Hours of Instruction /week: 3T**
Semester V **No. of credits: 3**
Course Code:24BEME22

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

Artificial Neural Networks

PE 2
Semester: V **Hours of Instruction/week: 3T**
Course Code: 24BEME23 **No. of credits: 3**
Prerequisite: Artificial Intelligence

Course Learning Objectives (CLOs):
CLO1: To understand the biological neural network and to model equivalent neuron models
CLO2: To explore the Neuro dynamic models for various problems.

UNIT - I Introduction and Learning Process **9**

Introduction: A Neural Network – Human Brain – Models of a Neuron – Neural Networks viewed as Directed Graphs – Network Architectures – Knowledge Representation – Artificial Intelligence and Neural Networks – Learning Process: Error Correction Learning – Memory Based Learning – Hebbian Learning – Competitive – Boltzmann Learning – Credit Assignment Problem – Memory – Adaption – Statistical Nature of the Learning Process

UNIT - II Single and Multi- Layer Perceptrons **9**

Single Layer Perceptrons: Adaptive Filtering Problem – Unconstrained Organization Techniques – Linear Least Square Filters – Least Mean Square Algorithm – Learning Curves – Learning Rate Annealing Techniques – Perceptron – Convergence Theorem – Relation Between Perceptron and Bayes Classifier for a Gaussian Environment – Multilayer Perceptron: Back Propagation Algorithm XOR Problem – Heuristics – Output Representation and Decision Rule – Computer Experiment – Feature Detection

UNIT – III Back Propagation **9**

Back Propagation and Differentiation – Hessian Matrix – Generalization – Cross Validation – Network Pruning Techniques – Virtues and Limitations of Back Propagation Learning – Accelerated Convergence – Supervised Learning

UNIT – IV Self-Organization Maps (SOM) **9**

Two Basic Feature Mapping Models – Self-Organization Map – SOM Algorithm – Properties of Feature Map – Computer Simulations – Learning Vector Quantization – Adaptive Patter Classification

UNIT – V Neuro Dynamics and Hopfield Models **9**

Neuro Dynamics: Dynamical Systems – Stability of Equilibrium States – Attractors – Neuro Dynamical Models – Manipulation of Attractors as a Recurrent Network Paradigm – Hopfield Models – Hopfield Models – restricted boltzmen machine

Total Hours: **45**

References:

1 Simon S Haykin. (1997). *Neural Networks a Comprehensive Foundation.* Pearson. 2nd Edition

2 Jacek M. Zurada. (2006). *Introduction to Artificial Neural Systems.* JAICO Publishing. 1st Edition.

3 Dr.J.Purushotham. (2023). *A Text Book on Artificial Neural Networks Staple Bound*. Prashas Research Consulting Pvt. Ltd.

4 B. Vegnanarayana. (2005). *Artificial Neural Networks.* Prentice Hall of India Ltd.

Course Outcomes:

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

CO1: Discuss the similarity of Biological networks and Neural networks

CO2: Build the training of neural networks using various learning rules.

CO3: Identify the concepts of forward and backward propagations.

CO4: Analyze the self-organization maps and its classification

CO5: Apply Hopfield models to solve pattern recognition and optimization problems.

CO-PO MAPPING

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

Quantum Computing

PE 2
Semester: V **Hours of Instruction/week: 3T**
Course Code: 24BEME24 **No. of credits: 3**
Prerequisite: Linear Algebra and Queueing Theory

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, 2002.

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

Business Intelligence

PE 1

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

Course Code: 24BEME05 **No. of credits: 3**

Prerequisite: Data Mining

Course Learning Objectives (CLOs):

CLO1: To gain knowledge on how to transform data and make it suitable for data-driven predictive tasks.

CLO2: To compute basic statistics using real-world datasets of consumer activities, like product Reviews.

