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. Artificial Intelligence and Data Science

Programme Specific Outcomes:

PSO1: Apply the concepts learnt through courses like Data Structures, Data Mining, Cloud Computing, Machine Learning, Data Science, Computer Vision, Data Visualization and programming languages to solve real life problems

PSO2: Acquaint with the contemporary trends in industries and thereby innovate novel solutions to existing problems

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)								
	24BEAC01	Data Structures and Algorithms – I	3	-	3	50	50	100	3
	24BEAC02	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
II	**Core Courses Engineering Sciences (ES)**								
	24BEES21	Object Oriented Programming using Java	3	0/2	3	50	50	100	4
	Core Courses Professional Core (PC)								
	24BEAC03	Foundations of Data Science	3	-	3	50	50	100	3
	24BEAC04	Data Structures and Algorithms – II	3	-	3	50	50	100	3
	24BEAC05	Database Management Systems	3	-	3	50	50	100	3
	24BEAC06	Software Engineering	3	-	3	50	50	100	3
	24BEAC07	Data Structures and Algorithms - II Laboratory	-	0/3	3	50	50	100	1
	24BEAC08	Database Management Systems Laboratory	-	0/3	3	50	50	100	1
IV	**Non-Credit Mandatory Courses (NCMC)**								
	24BEMC03	Consumer Affairs	3	-	2	100	-	100	Remark
	24BEOV01	Value Added Course-Computer Animation	2	-	-	100	-	100	Remark
Fourth Semester									
II	**Basic Sciences (BS)**								
	24BESM09	Mathematics-IV (Linear Algebra and Queueing Theory)	3	1/0	3	50	50	100	4
	Core Courses Professional Core (PC)								
III	24BEAC09	Operating Systems	3	-	3	50	50	100	3
	24BEAC10	Artificial Intelligence	3	-	3	50	50	100	3
	24BEAC11	Computer Networks	3	0/2	3	50	50	100	4
	24BEAC12	Design and Analysis of Algorithms	3	-	3	50	50	100	3
	24BEAC13	Exploratory Data Analysis	3	-	3	50	50	100	3
	24BEAC14	Operating Systems Laboratory	-	0/3	3	50	50	100	1
	24BEAC15	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 or 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)**								
	24BEAC16	Computer Vision and Image Processing	3	-	3	50	50	100	3
	24BEAC17	Web Programming for AI	3	-	3	50	50	100	3
	24BEAC18	R for Data Science	3	-	3	50	50	100	3
	24BEAC19	Theory of Computation	3	-	3	50	50	100	3
	24BEAC20	Big Data Mining	3	-	3	50	50	100	3
	24BEAC21	Web Programming for AI Laboratory	-	0/3	3	50	50	100	1
	24BEAC22	Big Data Mining Laboratory	-	0/3	3	50	50	100	1
	Professional Electives (PE)								
		Professional Elective-I (PE1/PE2)	3	-	3	50	50	100	3
IV	**Non-Credit Mandatory Courses (NCMC)**								
	24BEMC05	Design Thinking	1	0/2	2	100	-	100	Remark
	24BESS01	Soft Skills	2	-	2	100	-	100	Remark

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

PE1:	**PE2:**
24BEAE01 Knowledge Representations and Reasoning	24BEAE21 Artificial Neural Networks
24BEAE02 Cognitive Computing	24BEAE22 Cryptography and Network Security
24BEAE03 Business Intelligence and Analytics	24BEAE23 Quantum Computing
24BEAE04 Robotics	24BEAE24 Soft Computing in Data Science

Part	Course Code	Name of Course/Component	Hours of Instruction/week		Scheme of Examination				
			Theory	Tutorial/ Practical	Duration of exam	CIA	CE	Total	Credits
Sixth Semester									
III	**Core Courses Professional Core (PC)**								
	24BEAC23	Data Analytics and Data Visualization	3	-	3	50	50	100	3
	24BEAC24	Machine Learning	3	-	3	50	50	100	3
	24BEAC25	Natural Language Processing	3	-	3	50	50	100	3
	24BEAC26	Speech Processing and Analytics	3	-	3	50	50	100	3
	24BEAC27	Data Analytics and Data Visualization Laboratory	-	0/3	3	50	50	100	1
	24BEAC28	Machine Learning Laboratory	-	0/3	3	50	50	100	1
	24BEAC29	Mini Project	-	0/4	-	100	-	100	2
	Professional Electives (PE)								
		Professional Elective-II (PE1/PE2)	3	-	3	50	50	100	3
	24BEAE40-24BEAE59	Professional Elective-III (PE1/PE2) Title of MOOC (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 or 8 weeks Industrial Internship during summer vacation

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

PE1:	**PE2:**
24BEAE05 Regression Modelling	24BEAE25 Recommender Systems
24BEAE06 Predictive Analytics	24BEAE26 Mobile Application Development
24BEAE07 Streaming Data Analytics	24BEAE27 Cloud Computing and Virtualization
24BEAE08 Generative AI	24BEAE28 Internet of Things and Applications

Professional Elective-III

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

Part	Course Code	Name of Course/Component	Hours of Instruction/week		Scheme of Examination				
			Theory	Tutorial/ Practical	Duration of exam	CIA	CE	Total	Credits
Seventh Semester									
I	**Humanities and Social Sciences (HS)**								
	24BEHS08	Engineering Economics	3	-	3	50	50	100	3
III	**Core Courses Professional Core (PC)**								
	24BEAC30	Deep Learning	3	-	3	50	50	100	3
	24BEAC31	Deep Learning Laboratory	-	0/3	3	50	50	100	1
	24BEAC32	Industrial Internship[#]	-	-	3	100	-	100	2
	24BEAC33	Project Work - Phase I	-	0/4	-	100	-	100	2
	Professional Electives (PE)								
		Professional Elective - IV (PE1 or PE2)	3	-	3	50	50	100	3
	24BEAE60 - 24BEAE79	Professional Elective-V (PE1 or PE2) Title of MOOC(SWAYAM-NPTEL)[##]	3	-	3	-	-	100	3
	Open Electives (OE)								
	24BEBO01/ 24BEVO01/ 24BELO01/ 24BEFO01/ 24BEPO01/	Open Elective – I	3	-	3	50	50	100	3
IV	**Non-Credit Mandatory Courses (NCMC)**								
	24BEMC07	Disaster Management	3	-	-	100	-	100	Remark
	24BEMA01	Artificial Intelligence and Data Science(CBT)	-	-	2	100	-	100	Remark

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

PE1:	**PE2:**
24BEAE09 Responsible AI	24BEAE29 Text and Speech Analysis
24BEAE10 Robotics and Intelligent Systems	24BEAE30 Artificial Intelligence in Cyber Security
24BEAE11 Reinforcement Learning	24BEAE31 Block Chain Technology
24BEAE12 Intelligent Multi Agent and Expert Systems	24BEAE32 Text, Web and Social Media Analytics

Professional Elective-V

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

Open Elective - I

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

Eighth Semester									
III	**Core Courses Professional Core (PC)**								
	24BEAC34	Project Work - Phase II	-	0/20	-	100	100	200	10
	Open Electives (OE)								
	24BEBO02/ 24BEVO02/ 24BELO02/ 24BEFO02/ 24BEPO02/	Open Elective- II	3	-	3	50	50	100	3
	24BEBO03/ 24BEVO03/ 24BELO03/ 24BEFO03/ 24BEPO03/	Open Elective- III	3	-	3	50	50	100	3
								Total Credits	**165**

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

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/ 24EVBNC1-2/ 24EVBSP 1-2	NSS I & II / NCC I & II / Sports I & II (Representing the Institute)	-	Remark
Value Based Elective- II				
6	24EVBAP1/ 24EVBGP1/ 24EVBWS1/ 24BSCGA1/ 24BSCQA1/	Principles of Dr. Ambedkar's Philosophy/ Gandhian Philosophy/ Women Empowerment Perspective in the Current Scenario/ General Awareness/ Quantitative Aptitude/	Varied duration	Remark
D. Computer Based Test (CBT)				
7	24BEMA01	Artificial Intelligence and Data Science	-	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, Elective III & Elective V (- with credit transfer).
4. # 6 to 8 weeks Industrial Internship during 4^{th} and/or 6^{th} semester during summer vacation.