UNIT - I Business Intelligence – Introduction 9

A Frame work for Business Intelligence (Bl)- The Architecture of Bl - Benefits of business intelligence- how business intelligence differs from competitive intelligence and knowledge management.

UNIT – II Data Warehousing 9

Characteristics of Data Warehousing- Data Marts- Data warehousing process- Data warehousing Architectures – Data Integration and the Extraction, Transformation and Load (ETL) Process- OLAP Versus OLTP- Data warehousing implementation issues – Real time data warehousing.

UNIT – III Business Reporting, Visual Analytics and Business Performance Management 9

Data and Information Visualization – Different types of Charts and Graphs- Emergence of Data visualization and Visual analytics - Performance Dashboard - Balance Score Cards – Dashboards Versus Scorecards - Six Sigma as a performance measurement system.

UNIT – IV Data mining – Supervised learning & Unsupervised learning 9

Data mining concepts and applications – Data mining process – Data mining methods – Classification techniques – Decision trees, Case studies. Unsupervised learning-Cluster Analysis – Partition and Hierarchical methods- Association rule mining –Data mining software Tools - Case studies.

UNIT – V Text Analytics, Text Mining and Sentiment Analysis 9

Text analytics and Text mining concepts and definition – Text mining process – Text mining tools – Sentiment analysis overview – Sentiment analysis applications – Sentiment analysis process. Web Analytics-Web Mining-Web mining overview – Web content and Web structure mining – Search Engines - Search Engine Optimization.

Total Hours: **45**

References:

1 Ramesh Sharda, Dursun Delen, Efraim Turban,(2017)*Business Intelligence, Analytics, and Data Science: A Managerial Perspective*, 4th Edition, Pearson.

2 David Loshin Morgan, Kaufman(2012) ―*Business Intelligence: The Savvy Manager"s Guide*‖, 2nd Edition.

3 Efraim Turban, Ramesh Sharda, Dursun Delen (2013). *Decision Support and Business Intelligence Systems.*9th Edition. Pearson Education.

Course Outcomes:

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

CO1: Explain knowledge of Business Intelligence

CO2: Illustrate the concepts and architectures of data warehousing.

CO3: Identify the impact of business reporting, information visualization, and dashboards.

CO4: Apply business intelligence methods to various situations.

CO5: Develop business intelligence application for the real life scenario.

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	-	-

Exploratory Data Analysis

PE 2
Semester: VI **Hours of Instruction/week: 3T**
Course Code: 24BEME06 **No. of credits: 3**
Prerequisite: Artificial Intelligence

Course Learning Objectives (CLOs):

CLO1: To outline an overview of exploratory data analysis and implement data visualization using Matplotlib.
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 forEDA- 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 - Scatterplots and Resistant Lines.

UNIT - V Multivariate and Time Series Analysis **9**

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables andBeyond – 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 withPython*", Packt Publishing.

2 Jake Vander Plas,(2017). *Python Data Science Handbook: Essential Tools for Working with Data*, 1st Edition, O Reilly.

3 Catherine Marsh, Jane Elliott,(2008) "*Exploring Data: An Introduction to Data Analysis for Social Scientists*", 2nd Edition, Wiley Publications.

Course Outcomes:

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

CO1: Discuss the fundamentals of exploratory data analysis.

CO2: Implement the data visualization using Matplotlib.

CO3: Perform univariate data exploration and analysis.

CO4: Apply bivariate data exploration and 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	1	-	-	2	2	3	2
CO2	2	2	2	3	3	-	-	1	3	2	2	2
CO3	2	3	2	2	3	1	1	-	2	2	2	1
CO4	2	2	2	2	3	-	-	-	3	2	2	1
CO5	2	2	1	2	1	-	-	-	1	2	2	1

Fog and Edge Computing

PE 1
Semester: VI **Hours of Instruction/week: 3T**
Course Code: 24BEME07 **No. of credits: 3**

Prerequisite: Cloud Computing

Course Learning Objectives (CLOs):

CLO1: To become familiar with the concepts of Fog and Edge computing
CLO2: To understand the architecture and its components and working of components and its Performance

UNIT - I Introduction to Fog and Edge Computing 9

Fog and Edge Computing(FEC) - Definition-FEC Completing the Cloud - Advantages of FEC-Hierarchy of FEC-Business Models - Opportunities and Challenges- Addressing the Challenges in Federating Edge Resources – Introduction – The networking challenge- The management challenge.

UNIT - II Middleware 9

Introduction-Need for Fog and Edge Computing Middleware- Design Goals-Stateof-the-Art Middleware Infrastructures-System Model- Proposed Architecture-Case Study Example-FutureResearch Directions. Lightweight Container Middleware for Edge Cloud Architectures-IntroductionClusters for Lightweight Edge Clouds-Architecture Management – Storage and Orchestration- IoT Integration- Security Management for Edge Cloud Architectures -Future Research Directions.

UNIT - III Data Management and Predictive Analysis in Fog Computing 9

Problem definition &biological motivation – similarity and differences – global alignment, local alignment – gap penalty models substitution matrices – PAM, BLOSUM – Applying dynamic programming to pairwise alignment –Needleman – WUNSCH algorithm, Smith – waterman algorithm.

UNIT - IV Optimization Problems in Fog and Edge Computing 9

The Case for Optimization in Fog Computing – Formal Modeling- Framework for Fog Computing Metrics -Optimization Opportunities along the Fog Architecture - Optimization Opportunities along the Service Life Cycle – Toward a Taxonomy of Optimization Problems in Fog Computing - optimization Techniques.

UNIT - V Case Studies **9**

Smart Surveillance Video Stream Processing at the Edge for Real-Time -Smart Transportation Applications-Intelligent Traffic Lights Management (ITLM) System -Fog Orchestration Challenges and Future Directions.

Total Hours: **45**

References:

1 Flavio Bonomi, Rodolfo Milito, Preethi Natarajan and Jiang Zhu (2011) "*Fog Computing: A Platform for Internet of Things and Analytics*", Springer International.

2 Flavio Bonomi, Rodolfo Milito, Jiang Zhu, Sateesh Addepalli(2012) MCC‟ *"Fog Computing and Its Role in the Internet of Things*", Helsinki, Finland.

3 Shanhe Yi, Cheng Li, Qun Li, Mobidata (2015) "*A Survey of Fog Computing: Concepts, Applications and Issues"*.

Course Outcomes:

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

CO1: Understand the use of IoT architecture with its entities and protocols via Edge and Fog, up to the cloud.

CO2: Get familiar on security & privacy issues related to area of Fog & Edge computing, IoT and big data.

CO3: Exploit Fog and Edge computing in implementing real time applications.

CO4: To access and use the services in the Cloud.

CO5: Understanding of latest advances and its applications in cloud, Fog and Edge computing.

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	-	-

Image and Video Analytics

PE 1
Semester: VI **Hours of Instruction/week: 3T**
Course Code: 24BEME08 **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 multisperalct 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-FasterR-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures.

UNIT - IV Face Recognition and Gesture Recognition **9**

Face Recognition-Introduction-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**

Association rules, Cluster analysis, Principal Components, Random forests and analysis.

Total Hours: **45**

References:

1. VaibhavVerdhan .(2021).*Computer Vision Using Deep Learning Neural Network Architectures with Python* and Keras,Apress.
2. Milan Sonka, Vaclav Hlavac& Roger Boyle (2013). *"Image Processing, Analysis, and Machine Vision"*, Thomson Learning .4th Edition.
3. Richard Szeliski. (2011). "*Computer Vision: Algorithms and Applications*", Springer Verlag London Limited.
4. E. R. Davies. (2012). "*Computer & Machine Vision*", Academic Press. 4thEdition.
5. D. A. Forsyth& J. Ponce.(2003). "*Computer Vision: A Modern Approach",* Pearson Education.