List of Professional Electives (PE1) Artificial Intelligence and Machine Learning Domain

Part	*Semester*	*Course Code*	*Name of Course/component*
III	**V *Semester* Professional Elective I**	24BEAE01	Knowledge Representations and Reasoning
		24BEAE02	Cognitive Computing
		24BEAE03	Business Intelligence and Analytics
		24BEAE04	Robotics
	VI *Semester* Professional Elective II	24BEAE05	Regression Modelling
		24BEAE06	Predictive Analytics
		24BEAE07	Streaming Data Analytics
		24BEAE08	Generative AI
	VI *Semester* Professional Elective III	24BEAE40/ 24BEAE41/ - 24BEAE49	**## MOOC (12 Weeks Course in SWAYAM-NPTEL)**
	VII *Semester* Professional Elective IV	24BEAE09	Responsible AI
		24BEAE10	Robotics and Intelligent Systems
		24BEAE11	Reinforcement Learning
		24BEAE12	Intelligent Multi Agent and Expert Systems
	VII *Semester* Professional Elective V	24BEAE60/ 24BEAE61/ - 24BEAE69	**## MOOC (12 Weeks Course in SWAYAM-NPTEL)**

List of Professional Electives (PE2) Design, Security, Data Science Domain

Part	*Semester*	*Course Code*	*Name of Course/component*
III	**V *Semester* Professional Elective I**	24BEAE21	Artificial Neural Networks
		24BEAE22	Cryptography and Network Security
		24BEAE23	Quantum Computing
		24BEAE24	Soft Computing in Data Science
	VI *Semester* Professional Elective II	24BEAE25	Recommender Systems
		24BEAE26	Mobile Application Development
		24BEAE27	Cloud Computing and Virtualization
		24BEAE28	Internet of Things and Applications
	VI *Semester* Professional Elective III	24BEAE50/ 24BEAE51/ - 24BEAE59	**## MOOC (12 Weeks Course in SWAYAM-NPTEL)**
	VII *Semester* Professional Elective IV	24BEAE29	Text and Speech Analysis
		24BEAE30	Artificial Intelligence in Cyber Security
		24BEAE31	Block Chain Technology
		24BEAE32	Text, Web and Social Media Analytics
	VII *Semester* Professional Elective V	24BEAE70/ 24BEAE71/ - 24BEAE79	**## MOOC (12 Weeks Course in SWAYAM-NPTEL)**

Open Electives offered by the Department

Part	*Semester*	*Course code*	*Name of the 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 (Machine Learning) (OPTIONAL)

Part	Semester	Course Code	Name of Course/component
III	**V Semester**	24BEAH01	Wearable Computing
		24BEAH02	Sentiment Analysis
	VI Semester	24BEAH03	Virtual and Augmented Reality
		24BEAH04	Text Analytics
	To be completed between 5th to 7th semesters	24BEAH51/ 24BEAH52/ - 24BEAH60	**MOOC (12 Weeks Course in SWAYAM – NPTEL)**
		24BEAH61/ 24BEAH62/ - 24BEAH70	**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**

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)

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, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club funds. Generate pay slips for the employees with their gross and net salary.
4. Write a program for the following using inheritances:
   a) Finding area of sphere using single inheritance.
   b) Calculating performance of the students using multi-level inheritance.
   c) Students' information manipulation using hierarchical inheritance.
5. Write a program for calculating area of rectangle and triangle using interface.
6. Write a program for employee management using packages.
7. Write a program to implement exception handling and creation of user defined exceptions.
8. Write a program for manipulating strings.
9. Develop applications to demonstrate the features of generics classes.
10. Develop applications using JavaFX controls, layouts and menus.

Total Hours: 30

References:

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

Foundations of Data Science

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

Course Code: 24BEAC03 **No. of credits: 3**

Course Learning Objectives (CLOs):

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

UNIT - I Introduction 9

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

UNIT - II Data Preprocessing 9

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

UNIT - III Python Libraries for Data Wrangling 9

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

UNIT - IV Data Visualization 9

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

UNIT - V Text Analysis 9

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

Total Hours: **45**

References:

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

Course Outcomes:

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

CO1: Explain the principles and purposes of data science, and articulate the different dimensions of the area.

CO2: Explore the various data pre-processing and manipulation techniques including various distributed analysis paradigms.

CO3: Use the Python libraries for Data Wrangling.

CO4: Apply tools and techniques to visualize large-scale data.

CO5: Analyse the filtering and clustering techniques on text data.

CO - PO MAPPING

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

Data Structures and Algorithms – II

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

Course Code: 24BEAC04 **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. 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.
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	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

Database Management Systems

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

Course Code: 24BEAC05 **No. of credits: 3**

Course Learning Objectives (CLOs):

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

UNIT - I Relational Databases **9**

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

UNIT - II Relational Data Model **9**

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

UNIT - III Transactions **9**

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

UNIT - IV Implementation Techniques **9**

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

UNIT - V NoSQL Database **9**

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

Total Hours: **45**

References:

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

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

3 Raghu Ramakrishnan, Johannes Gehrke. (2013). *Database Management Systems*. Tata Mc Graw 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: 24BEAC06 **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 and 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: 24BEAC07 **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 Red Black Tree
6. Construct a B-Tree of order 3 by inserting numbers of given data
7. Implementation of Breadth First Search and Depth First Search
8. Implementation of Dijkstra's Algorithm
9. Implementation of Prim's and Kruskal's Algorithm
10. Implementation of Hashing Techniques
11. Implementation of Heap sort
12. Implement Collision Resolution techniques

Total Hours: **45**

Software Requirements:

Turbo C, Python and Java

References:

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

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

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

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

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

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

7 www.nptel.ac.in

Course Outcomes:

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

CO1: Implement 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: 24BEAC08 **No. of credits: 1**

Course Learning Objectives (CLOs):

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 correlated 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	-

Mathematics-IV (Linear Algebra and Queueing Theory)

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*. McGraw 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: 24BEAC09 **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: Examine the secondary storage structure and different operating systems.

CO - PO MAPPING

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

Artificial Intelligence

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

Course Code: 24BEAC10 **No. of credits: 3**

Course Learning Objectives (CLOs):

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

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

UNIT - I AI Foundation and Intelligent Agents 9

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

UNIT - II Search Methods and Optimization Techniques 9

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

UNIT - III Backtracking and Knowledge Representation 9

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

UNIT - IV Planning and Reasoning 9

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

UNIT - V Learning and AI Applications 9

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

Total Hours: **45**

References:

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

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

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

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

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

Course Outcomes:

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

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

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

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

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

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

CO - PO MAPPING

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

Computer Networks

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

Course Code: 24BEAC11 **No. of credits: 4**

Course Learning Objectives (CLOs):

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

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

UNIT - I Introduction to Computer Networks 9

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

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

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

UNIT - III Network Layer 9

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

UNIT - IV Transport Layer 9

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

UNIT - V Application Layer 9

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

Total Hours: **45**

List of Experiments

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

30 Hours

References:

1. Tanenbaum. (2013). *Computer Networks*, Pearson Education, 5th Edition.
2. William Stallings. (2013). *Data and computer communications.* Pearson Education India.
3. Behrouz A Forouzan, Firouz Mosharraf. (2011). *Computer Networks A Top- Down Approach.* McGraw Hill Education.
4. M.Dave. (2012). *Computer Networks.* Centage learning.

Course Outcomes:

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

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

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

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

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

CO5: Examine the functionalities of application layer protocols.

CO - PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	-	-	-	-	1	2	-	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: 24BEAC12 **No. of credits: 3**

Course Learning Objectives (CLOs):

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

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

UNIT - I Introduction 9

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

UNIT - II Brute Force and Divide and Conquer Methods 9

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

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

UNIT - III Dynamic Programming and Greedy Methods 9

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

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

UNIT - IV Backtracking, Branch and Bound Methods 9

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

UNIT - V NP-Complete and Approximation Algorithm 9

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

Total Hours: **45**

References:

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

2 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, UmeshVazirani. (2006). *Algorithm*s. 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 Exampl*es. 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 algorithms 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

Exploratory Data Analysis

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

Course Code: 24BEAC13 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To familiarize an overview of exploratory data analysis

CLO2: To use Data exploration and visualization techniques for multivariate and time series data

UNIT - I Exploratory Data Analysis 9

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.

UNIT - II EDA Using Python 9

Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.

UNIT - III Univariate Analysis 9

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality

UNIT - IV Bivariate Analysis 9

Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines.