Course Outcomes:

Upon completion of this 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: Develop various object detection techniques.

CO4: Understand the various face recognition mechanisms.

CO5: Elaborate on deep learning-based 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	-	-

Block Chain Technology

PE 2
Semester VI **Hours of Instruction/week: 3T**
Course Code: 24BEME25 **No. of credits: 3**
Prerequisite: Computer Networks

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 Block chain – 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-Blockchainas-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*", 2nd Edition, Packt Publishing Ltd.

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 and 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: Discuss and describe the history, types and applications of Blockchain.

CO2: Identify the familiarity with cryptography and Consensus algorithms.

CO3: Create and deploy projects using Web3j.

CO4: Implement an ICO on Ethereum.

CO5: Design blockchain based application 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

Streaming Analytics

PE 2
Semester VI **Hours of Instruction/week: 3T**
Course Code: 24BEME26 **No. of credits: 3**
Prerequisite: Machine Learning

Course Learning Objectives (CLOs):

CLO1: To provide students with the knowledge and skill sets to work with very large datasets and continuous streaming data which need to be processed in realtime.
CLO2: To provide hands-on experience with the technologies that enable the ingestion and management of Big Data and real-time data**.**

UNIT - I Introduction to Stream Computing 9

Streaming Data – Sources – Difference between Streaming Data and Static Data. Overview of Large Scale Stream Processing Engines – Issues in Stream Processing.

UNIT - II Streaming Analytics Architecture 9

Phases in Streaming Analytics Architecture - Vital Attributes - High Availability – Low Latency– Horizontal Scalability-Fault Tolerance - Service Configuration and Management –Apache ZooKeeper.

UNIT - III Data flow Management 9

Distributed Data Flows – At Least One Delivery – Apache Kafka – Apache Flume – Zero MQ - Messages, Events, Tasks& File Passing.

UNIT - IV Processing & Storing Streaming Data 9

Distributed Stream Data Processing: Co-ordination, Partition and Merges, Transactions.Duplication Detection using Bloom Filters - Apache Spark Streaming Examples Choosing astorage system – NoSQL Storage Systems.

UNIT - V Delivering Streaming Metrics 9

Visualizing Data – Mobile Streaming Apps –Times Counting and Summation – StochasticOptimization – Delivering Time Series Data.

Total Hours: **45**

References:

1 Byron Ellis (2014).*Real-Time Analytics: Techniques to Analyze and Visualize Streaming Data*, Wiley, 1st Edition

2 SherifSakr (2014).*Large Scale and Big Data: Processing and Management*, CRC Press.

3 Jure Leskovec, AnandRajaraman and Jeffrey D. Ullman (2014).*Mining of Massive Datasets*, Cambridge University Press.

Course Outcomes:

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

CO1: Discuss the need for stream computing.

CO2: Comprehend the architecture of stream analytics.

CO3: Identify data flow management pipelines and its tasks

CO4: Analyze the Processing and Storing Streaming Data

CO5: Analyze the results of streaming analytics.

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	-	1	-	-	1	1	-	-
CO3	2	3	3	1	-	-	2	1	3	2	-	-
CO4	3	2	2	-	2	-	-	-	2	1	-	-
CO5	2	-	2	-	-	-	-	1	1	2	-	-

Internet of Things and Applications

PE 2

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

Course Code: 24BEME27 **No. of credits: 3**

Prerequisite: 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- SimplifiedIoT 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 Case Studies / Industrial 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.

Total Hours: **45**

References:

1 David Hanes, GanzaloSalgueiro, Patrick Grossetete, Rob Barton and 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 ArshdeepBahga, 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 fundamental and architecture of Internet of Things.

CO2: Use the appropriate IoT protocols for various applications.

CO3: Identify various types of design and its communication technologies.

CO4: Analyze the services offered from Data Analytic tools in IoT.

CO5: Apply IoT applications in Real World Design Constraints.

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	-	-

UI and UX Design

PE 2

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

Course Code: 24BEME28 **No. of credits: 3**

Prerequisite: Web Technology

Course Learning Objectives (CLOs):

CLO1: To gain knowledge on the basic concepts and structure of user Interface and design process.

CLO2: To provide knowledge of different interaction styles.

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 UI/ UX Design Tools **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- student 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

Generative AI

PE 1
Semester: VII **Hours of Instruction/week: 3T**
Course Code: 24BEME09 **No. of credits: 3**
Prerequisite: Artificial Intelligence

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 Machinesto Paint, Write, Compose and Play*, O'Reilly Media, Inc. 2nd Edition.

2 Rafael Valle. (2019). *Hands-on Generative Adversarial Networks with Keras*, Packet Publisher.

3 Ian Goodfellow, Yoshua Bengio & Aaron Courville. (2016). *Deep Learning*. MIT Press.

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 and apply effective prompt engineering techniques and its approaches.

CO3: Apply a range of sequential data processing techniques and Generative AI models across various domains.

CO4: Build, train and apply generative models and develop familiarity with platforms.

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

Responsible AI

PE 1
Semester: VII **Hours of Instruction/week: 3T**
Course Code:24BEME10 **No. of credits: 3**
Prerequisite: Artificial Intelligence

Course Learning Objectives (CLOs):

CLO1: To gain a thorough understanding of responsible AI models with and their role in artificial intelligence.
CLO2: To identify the privacy &security methods and know the approaches for responsible AI.

UNIT - I Introduction **9**

Autonomy – Adaptability – Interaction – Need for Ethics in AI - Fairness and Bias: Sources of Biases – Exploratory data analysis – limitations of a dataset – Group fairness and individual fairness – Counterfactual fairness - AI harms - AI risks: Case Study.

UNIT - II Ethical decision making **9**

Seven Principles of Responsible AI - Ethical theories – Values - Ethics in practice – Implementing Ethical Reasoning – The ART of AI: Accountability, Responsibility, Transparency.

UNIT - III Interpretability and explainability **9**

Importance of Interpretability – Taxonomy of Interpretability Methods – Scope of Interpretability – Evaluation of Interpretability – Interpretable Models: Linear Regression – Logistic Regression – Decision Tree.

UNIT - IV Privacy preservation **9**

Introduction to data privacy – Methods of protecting data – Importance of balancing data privacy and utility - Attack model – Privacy Preserving Learning – Differential Privacy – Federated Learning – Case Study.

UNIT - V Ensuring responsible AI **9**

Approaches to Ethical Reasoning by AI – Designing Artificial Moral Agents – Implementing Ethical Deliberation – Levels of Ethical Behaviour – The ethical status of AI system – Governance for Responsible AI – Codes of Conduct – Inclusion and Diversity.

Total Hours: **45**

References:

1. Virginia Dignum.(2019). *Responsible Artificial Intelligence: How to Develop and use AI in a Responsible Way* .Springer Nature.
2. Christoph Molnar. (2019).*Interpretable Machine Learning.* Lulu.1st Edition.
3. Beena Ammanath. (2022).*Trustworthy AI*. Wiley.
4. Adnan Masood, Heather Dawe, Dr. Ehsan Adeli.(2103). *Responsible AI in the Enterprise.* Packt Publishing.

Course Outcomes:

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

CO1: Discuss the fundamental concepts of AI, recognize ethical considerations, and analyze biases and limitations through real-world case studies.

CO2: Apply ethical theories and principles to implement responsible AI practices, emphasizing accountability, responsibility and transparency.

CO3: Evaluate the importance of interpretability, categorize methods, and apply them for effective communication of results.