UNIT - V Multivariate And Time Series Analysis 9

Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling

Total Hours: **45**

References:

1 Suresh Kumar Mukhiya, Usman Ahmed. (2020). *Hands-On Exploratory Data Analysis with Python.* Packt Publishing.

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

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

4 Claus O. Wilke. (2019). *Fundamentals of Data Visualization*. O'reilly publications.

Course Outcomes:

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

CO1: Explain the concept of exploratory data analysis and its related terminologies

CO2: Implement the data visualization using Matplotlib

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

Operating Systems Laboratory

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

Course Code: 24BEAC14 **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: 24BEAC15 **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.* Create Space 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

Computer Vision and Image Processing

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

Course Code: 24BEAC16 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To familiarize the fundamental concepts of computer vision and image processing
CLO2: To analyse the image processing and computer vision techniques to solve complex image analysis problems.

UNIT - I Computer Vision and Image Formation 9

Introduction to Computer Vision and Basic Concepts of Image Formation – Introduction and Goals of Computer Vision – Image Formation and Radiometry – Geometric Transformation – Geometric Camera Models – Image Reconstruction from a Series of Projections

UNIT - II Image Processing Concepts 9

Fundamentals of Image Processing – Image Transforms – Image Filtering – Colour Image Processing – Mathematical Morphology – Image Segmentation

UNIT - III Image Descriptors and Features 9

Texture Descriptors – Colour Features – Edge Detection – Object Boundary and Shape Representations – Interest or Corner Point Detectors – Histogram of Oriented Gradients (HOG) – Scale Invariant Feature Transform (SIFT) – Speeded up Robust Features (SURF) – Saliency

UNIT - IV Fundamental Pattern Recognition 9

Introduction to Pattern Recognition – Linear Regression–Basic Concepts of Decision Functions – Elementary Statistical Decision Theory – Gaussian Classifier – Parameter Estimation – Clustering for Knowledge Representation – Dimension Reduction – Template Matching – Artificial Neural Network (ANN) for Pattern Classification–Convolutional Neural Networks (CNNs)–Autoencoder

UNIT - V Applications of Computer Vision 9

Machine Learning Algorithms and their Applications in Medical Image Segmentation – Motion Estimation and Object Tracking – Face and Facial Expression Recognition – Gesture Recognition – Image Fusion – Programming Examples

Total Hours: **45**

References:

1 Manas Kamal Bhuyan. (2020).*Computer Vision and Image Processing Fundamentals and Applications*. CRC Press.1st Edition.

2 S. Nagabhushana. (2005). *Computer Vision and Image Processing*. New Age International Pvt Ltd, 1st Edition

3 Mark Nixon and Alberto S. Aquado. (2012). *Feature Extraction & Image Processing for Computer Vision*. Academic Press.3rd Edition

Course Outcomes:

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

CO1: Discuss the deep understanding of image formation and image processing principles

CO2: Identify various image processing concepts and techniques.

CO3: Assess the impact of different feature selection and combination strategies on the overall performance of image processing systems.

CO4: Identify and analyze the common pattern recognition applications in various fields, such as image recognition, speech recognition, and bioinformatics.

CO5: Analyze the performance of computer vision models based on metrics such as accuracy, precision, recall, and F1-score.

CO - PO MAPPING

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

Web Programming for AI

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

Course Code: 24BEAC17 **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 and aside Elements – nav and a 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 – 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

R for Data Science

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

Course Code: 24BEAC18 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To understand the concepts of R programming
CLO2: To compare Graphics features and apply object-oriented concepts for real-world applications.

UNIT - I Introduction to R **9**

Introduction to Functions – Some important R Data Structures – Help functions in R– Vectors – Scalars – Vectors – Arrays – Matrices – Declarations – recycling – Common Vector operations – Using all and any – Vectorised operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element names

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

Creating matrices, General Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists –Creating lists – General list operations – accessing list components and values – applying functions to lists – recursive lists – Data Frames – Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames.

UNIT - III R Programming structures **9**

Control statements – Arithmetic and Boolean operators and values – Default values for arguments, return values – Functions are objects – Environment and Scope issues – Writing Upstairs – Recursion – Replacement functions – Tools for composing function code – Math and Simulations in R – Math functions – functions for statistical Distributions – Sorting – Linear Algebra operations – Set operations – simulation programming in R.

UNIT - IV Object-Oriented Programming **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 R Graphics **9**

Base graphics – ggplot2 – Lattice – Interactive graphics – Exporting graphics – Customization – Integration with other packages – Case study

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

Theory of Computation

Semester: V **Hours of Instruction/week: 3T**
Course Code: 24BEAC19 **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. 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 and 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

Big Data Mining

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

Course Code: 24BEAC20 **No. of credits: 3**

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, JianPei.(2011).*Data Mining Concepts and Techniques.* Morgan Kaufman Publications. 3rd Edition.

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, students 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 item set 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

Web Programming for AI Laboratory

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

Course Code: 24BEAC21 **No. of credits: 1**

Course Learning Objective (CLO):

CLO1: To 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-Textarea Controls - Pull-
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

Big Data Mining Laboratory

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

Course Code: 24BEAC22 **No. of credits: 1**

Course Learning Objective (CLO):

CLO1: To impart the knowledge on various data mining concepts and techniques that can be applied to text mining, web mining etc.

List of Experiments

1. Introduction to exploratory data analysis using R.
2. Demonstrate the Descriptive Statistics for a sample data like mean, median, variance and correlation etc.,
3. Demonstrate Missing value analysis using sample data
4. Demo of Apriori algorithm on various data sets with varying confidence and support.
5. Demo of FP Growth algorithm on various data sets with varying confidence and support.
6. Demo on Classification Techniques such as Decision Tree (ID3 / CART), Bayesian etc., and using sample data.
7. Demonstration of Clustering Techniques K-Medoid.
8. Demonstration of Clustering Techniques Hierarchical.
9. Demonstration on Document Similarity Techniques and measurements.
10. Simulation of Page Rank Algorithm.
11. Demonstration on Hubs and Authorities.
12. Mini Project

Total Hours: 45

Software Requirements:

R,Weka

References:

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman. (2014).*Mining of Massive Datasets*.Cambridge University Press. 2nd Edition.
2. Ian H.Witten, Eibe Frank. (2011).*Data Mining – Practical Machine Learning Tools and Techniques*. Morgan Kaufman Publications. 3rd Edition.
3. Jiawei Han and Micheline Kamber. (2013).*Data Mining: Concepts and Techniques*, Morgan Kaufmann Publishers. 3rd edition.
4. https://www.rdatamining.com/
5. EMC Education Services. (2015). *Data Science and Big Data Analytics: Discovering- Analyzing- Visualizing and Presenting Data.* Wiley.

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

CO1: Interpret the contribution of data warehousing and data mining to the decision support systems.

CO2: Construct the data needed for data mining using preprocessing techniques

CO3: Discover interesting patterns from large amounts of data using Association Rule Mining

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	3	3	2	3	-	-	-	3	2	2	2
CO3	3	3	2	3	3	-	-	-	3	3	2	2

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

Data Analytics and Data Visualization

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

Course Code: 24BEAC23 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To provide fundamental knowledge on analytics with R programming. .

CLO2: To acquire fundamental knowledge of various techniques of analysis of the data along with mining and Business Analytics

UNIT - I Introduction to Analytics **9**

Analytics life cycle Business analytics – lending analytics – recommendation analytics – Healthcare Analytics – financial analytics – sports analytics – Data Analytics: Introduction to Tools and Environment – Application of Modeling in Business – Databases – Types of Data and variables – Data Modeling Techniques.

UNIT - II Wholeness of the data **9**

Analytics – important of analytics – Business Intelligence – Pattern Recognition – Data Processing Chain – Business Intelligence Concepts and Applications – BI for Better Decisions – BI Tools – BI Skills – BI Applications – Data Analytics Life Cycle – R – Features of R

UNIT - III Sources of Analytics **9**

Data warehousing Architecture – Data Source – ETL process – Data warehouse Best practices – gathering and selecting the data –data cleansing and preparation – data mining best practices – Types of charts – tips for data visualization.

UNIT - IV Introduction to Data Visualization **9**

Definition – Methodology – Seven Stages of Data Visualization – Data Visualization Tools. Visualizing - Data: Mapping Data onto Aesthetics – Visualizing Amounts – Visualizing Distributions: Histograms and Density Plots – Visualizing Propositions – Visualizing Associations: Among Two or More Quantitative Variables – Visualizing Time Series and Other Functions of an Independent Variable – Trends – Visualizing Geospatial Data.

UNIT - V Visualization with Tableau **9**

Tableau Software Ecosystem – Toolbar Icons – Data Window and Aggregation – Connect to Data – Sorting Data – Measure Names – Number of Records & Measures – Cross-tabulation – Heat Maps – Tree maps – Bar Chart – Line Chart – Pie Chart – Scatter Plot – Histogram – Boxplot.