CO4: Apply privacy-preserving techniques to protect sensitive data in AI applications

CO5: Analyze ethical reasoning approaches, design moral agents, and implement ethical deliberation, governance, and inclusion for responsible AI practices

CO - PO MAPPING

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

Cognitive Computing

PE 1
Semester: VII **Hours of Instruction/week: 3T**
Course Code: 24BEME11 **No. of credits: 3**
Prerequisite: Artificial Intelligence, Bigdata

Course Learning Objectives (CLOs):

CLO1: To gain knowledge on 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 businessknowledge to plan for the future - answering business questions in new ways - building businessspecific 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 in sights - 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. (https://probmods.org/.)

Course Outcomes:

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

CO1: Explain the fundamental concepts and design principles of cognitive computing.

CO2: Describe Natural language processor role in Cognitive computing.

CO3: Analyze the relationship between Big Data and Cognitive Computing

CO4: Analyze the process of building a cognitive application and taking a product to market.

CO5: Comprehend the applications of cognitive computing.

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	-	-

Social Media Analytics

PE1

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

Course Code: 24BEME12 **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 Publishing.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 why Twitter is popular and use of API to explore trending topics, search tweets, analyse tweet content, and visualize data.

CO3: Identify 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

Wearable Computing

PE 2
Semester VII **Hours of Instruction/week: 3T**

Course Code: 24BEME29 **No. of credits: 3**

Prerequisite: Internet of Things

Course Learning Objectives (CLOs):
CLO1: To gain knowledge on constraints unique to wearable and ubiquitous computing platforms.
CLO2: To recognize the state-of-the-art hardware and software development tools to computer system design.

UNIT - I Introduction to Wearable Technologies 9

Fundamentals of Wearable Technologies - History of wearable Technologies -User Experience Design for Internet of Things -Social Aspects of Wearability - Internet of Things – Applications - Wearable Chemical and Biochemical Sensors - Technology ofConnected Devices – Device Types, Sensors, Actuators.

UNIT - II Wearable Computing Applications 9

Medical Applications of Wearable Technologies - Wearable Technologies - Energy Expenditure and Energy Harvesting -Technology of Connected Devices – Energy Considerations - Flexible Electronics and Textiles for Wearable Technologies.

UNIT - III Wearable Computing Architecture 9

Wearable Algorithms - Web of Things – Architecture Standardization- Data Mining for Body Sensor Network - Internet of Things– Embedded Device UX Design.

UNIT - IV Communication Technologies 9

Physical Activity Modeling and Behavior Change - Internet of Things – Interface and Interaction Design - Human BodyCommunication for a Data Rate Sensor Network. Internet of Things – Networking. - Wireless Body Area Networks – WearableComputing as a form of urban design.

UNIT - V Wearable Computing Case Studies 9

Wearable Sensors for Monitoring of Physical and Physiological Changes and for Early Detection of Diseases - Wearable andNon-Invasive Assistive Technologies.

Total Hours: **45**

References:

1 Paul Scherzand Simon Monk. (2016) ,*Practical Electronics for Inventors*, 3rd Edition

2 OmeshTickoo, Ravi Iyer (2016)*Making Sense of Sensors: End-to-End Algorithms and Infrastructure Design.*

3 Woodrow Barfield (2015) *Fundamentals of Wearable Computers and Augmented Reality*, 2nd Edition.

Course Outcomes:

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

CO1: Discuss the advanced concept of Wearable Computing and emerging technologies.

CO2: Extend the knowledge achieved and apply it to solve real world problems.

CO3: Identify the different methodologies for research on wearable technology.

CO4: Analyze the ethical issues related to the Wearable devices and contribute innovative thinking and innovation processes.

CO5: Ability to integrate several domain through wearable technology.

CO - PO MAPPING

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

Time Series Analysis and Forecasting

PE 2

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

Course Code: 24BEME30 **No. of credits: 3**

Prerequisite: Predictive Analytics

Course Learning Objectives (CLOs):

CLO1: To equip various forecasting techniques and familiarize on modern statistical methods for analyzing time-series data.