Total Hours: **45**

1. V Granville. (2014). *Developing Analytic Talent: Becoming a Data Scientist.* John Wiley & Sons.
2. Dan Murray,Christian. (2103). *Chabot Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software.* Wiley.
3. Ben Fry (2008).*Visualizing Data: Exploring and Explaining Data with the Processing Environment.*O'Reilly. 1st Edition.
4. A. Maheshwari. (2015).*Data Analytics made Accessible-Seattle:* Amazon Digital Services.

Course Outcomes:

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

CO1: Interpret Data Analytics fundamentals and Business Intelligence.

CO2: Demonstrate the usage of data warehousing- mining and importance in analytics.

CO3: Applicability of various exploratory data visualization techniques and various interactive methods.

CO4: Identify the tools and techniques used in data visualization.

CO5: Implement the application using Tableau.

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

Machine Learning

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

Course Code: 2 4BEAC24 **No. of credits: 3**

Course Learning Objectives (CLOs):
CLO1: To introduce the fundamental concepts of machine learning and its applications.
CLO2: To understand the methods of solving real life problems using the machine learning techniques

UNIT - I Introduction 9

Machine learning: What and why? – Examples of Machine Learning Applications - Types of Machine Learning Supervised Learning - Machine Learning Process- The Curse of Dimensionality, Overfitting - Training, Testing, and Validation Sets - The Confusion Matrix & Basic Statistics - Bias Variance Tradeoff.

UNIT - II Neurons, Neural Networks and Linear Discriminants 9

Hebb's Rule - Neural Networks - The Perceptron - Linear Separability & Linear Regression. The Multi-layer Perceptron: Biases, Algorithm - Local minima and Stochastic gradient Descent Examples Of Using The MLP : Regression Problem & Classification Example - Deriving Back-Propagation.

UNIT - III Dimensionality Reduction and Evolutionary Models 9

Linear Discriminant Analysis (LDA) - Principal Components Analysis (PCA), Factor Analysis - Independent Components Analysis -Probabilistic Model - Gaussian Mixture Models: EM Algorithm - Nearest Neighbour Methods - Support Vector Machines.

UNIT - IV Learning Techniques 9

Evolutionary Learning - The Genetic Algorithms (GA)- Reinforcement Learning - Decision Trees - Classification And Regression Trees (CART) - Ensemble Learning :Boosting, Bagging, Random Forests - Unsupervised Learning : K-Means – Algorithm - Vector Quantisation.

UNIT - V Graphical Models 9

Bayesian Networks - Markov Random Fields - Hidden Markov Models (HMMS) - Markov Chain Monte Carlo (MCMC) Methods - Deep Belief Networks (DBN)

Total Hours: **45**

References:

1. Stephen Marsland. (2014). Machine Learning – An Algorithmic Perspective. 2nd Edition. Chapman and Hall / CRC Machine Learning and Pattern Recognition Series.
2. Ethem Alpaydin. (2014). Introduction to Machine Learning (Adaptive Computation and Machine Learning Series). MIT Press.3rd Edition
3. William F.Clocksin & Christopher S.Mellish. (2003). Programming in Prolog: Using the ISO Standard. Springer. 5th Edition
4. Gerhard Weiss. (2013). Multi Agent Systems. MIT Press. 2nd Edition
5. David L.Poole & Alan K.Mackworth. (2010). Artificial Intelligence: Foundations of Computational Agents. Cambridge University Press

Course Outcomes:

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

CO1: Acquire the basic concepts of machine learning.

CO2: Acquire the basic concepts of machine learning.

CO3: Choose and apply dimensionality reduction techniques and Evolutionary Models learning algorithms for any given problem

CO4: Apply the appropriate machine learning techniques for any given problem.

CO5: Design a system that uses the appropriate graph models of machine learning

CO - PO MAPPING

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

Natural Language Processing

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

Course Code: 24BEAC25 **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 NLP systems.

UNIT - I Introduction **9**

Speech and Language Processing – Ambiguity – Models and algorithms – Language – Thought – Understanding Regular Expressions – Basic Regular Expression Patterns –Words – Text Normalization – Minimum Edit Distance – Automata – Words and Transducers – Morphology – Finite –State Morphological Parsing – Building A Finite-State Lexicon–Finite State Transducers – FSTS for Morphological Parsing – Combining FST Lexicon And Rules – The Porter Stemmer

UNIT - II Word Level Analysis **9**

N-grams Language – N-grams – Evaluating Language Models – Generalization and Zeros – Smoothing –Kneser-Ney Smoothing –The Web and Stupid Backoff– Perplexity's Relation to Entropy – English Word Classes –The Penn Treebank Part-of-Speech Tagset– Part-of-Speech Tagging – HMM Part-of-Speech Tagging – Maximum Entropy Markov Models

UNIT - III Syntax Analysis **9**

Constituency – Context Free Grammars – Grammar Rules for English –Treebanks– Grammar Equivalence and Normal Form – Lexicalized Grammars –Ambiguity – CKY Parsing: A Dynamic Programming Approach – Partial Parsing – Probabilistic ContextFreeGrammars Dependency Parsing

UNIT - IV Semantic Analysis and Coreference Resolution **9**

Semantic Augmentations to Context Free Grammar Rules – Word Senses and WordNet – Word Sense Disambiguation – Word Sense Induction – Semantic Roles – FrameNet – Semantic Role Labeling – Coreference Phenomena: Linguistic Background – Coreference Tasks and Datasets – Mention Detection – Architectures for Coreference Algorithms

UNIT - V Discourse Analysis and Speech Processing **9**

Discourse Coherence – Discourse Structure Parsing – Centering and Entity Based Coherence – Question Answering –Factoid Question Answering – Classical QA Models – Chatbots and Dialogue systems – Frame-based Dialogue Systems – Dialogue–State Architecture

Total Hours: **45**

References:

1 Daniel Jurafsky, James H. Martin.(2019). *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech*. Pearson Publication.

2 Breck Baldwin. (2015). *Language Processing with Java and Ling Pipe Cookbook*. Atlantic Publisher

3 Richard M Reese. (2015). *Natural Language Processing with Java.* O'Reilly Media.

4 Nitin Indurkhya 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: Analyze the semantic processing tasks, simple document indexing and searching system using the concepts of NLP

CO5: Design the dialogue system and know the discourse model

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

Speech Processing and Analytics

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

Course Code: 24BEAC26 **No. of credits: 3**

Course Learning Objectives (CLOs):

CLO1: To understand the need for morphological processing and their representation
CLO2: To learn about the various representations of semantics and discourse

UNIT - I Speech Processing 9

Phonetics – Articulatory Phonetics -Phonological Categories – Acoustic Phonetics and Signals – Speech Synthesis – Text Normalization – Phonetic and Acoustic Analysis – Diphone Waveform synthesis – Evaluation – Automatic Speech Recognition – Architecture – Hidden Markov Model to Speech – MFCC vectors – Acoustic Likelihood Computation – Evaluation. Triphones – Discriminative Training.

UNIT - II Speech Analysis 9

Features – Feature Extraction and Pattern Comparison Techniques: Speech distortion measures – mathematical and perceptual – Log Spectral Distance – Cepstral Distances – Weighted Cepstral Distances and Filtering – Likelihood Distortions – Spectral Distortion using a Warped Frequency Scale – LPC – PLP and MFCC Coefficients – Time Alignment and Normalization – Dynamic Time Warping – Multiple Time – Alignment Paths.

UNIT - III Speech Modeling 9

Hidden Markov Models: Markov Processes – HMMs – Evaluation, Optimal State Sequence – Viterbi Search – Baum-Welch Parameter Re-estimation – Implementation issues.

UNIT - IV Speech Recognition 9

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-gram – context dependent sub-word units – Applications and present status.

UNIT - V Speech Synthesis 9

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods – sub-word units for TTS – Intelligibility and naturalness – role of prosody – Applications and present status.

Total Hours: **45**

References:

1. Jurafsky and Martin. (2008).*Speech and Language Processing*, Pearson Prentice Hall. 2nd Edition.
2. Ben gold and Nelson Morgan.(2006). *Speech and audio signal processing, processing and perception of speech and music.* Wiley.2nd Edition.
3. Thomas F Quatieri.(2001). *Discrete-Time Speech Signal Processing – Principles and Practice*. Pearson Education.
4. Claudio Becchetti and Lucio Prina Ricotti.(1999). *Speech Recognition*. John Wiley and Sons.
5. Lawrence Rabiner and Biing-Hwang Juang.(2003). *Fundamentals of Speech Recognition*. Pearson Education.
6. Frederick Jelinek.(2022). *Statistical Methods of Speech Recognition*. MIT Press

Course Outcomes:

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

CO1: Identify the different linguistic components of natural language

CO2: Design a morphological analyser for a given natural language

CO3: Decide on the appropriate parsing techniques necessary for a given language and application

CO4: Design new tagset and a tagger for a given natural language

CO5: Design applications involving natural language

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

Data Analytics and Data Visualization Laboratory

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

Course Code: 24BEAC27 **No. of credits: 1**

Course Learning Objective (CLO):
CLO1: To understand the various search methods and visualization techniques.

List of Experiments:

1. Download, Install and Explore the features of Numpy, Scipy, Jupyter, Statsmodels and Panda Packages.
2. Working with Numpy arrays and Panda data frames.
3. Installation of R-Studio on windows.
4. Data input/output and data storage formats using R programs
5. Reading Data From Text Files, Excel and the web and Exploring various commands for analytics on the Iris Data Set.
6. Application to analyse Stock Market Data using R Language.
7. Data Visualization using Pie Chart & Bar Chart Plotting Framework.
8. Data Visualization using Boxplot Chart Plotting Framework.
9. Data Visualization using Histogram Plotting Framework.
10. Data Visualization using Scatterplot & Line Grap Plotting Framework.
11. Application to adjust the Number of Bins in the Histogram using R Language.
12. Graphics and visualization using R programs

Total Hours: **45**

Software Requirements:
Python, MATLAB,R

References:

1 EMC Education Services. (2015). *Data Science and Big Data Analytics: Discovering- Analyzing- Visualizing and Presenting Data*. Wiley.
2 V Granville. (2014). *Developing Analytic Talent: Becoming a Data Scientist*. John Wiley & Sons.
3 Dan Murray,Christian. (2103). *Chabot Tableau Your Data!: Fast and Easy Visual Analysis with Tableau Software*. Wiley.
4 Ben Fry (2008).*Visualizing Data: Exploring and Explaining Data with the Processing Environment.* O'Reilly. 1st Edition.

Course Outcomes:
At the end of the course, students will be able to:
CO1: Identify the implementation procedures Python and R Language.
CO2: Analyze various data set to explore the data.
CO3: Identify the different types of data visualization techniques.

CO-PO MAPPING

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

Machine Learning Laboratory

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

Course Code: 24BEAC28 **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 Matpoltlib by loading dataset in Python.
2. Implement K-nearest Neighbors 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 Neighbours algorithm to classify the iris dataset.
10. Implement Liner Regression with PyTorch.
11. Implement Liner Regression with TensorFlow.
12. Mini Project.

Total Hours: **45**

Software Requirements:
Java, Python, MATLAB

References:

1 Christopher Bishop. (2016). *Pattern Recognition and Machine Learning*. Springer.

2 Ethem Alpaydin. (2014). *Introduction to Machine Learning (Adaptive Computation and Machine Learning Series).* MIT Press.3rd Edition

3 Oliver Theobald. (2017). *Machine Learning with Python: A Practical Beginners' Guide.*

4 Trevor Hastie, Robert Tibshirani & Jerome Friedman. (2013). *The Elements of Statistical Learning*. Springer.

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

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

CO2: Create Python programs for various machine learning algorithms.

CO3: Apply Machine Learning algorithms to solve real world problems

CO-PO MAPPING

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	-	-	-	3	2	2	2
CO2	2	2	3	2	3	-	-	-	3	3	3	2
CO3	2	3	2	2	3	-	-	-	3	3	3	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: 24BEAC30 **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 – Back propagation through time – Bidirectional RNN – Encoder Decoder Sequence-to-Sequence Architectures – Deep recurrent networks – Recursive neural networks – Challenge of long-term dependencies – LSTM and GRU –Attention and the Transformer

UNIT - IV Auto encoders, Representation Learning And Structured Models **9**

Auto encoders (AE) – AE variants – Applications of AE – Representation Learning – Greedy pre-training – Transfer learning and domain adaptation – Structured Probabilistic Models for Deep Learning – Using Graphs to Describe Model Structure – Sampling from Graphical Models – Restricted Boltzmann Machine

UNIT - V Deep Generative Models **9**

Sampling and Monte Carlo Methods – Deep Boltzman Machines —Directed Generative Nets – Variational Autoencoders – Generative Adversarial Networks– Normalizing flow models – Diffusion models – Deep Convolutional GAN

Total Hours: **45**

References:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville. (2017). *Deep Learning*. MIT Press.
2. *Magnus Ekman*. (2021).*Learning Deep Learning.* Addison-Wesley Professional.
3. *Charu C. Aggarwal*. (2018). *Neural Networks and Deep Learning*. Springer.
4. *Adam Gibson, Josh Patterson* (2017). *Deep Learning: A Practitioner's Approach.*OReilly.
5. *Umberto Michelucci*. (2018) .*Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks.* Apress.
6. *Nicholas Locascio and Nikhil Buduma.* (2017). *Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms.* OReilly.
7. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy. (2017). *Deep Learning with TensorFlow: Explore neural networks with Python.* Packt Publisher.

Course Outcomes:

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

CO1: Acquire knowledge 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 Auto encoders, 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: 24BEAC31 **No. of credits: 1**

Course Learning Objective (CLO):

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 Train Simple Perceptron with Gradient Descent for regression
2. Write a program Train MLP with Back propagation for classification
3. Write a program 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:

Python, MATLAB

References:

1 Ian Goodfellow, Yoshua Bengio, Aaron Courville. (2017). *Deep Learning*. MIT Press.

2 François Chollet. (2017). *Deep Learning with Python.* Manning Publications Co

3 Rajiv Chopra (2018). *Deep Learning – A Practical Approach.* Khana Publications

Course Outcomes:

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

CO1: Create a python program to train Perceptron, MLP and CNN for regression and classification.

CO2: Implement Face Recognition, Recommender systems and Time Series Prediction using DL algorithms

CO3: Use GAN for image generation and autoencoders for fake videos generation.

CO - PO MAPPING

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

Knowledge Representations and Reasoning

PE1 **Hours of Instruction/week: 3T**
Semester: V
Course Code: 24BEAE01 **No. of credits: 3**
Prerequisite: Data Structures and Algorithms
Course Learning Objectives (CLOs):

CLO1: To introduce the study of ontologies as a KR paradigm and applications of ontologies.

CLO2: To understand process, knowledge acquisition and sharing of ontology

UNIT - I **Concepts and Logic** **9**

The Key Concepts: Knowledge Representation – Reasoning – Why knowledge representation and Reasoning – Role of logic.

Logic: Historical background – Representing knowledge in logic –Varieties of logic – Name – Type – Measures – Unity Amidst diversity.

UNIT - II **Ontology** **9**

Ontological categories – Philosophical background – Top-level categories – Describing physical entities – Defining abstractions – Sets – Collections – Types and Categories – Space and Time.

UNIT - III **Knowledge Representations** **9**

Knowledge Engineering – Representing structure in frames – Rules and data – Object-oriented systems – Natural language Semantics – Levels of representation.

UNIT - IV **Processes and Contexts** **9**

Processes: Times – Events and Situations – Classification of processes – Procedures – Processes and Histories – Concurrent processes – Computation – Constraint satisfaction – Change.

Contexts: Syntax of contexts – Semantics of contexts – First-order reasoning in contexts – Modal reasoning in contexts – Encapsulating objects in contexts.

UNIT - V **Knowledge Soup,Knowledge Acquisition and Sharing** **9**

Knowledge Soup: Vagueness – Uncertainty – Randomness and Ignorance – Limitations of logic – Fuzzy logic – Non monotonic Logic –Theories – Models and the world – Semiotics.

Knowledge Acquisition and Sharing: Sharing Ontologies – Conceptual schema – Accommodating multiple paradigms – Relating different knowledge representations – Language patterns –Tools for knowledge acquisition.

Total Hours: **45**

References:

1. John F. Sowa.(1999*).Knowledge Representation logical,Philosophical, and Computational Foundations* .Course Technology Inc.
2. Hector J. Levesque, Ronald J. Brachman. (2004).*Knowledge Representation and Reasoning*.Morgan Kaufmann Publishers In.

Course Outcomes:

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

CO1: Identify the knowledge based systems intended for computer implementation.