CLO2: To amalgamate the intellectual facts of the time series data to implement in the field projects scientifically.

UNIT - I Exploratory analysis of Time Series **9**

Graphical display, classical decomposition model, Components and various decompositions of Time Series Models-Numerical description of Time Series: Stationarity, Autocovariance and Autocorrelation functions - Data transformations - Methods of estimation –Trend, Seasonal and exponential.

UNIT - II Smoothing Techniques **9**

Moving Averages: Simple, centered, double and weighted moving averages; single and double exponential smoothing – Holt's and winter's methods - Exponential smoothing techniques for series with trend and seasonality-Basic evaluation of exponential smoothing.

UNIT - III Stationary and Non-stationary models **9**

Time series data, Trend, seasonality, cycles and residuals, Stationary, White noise processes, Autoregressive (AR), Moving Average (MA), Autoregressive and Moving Average (ARMA) and Autoregressive Integrated Moving Average (ARIMA) processes, Choice of AR and MA periods.Tests for Nonstationarity: Random walk –random walk with drift –Trend stationary – General Unit Root Tests: Dickey Fuller Test, Augmented Dickey Fuller Test.

UNIT - IV Forecasting **9**

Nature of Forecasting – Forecasting methods- qualitative and quantitative methods – Steps involved in stochastic model building – Forecasting model evaluation. Model selection techniques: AIC, BIC and AICC – Forecasting model monitoring.

UNIT - V Transfer function and Intervention analysis 9

Transfer function models- Transfer function – noise models; Cross correlation function; Model specification; Forecasting with Transfer function – noise models;Intervention analysis.

Total Hours: **45**

References:

1 *Terence C. Mills, Applied Time Series Analysis* (2019): A Practical Guide to Modeling and Forecasting, Academic Press.

2 *Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulahci(2016).* Introduction to Time Series Analysis and Forecasting, 2nd Edition, Wiley.

3 *George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung(2016),* Time Series Analysis: Forecasting and Control, 5th Edition., Wiley.

4 *Brockwell, P. J., & Davis, R. A.*,(2016)Introduction to time series and forecasting, 3rd Edition., Springer.

Course Outcomes:

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

CO1: Explore the fundamental advantages and apply essential of forecasting techniques.

CO2: Identify an appropriate forecasting method in any given situation.

CO3: Apply stationary and non-stationary methods in real-time problems.

CO4: Analyze various forecasting methods and model selection techniques.

CO5: Examine the Transfer function and Intervention analysis.

CO - PO MAPPING

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

Virtual and Augmented Reality

PE 2
Semester VII **Hours of Instruction/week: 3T**
Course Code: 24BEME31 **No. of credits: 3**
Prerequisite: Artificial Intelligence

Course Learning Objectives (CLOs):
CLO1: To know the basic concepts of virtual reality and understand visual computation in computer Graphics.
CLO2: To familiarize the interaction between system and computer and to know basic concepts of augmented reality.

UNIT - I Introduction of Virtual Reality **9**

Fundamental Concept and Components of Virtual Reality – Primary Features and Present Development on Virtual Reality – Multiple Models of Input and Output Interface in Virtual Reality: Input – Tracker – Sensor – Digital Glove – Movement Capture – Video based Input – 3D Menus & 3DScanner – Output –Visual /Auditory / Haptic Devices.

UNIT - II Visual Computation in Virtual Reality **9**

Fundamentals of Computer Graphics –Software and Hardware Technology on Stereoscopic Display –Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering.

UNIT - III Interactive Techniques in Virtual Reality **9**

Body Track – Hand Gesture – 3D Manus – Object Grasp. Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3D Standard; Vega – MultiGen – Virtools.