CO2: Illustrate and acquire theoretical knowledge about principles for logic-based representation and reasoning

CO3: Demonstrate and explore the knowledge-engineering process in knowledge representation

CO4: Apply knowledge to design and implement context-aware systems and solve complex computational problems

CO5: Analyze the knowledge soup concepts and their application in representing interconnected knowledge domains.

CO - PO MAPPING

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

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Cognitive Computing

PE1 **Hours of Instruction/week: 3T**

Semester: V

Course Code: 24BEAE02 **No. of credits: 3**

Prerequisite: Artificial Intelligence

Course Learning Objectives (CLOs):

CLO1: To learn the new model or paradigm for application development using cognitive computing.
CLO2: To identify and evaluate patterns and complex relationships in large and unstructured data sets.

UNIT - I **Foundations of Cognitive Computing** **9**

Cognitive computing as new generation – Uses of cognitive systems – What makes system cognitive – Gaining insights from data – Artificial intelligence – The foundation – Understanding cognition – Understanding complex relationships – The elements of cognitive systems.

UNIT - II **Design Principles of Cognitive Systems** **9**

Components of cognitive systems – Building the Corpus – Bringing data into the cognitive system – Machine learning – Hypothesis generation and scoring – Presentation and visualization services.

UNIT - III **Natural Language Processing-Support of Cognitive System** **9**

The role of NLP in a cognitive system – Understanding linguistics – Phonology – morphology – lexical analysis – syntax and syntactic analysis – importance of Hidden Markov models – Semantic Web – Applying natural language technologies to business problems – Enhancing shopping experience – fraud detection.

UNIT - IV **Watson as a Cognitive System** **9**

Watson defined – Advancing research with a "Grand Challenge" – Preparing Watson for jeopardy – commercial applications – components of deepQA architecture – Question analysis – hypothesis generation – scoring and confidence generation.

UNIT - V **CASE STUDIES** **9**

Cognitive Systems in health care – Cognitive Assistant for visually impaired AI for cancer detection – Predictive Analytics –Text Analytics – Image Analytics – Speech Analytics – IBM Watson – Introduction to IBM's PowerAI Platform – Introduction to Google's Tensor flow Development Environment.

Total Hours: **45**

References:

1. Judith Hurwitz, Marcia Kaufman, Adrian Bowles.(2015).*Cognitive Computing and Big Data* Analytics. Wiley.
2. Kai Hwang. (2017).*Cloud Computing for Machine Learning and Cognitive Application.* Wiley.

Course Outcomes:

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

CO1: Explain the concepts of cognitive computing and how it differs from traditional Approaches.

CO2: Analyze the business implications of cognitive computing.

CO3: Apply natural language technologies to business problems.

CO4: Develop applications for Watson.

CO5: Solve the case studies of cognitive computing.

CO - PO MAPPING

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

Business Intelligence and Analytics

PE1 **Hours of Instruction/week: 3T**
Semester: V
Course Code:24BEAE03 **No. of credits: 3**

Prerequisite: Theory of Computation

Course Learning Objectives (CLOs):

CLO1: To learn the Business Intelligence, Analytics, Decision Support system and list the technologies for Decision making, Automated decision systems.

CLO2: Illustrate sentiment analysis techniques, Multi-criteria Decision making systems and predictive modelling techniques.

UNIT - I An Overview of Business Intelligence, Analytics and Decision Support 9

Information Systems Support for Decision Making – An Early Framework for Computerized Decision Support –The Concept of Decision Support Systems – A Framework for Business Intelligence –Business Analytics Overview – Introduction to Big Data Analytics.

UNIT - II DecisionMaking 9

Introduction and Definitions – Phases of the Decision – Making Process –The Intelligence Phase – Design Phase – Choice Phase – Implementation Phase – Decision Support Systems Capabilities – Decision Support Systems Classification – Decision Support Systems Components.

UNIT - III Neural Networks and Sentiment Analysis 9

Basic Concepts of Neural Networks – Developing Neural Network – Based Systems – Illuminating the Black Box of ANN with Sensitivity – Support Vector Machines A Process Based Approach to the Use of SVM – Nearest Neighbour Method for Prediction – Sentiment Analysis Overview – Sentiment Analysis Applications – Sentiment Analysis Process –Sentiment Analysis – Speech Analytics.

UNIT - IV Model-Based Decision Making 9

Decision Support Systems modelling – Structure of mathematical models for decision support – Certainty – Uncertaintyand Risk – Decision modelling with spread sheets – Mathematical programming optimization – Decision Analysis with Decision Tables and Decision Trees – Multi-Criteria Decision Making with Pairwise Comparisons.

UNIT - V Automated Decision Systems and Expert Systems 9

Automated Decision Systems – The Artificial Intelligence field – Basic concepts of Expert Systems – Applications of Expert Systems – Structure of Expert Systems – Knowledge Engineering – Development of Expert Systems.

Total Hours: **45**

References:

1. Edward Mize. (2017).*The Ultimate Beginner's Guide to Data Analytics*. Paperback.
2. Ramesh Sharda, Dursun Delen, Efraim Turban,J.E.Aronson,Ting-Peng Liang,David King.(2013).*Business Intelligence and Analytics: System for Decision Support.* 10th Edition. Pearson Global Edition.

Course Outcomes:

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

CO1: Gain knowledge in concepts and components of business intelligence, analytics, and decision support.

CO2: Demonstrate an impact of decision making and the decision-making process.

CO3: Apply Neural Networksto solve binary, multi-class classification problemsand sentiment analysis techniques.

CO4: Evaluate the performance of models and decision support systems in real-world scenarios.

CO5: Analyze the impact of automated decision systems and expert systems on organizational performance and decision-making processes.

CO - PO MAPPING

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

Robotics

PE1 **Hours of Instruction/week: 3T**
Semester: V
Course Code: 24BEAE04 **No. of credits: 3**

Prerequisite: Artificial Intelligence

Course Learning Objectives (CLOs):

CLO1: To learn the concepts of Robotic system, its components and control related to robotics.
CLO2: To identify different sensors and their applications of robot.

UNIT - I Introduction 9

Robot anatomy – Definition – Law of robotics – History and Terminology of Robotics Accuracy and repeatability of Robotics – Simple problems Specifications of Robot – Speed of Robot – Robot joints and links – Robot classifications – End Effectors – Architecture of robotic systems Robot Drive systems Hydraulic – Pneumatic and Electric system.

UNIT - II Sensors 9

Proximity sensor (Range sensor) – Tactile sensor (Contact sensor) – Current sensor – Tilt sensors – Gyroscope – Encoders – Hall effect sensors – Temperature sensor – Acceleration sensor – Image sensor – Camera –Touch sensors – Range sensors – Robotic vision sensor – Force sensor and Light sensors.

UNIT - III Robot Drives, Actuators and Control 9

Functions of Drive Systems – Interfacing of Relay – Solenoid – Pneumatic – Hydraulic actuator basics – Programming for control – Motor driver and speed control – PWM.

UNIT - IV Robot Cell Design 9

Robot work cell design and control – Sequence control – Operator interface – Safety monitoring devices in Robot – Mobile robot working principle.

UNIT - V Industrial Robotics and Applications 9

Introduction to different systems in Industrial Robotics – Automation – Introduction to PLC and SCADA – Robot applications Material handling – Machine loading and unloading – Assembly – Inspection –Welding – Spray painting and undersea robot.

Total Hours: **45**

References:

1. S.R. Deb. (2010). *Robotics Technology and Flexible Automation*. Tata McGraw-Hill Education. 2nd Edition
2. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta.(2012).*Industrial Robotics- Technology Programming and Applications*.McGraw Hill.

Course Outcomes:

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

CO1: Discuss a comprehensive understanding of the anatomy, history, and terminology of robotics.
CO2: Identify and evaluate the appropriate sensor types for specific robotic and electronic applications based on their characteristics and requirements.
CO3: Analyze the characteristics and performance metrics of various types of robot drives and actuators used in robotics.
CO4: Explore emerging technologies such as artificial intelligence and machine learning in robot cell design.
CO5: Apply principles of system integration to address real-world challenges in robotics applications.

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

Artificial Neural Networks

PE 2 **Hours of Instruction/week: 3T**
Semester: V
Course Code:24BEAE21 **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, student 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

Cryptography and Network Security

PE2

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

Course Code: 24BEAE22 **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. (2003).*Cryptography And Network Security – Principles and Practices.* Pearson Education. 3rd Edition.
2. Behrouz A. Foruzan.(2007). *Cryptography and Network Security*. Tata McGraw-Hill.
3. Atul Kahate.(2003). *Cryptography and Network Security.* Tata McGraw-Hill.
4. https://nptel.ac.in/courses/106105031/

Course Outcomes:

At the end of the course, student 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	2	2	-	-	-	-	-	-	1	1	-	1
CO2	2	2	-	-	-	-	-	-	2	2	-	2
CO3	2	3	3	2	-	-	-	-	1	1	-	2
CO4	2	2	2	1	-	-	-	-	2	2	-	2
CO5	3	2	3	2	-	-	-	-	2	2	-	2

Quantum Computing

PE2 **Hours of Instruction/week: 3T**
Semester: V
Course Code: 24BEAE23 **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: super dense 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, student will be able to:

CO1: Illustrate the fundamental concepts of quantum computing and explore the super dense 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 inpractical 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

Soft Computing in Data Science

PE2

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

Course Code: 24BEAE24 **No. of credits: 3**

Prerequisite: Foundations of Data Science

Course Learning Objectives (CLOs):

CLO1: To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience, provide optimization associated with neural network learning and learn various evolutionary Algorithms.

CLO2: To become familiar with neural networks introduce case studies utilizing the above and illustrate the Intelligent behaviour of programs based on soft computing.

UNIT - I Introduction To Soft Computing And Fuzzy Logic 9

Introduction – Fuzzy Logic – Fuzzy Sets – Fuzzy Membership Functions – Operations on Fuzzy Sets – Fuzzy Relations – Operations on Fuzzy Relations – Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems.

UNIT - II Neural Networks 9

Supervised Learning Neural Networks –Perceptrons – Backpropagation – Multilayer Perceptrons – Unsupervised Learning Neural Networks – Kohonen Self-Organizing Networks.

UNIT - III Genetic Algorithms 9

Chromosome Encoding Schemes – Population initialization and selection methods – Evaluation function – Genetic operators – Cross over – Mutation – Fitness Function – Maximizing function.

UNIT - IV Neuro Fuzzy Modeling 9

ANFIS architecture – Hybrid learning – ANFIS as universal approximator – Coactive Neuro fuzzy modeling – Framework – Neuron functions for adaptive networks – Neuro fuzzy spectrum – Analysis of Adaptive Learning Capability.

UNIT - V Applications 9

Modeling a two input sine function – Printed Character Recognition – Fuzzy filtered neural networks – Plasma Spectrum Analysis – Hand written neural recognition – Soft Computing for Color Recipe Prediction.

Total Hours: **45**

References:

1 rojKaushik and Sunita Tiwari.(2018).*Soft Computing-Fundamentals Techniques and Applications.*1st Edition. McGraw Hill

2 With Case Studies and Applications from the Industry (2020).Apress.

3 S.N. Sivanandam, S.N. Deepa.(2019).*Principles of Soft Computing*.3rd Edition. Wiley India Pvt Ltd.

4 SaJANG, J.-S. R., SUN, C.-T., & MIZUTANI, E.(1997). *Neuro-fuzzy and soft computing: A computational approach to learning and machine intelligence*. Upper Saddle River. NJ. Prentice Hall.

Course Outcomes:

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

CO1: Discuss the fundamentals of fuzzy logic operators and inference mechanisms.

CO2: Identify neural network architecture for AI applications such as classification and clustering.

CO3: Learn the functionality of Genetic Algorithms in Optimization problems.

CO4: Use hybrid techniques involving Neural networks and Fuzzy logic.

CO5: Apply soft computing techniques 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	-	-	-	-	1	1	-	2
CO2	2	3	3	2	-	-	-	-	1	2	-	2
CO3	2	3	2	2	1	-	-	-	1	1	-	2
CO4	2	2	1	3	2	-	-	-	2	2	-	1
CO5	3	3	2	2	1	-	-	-	2	2	-	2

Regression Modelling

PE1 **Hours of Instruction/week: 3T**
Semester: VI
Course Code: 24BEAE05 **No. of credits: 3**

Prerequisite: Machine Learning

Course Learning Objectives:

CLO1: To aassess the relationship between variables in a data set and a continuous response variable.
CLO2: To 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.

Total Hours: **45**

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 identify unique 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: Describe the 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	2	2	3	2	2	-	-	-	1	1	1
CO4	3	2	2	3	2	1	-	1	1	1	1	2
CO5	2	3	2	2	2	1	3	1	3	1	2	3

Predictive Analytics

PE1
Semester: VI
Course Code: 24BEAE06

Hours of Instruction/week: 3T
No. of credits: 3

Prerequisite: Machine Learning

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 Non stationary 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- student 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: Analyse 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

Streaming Data Analytics

PE1 **Hours of Instruction/week: 3T**
Semester: VI
Course Code: 24BEAE07 **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 explore the hands-on experience with the technologies thatenable 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 – ZeroMQ – 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 a storage 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. Bill Franks. (2012).*Taming The Big Data Tidal Wave Finding Opportunities in HugeData Streams With Advanced Analytics*. Wiley.

Course Outcomes:

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

CO1: Discuss the stream computing and its role in processing continuous data streams.

CO2: Identify techniques and technologies for achieving performance in streaming analytics architectures.

CO3: Apply data flow management concepts to design and implement data processing pipelines

CO4: Analyse the processing and its role in storing, managing continuous streams of data.

CO5: Create informative and actionable visualizations of streaming metrics for monitoring and analysing streaming data pipelines.

CO - PO MAPPING

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

Generative AI

PE1 **Hours of Instruction/week: 3T**
Semester: VI
Course Code: 24BEAE08 **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 shot and 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) – VariationalAutoencoders (VAEs) – Transformer–based Models – Diffusion models Applications.

UNIT - IV Platforms for Generative AI 9

Introduction to Platforms – Features of platforms – Capabilities -Applications – Pre-trained Models – Challenges – Generation of Text to Text – Generation of Text to Image – Text to Code Generation – Explainable AI – Benefits – Use cases.

UNIT - V Ethical Issues and Limitations of Generative AI 9

Limitations of Generative AI – Issues and concerns – Considerations for Responsible Generative AI – Economic Implications – Social Implications – Future and professional Growth of Generative AI.

Total Hours: **45**

References:

1 David Foster.(2023).*Deep Learning: Teaching Machines to Paint, Write, Compose and Play*.2nd edition**.** O'Reilly Media, Inc.

2 Ian Goodfellow, YoshuaBengio, Aaron Courville.(2016). *Deep Learning***.** MIT Press

3 Rafael Valle.(2019)**.***Hands-on Generative Adversarial Networks with Keras*.Packt Publisher.

Course Outcomes:

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

CO1: Discuss the basic concepts of Generative AI and their roles

CO2: Identify and apply effective prompt engineering techniques and its approaches.

CO3: Analyze the performance and control the behaviour of generative AI models

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

CO5: Analyze the 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	2	2	1	1	-	-	-	-	2	1	-	-
CO2	3	3	3	2	2	-	-	-	2	2	-	1
CO3	2	3	3	2	3	-	-	-	1	1	-	2
CO4	2	3	3	2	2	-	-	-	2	1	-	2
CO5	2	3	3	2	3	-	-	-	1	1	-	2

Recommender Systems

PE2
Semester: VI **Hours of Instruction/week: 3T**

Course Code: 24BEAE25 **No. of credits: 3**

Course Learning Objectives (CLOs):

Prerequisite: Big Data Mining

CLO1:	Describe the purpose of recommendation systems.
CLO2:	Understand the components of a recommendation system including candidate generation, scoring and reranking

UNIT - I Introduction **9**

Recommender system functions – Linear Algebra notation: Matrix addition – Multiplication – transposition and – inverses – Covariance matrices – Understanding ratings – Applications of recommendation systems –Issue with recommender system.

UNIT - II Collaborative Filtering **9**

User-based nearest neighbor recommendation – Item-based nearest neighbor recommendation – Model based and pre-processing based approaches – Attacks on collaborative recommender systems.

UNIT -III Content & knowledge based recommendation **9**

High level architecture of content-based systems – Advantages and drawbacks of content based filtering – Item profiles – Discovering features of documents – Obtaining item features from tags – Representing item profiles – Methods for learning user profiles – Similarity based retrieval – Classification algorithms – Knowledge based recommendation: Knowledge representation and reasoning – Constraint based recommenders – Case based recommenders.