UNIT - IV Application of VR in Digital Entertainment **9**

VR Technology in Film & TV Production – VR Technology in Physical Exercises and Games – Demonstration of Digital Entertainment by VR

UNIT - V Augmented and Mixed Reality **9**

Taxonomy – Technology and features of augmented reality – difference between AR and VR – Challenges with AR – AR systems and functionality – Augmented reality methods – visualization techniques for augmented reality – wireless displays in educational augmented reality applications – mobile projection interfaces – marker – less tracking for augmented reality – enhancing interactivity in AR environments – evaluating AR systems.

Total Hours: **45**

References:

1 M. Claudia tom Dieck, Timothy Jung (2019). *Augmented Reality and Virtual .Reality The Power of AR and VR for BusinessSpringer* International Publishing

2 Alan B. Craig (2013). *Understanding Augmented Reality, Concepts and Applications*. Morgan Kaufmann

3 Alan Craig,William Sherman, Jeffrey Will (2009). *Developing Virtual Reality Applications, Foundations of Effective Design*. Morgan Kaufmann

Course Outcomes:

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

CO1: Formulate the various issues in fundamental concepts, components and visual computation of Virtual Reality.

CO2: Identify the fundamentals of Computer Graphics.

CO3: Identify various Interactive Techniques in Virtual Reality.

CO4: Describe the application of VR in Digital Entertainment.

CO5: Analyze the methods and visualization techniques in augmented reality.

CO - PO MAPPING

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

Principles of Programming Languages

PE 2
Semester VII **Hours of Instruction/week: 3T**
Course Code: 24BEME32 **No. of credits: 3**
Prerequisite: Data structures and algorithms

Course Learning Objectives (CLOs):
CLO1: To impart concepts of programming languages.
CLO2: To recognize the various object-oriented and functional programming concepts.

UNIT - I Introduction to Programming languages 9

Programming languages: Programming linguistics- Concepts and paradigms Syntax - semantics and pragmatics- Language processors - Historical development.Basic Concepts: Values and types: Types-Primitive types - Composite types -Recursive types - Type systems – Expressions.

UNIT - II Variables and storage 9

Variables and storage: Variables and storage - Simple variables – Composite variables - Copy semantics Vs reference semantics - Lifetime - Pointers -Commands - Expressions with side effects. Bindings and scope: Bindings andenvironments-Scope-Declarations - Blocks.

UNIT - III Data abstraction 9

Data abstraction: Program units, packages, and encapsulation - Abstract types-Objects and classes - Implementation notes. Type systems: Inclusion polymorphism- Parametric polymorphism - Overloading - Type conversions – Implementationnotes.

UNIT - IV Imperative, Object-oriented and Concurrent programming 9

Imperative programming-: Key concepts - Pragmatics. Case study: C. Object -oriented programming: Key concepts – Pragmatics. Case study: C++. Concurrentprogramming: Key concepts- Pragmatics. Case study: JAVA.

UNIT - V Functional and Logic programming 9

Functional Programming: Key concepts - Eager Vs normal-order Vs lazy evaluation– Pragmatics. Logic programming: Key concepts - Pragmatics - Case study:PROLOG. Scripting: Key concepts – Pragmatics - Case study: PYTHON.Conclusion: Language selection - Language design.

Total Hours: **45**

References:

1 Robert Sebesta. W, (2016), "*Concepts of Programming Languages*", 8th Edition,Pearson Education Limited, Noida.

2 Ravi Sethi, (2009), "*Programming Languages Concepts & Constructs*", 2nd Edition, Pearson Education, Noida.

3 David Watt. A, (2004),"*Programming Language Design Concepts*" 1st Edition,John Wiley & Sons Ltd, Noida.

Course Outcomes:

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

CO1: Discuss the programming language concepts.

CO2: Outline the concept of storage variables.

CO3: Identify the data abstraction concepts and polymorphism.

CO4: Analyze the OOP and Concurrent Programming.

CO5: Infer Functional and Logic Programming.

CO - PO MAPPING

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