UNIT - IV Hybrid approaches **9**

Opportunities for hybridization – Monolithic hybridization design: Feature combination – Feature Augmentation – Parallelized hybridization design: Weighted – Switching – Mixed – Pipelined hybridization design: Cascade Meta-level – Limitations of hybridization strategies

UNIT - V Recommender Systems and communities **9**

Communities – Collaboration and recommender systems in personalized web search – Social tagging recommender systems – Trust and recommendations – Group recommender systems.

Total Hours: **45**

References:

1. Francesco Ricci, LiorRokach, and BrachaShapira.(2015). *Recommender Systems Handbook*. Spring US.2nd Edition.
2. Jannach D., Zanker M, FelFeringA. (2011). *Recommender Systems: An Introduction*. Cambridge University Press.
3. Charu C. Aggarwal.(2016). *Recommender Systems: The Textbook.* 1/e. Springer.
4. https://www.geeksforgeeks.org/python-implementation-of-movie-recommender-system/

Course Outcomes:

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

CO1: Discuss Recommender system with its applications and issues

CO2: Apply Collaborative Filtering in Recommender System

CO3: Apply Content and Knowledge based Filtering in Recommender System

CO4: Evaluate variety of approaches for building recommender systems

CO5: Describe system evaluation methods from both algorithmic and users' perspectives

CO-PO MAPPING

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

Mobile Application Development

PE2
Semester: VI **Hours of Instruction/week: 3T**

Course Code: 24BEAE26 **No. of credits: 3**

Prerequisite: Web Programming for AI

Course Learning Objectives (CLOs):
CLO1: To understand the Service Model with reference to Cloud Computing.

CLO2: To realize the role of Virtualization Technologies.

UNIT - I Mobile Platform and Applications 9

Mobile Device Operating Systems – Special Constraints – Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS – Android – BlackBerry – Windows Phone – MCommerce – Structure – Pros and Cons – Mobile Payment System – Security Issues

UNIT - II Introduction to Android 9

Introduction to Android: The Android Platform – Android SDK – Eclipse Installation – Android Installation – Building you First Android application – Understanding Anatomy of Android Application – Android Manifest file.

UNIT - III Android Application Design Essentials 9

Anatomy of Android applications – Android terminologies – Application Context – Activities – Services – Intents – Receiving and Broadcasting Intents – Android Manifest File and its common settings – Using Intent Filter– Permissions.

UNIT - IV Android User Interface Design & Multimedia 9

User Interface Screen elements – Designing User Interfaces with Layouts – Drawing and Working with Animation – Playing Audio and Video – Recording Audio and Video – Using the Camera to Take and Process Pictures

UNIT - V Android APIs 9

Using Android Data and Storage APIs – Managing data using Sqlite – Sharing Data between Applications with Content Providers – Using Android Networking APIs – Using Android Web APIs – Using Android Telephony APIs – Deploying Android Application to the World.

Total Hours: **45**

References:

1 Google Developer Training. (2017). *Android Developer Fundamentals Course – Concept Reference*. Google Developer Training Team.

2 Reto Meier. (2012). *Professional Android 2 Application Development.* Wiley India Pvt Ltd.

3 Prasanth Kumar Pattnaik,Rajib Mall.(2012).*Fundamentals of Mobile Computing.* PHI Learning Pvt Ltd.

4. Lauren Darcey and Shane Conder. (2011).*Android Wireless Application Development.* Pearson Education. 2nd Edition.

Course Outcomes:

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

CO1: Explore the concepts of mobile programming.

CO2: Create, test and debug Android application by setting up Android development

CO3: Demonstrate methods in storing, sharing and retrieving data in Android applications

CO4: Design and develop Android applications with mobile user interfaces and multimedia

CO5: Create interactive applications in android using databases and deploy them in market place.

CO - PO MAPPING

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

Cloud Computing and Virtualization

PE2

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

Course Code: 24BEAE27 **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*.O 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*. AuerbachPublications
5. Buyya R, Broberg J.Goscinski A. (2011). *Cloud Computing: Principles and Paradigm*.John Wiley & Sons. 1st Edition

Course Outcomes:

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

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

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

CO3: Apply the concept of virtualization in the cloud computing

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

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

CO-PO MAPPING

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

Internet of Things and Applications

PE2

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

Course Code: 24BEAE28 **No. of credits: 3**

Prerequisite: Computer Networks

Course Learning Objectives (CLOs):

CLO1: To gain knowledge on the fundamentals of Internet of Things.

CLO2: To apply the concept of Internet of Things in the real world scenario.

UNIT - I Fundamentals of IoT **9**

Genesis of IoT– Genesis of IoT – IoT and Digitization – IoT impact – IoT challenges – IoT Architecture: One M2M – IoT World Forum (IoTWF) – Additional IoT Reference Models – Simplified IoT Architecture – IoT functional stack – IoT data management and compute stack.

UNIT - II IoT Protocols **9**

IoT Access Technologies: Physical and MAC layers – Topology and Security of IEEE 802.15.4 – 802.15.4g – 802.15.4e – 1901.2a – 802.11ah and LoRaWAN – Application Transport Methods – Supervisory Control and Data Acquisition (SCADA) – Application Layer Protocols – CoAP and MQTT.

UNIT - III IOT Design and Communication Technologies **9**

IOT Requirements – Hardware Software – Study of IOT Sensors – Tagging and Tracking – Embedded Products – IOT Design – IOT Connectivity and Management – IOT Security – IOT Communication– Cellular Machine-to- Machine (M2M) application networks – Software for M2M Applications – Hardware – IP Based Cellular Networks 3G – 4G.

UNIT - IV Data Analytics for IOT **9**

Data Analytics Overview and Challenges – Structured vs Unstructured Data – Data in Motion vs Data at Rest – Data Analytics Tools and Technology – NoSQL Databases Hadoop – Apache Kafka – Apache Spark – Edge Streaming Analytics –Network Analytics Chef –NETCONF–YANG.

UNIT - V IoT Applications **9**

Home Automation – Smart Lighting Home Intrusion Detection Smart Cities – Smart Parking – Smart Traffic Control Environment – Weather Monitoring System Air Pollution Monitoring Forest Fire Detection Agriculture – Smart Irrigation Manufacturing – Converged Plantwide Ethernet (CPwE) Reference Model – Power Utility Industry– Field Area Network (FAN) GridBlock.

Total Hours: **45**

References:

1 David Hanes, Ganzalo Salgueiro, 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 Arshdeep Bahga, Vijay Madisetti. (2015). *Internet of Things A hands on approach.* University press.

Course Outcomes:

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

CO1: Explain the fundamental and architecture of Internet of Things.

CO2: Use appropriate IoT protocols for various applications.

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

CO4: Apply the Data Analytic tools and technologies in IoT.

CO5: Analyze the applications of IoTin various domains

CO - PO MAPPING

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

Responsible AI

PE1 **Hours of Instruction/week: 3T**
Semester: VII
Course Code: 24BEAE09 **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).*Trust worthy 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, student 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

Robotics and Intelligent Systems

PE1 **Hours of Instruction/week: 3T**
Semester: VII
Course Code: 24BEAE10 **No. of credits: 3**

Prerequisite: Artificial Intelligence

Course Learning Objectives (CLOs):

CLO1: To familiarize the functional elements of Robotics and impart knowledge on setting software and hardware construction of the robot.
CLO2: To learn about planning and reasoning artificial intelligence and solve the risk in artificial intelligence

UNIT - I Introduction **9**

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

UNIT - II Setting Up Robots **9**

Robot Anatomy – Subsumption architecture – Software setup – Hardware – Use case – Story board

UNIT - III 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 - IV Algorithm **9**

Decision trees – Entropy – Random Forest – Grid searching and A* algorithm – GPS path finding.

UNIT - V AI In Robotics **9**

Robotic perception – Localization – Mapping – Configuring space – Planning uncertain movements – Dynamics and control of movement – Ethics and risks of artificial intelligence in robotics.

Total Hours: **45**

References:

1. Francis X. Govers.(2018). *Artificial Intelligence for Robotics*..Packt publishing Ltd. UK.1st Edition
2. Francis X. Govers. (2018).*Artificial Intelligence for Robotics: Build Intelligent Robots that Perform Human Tasks Using AI Techniques.*Packt Publishing
3. Peter Sincak, Pitoyo Hartono, Maria Vircikova, Jan Vascak, Rudolf Jaksa.(2015). *Emerging Trends in Robotics and Intelligent Systems.* 1st Edition. Springer.
4. Stuart Russell and Peter Norvig.(2010). *Artificial Intelligence: A Modern Approach.*Pearson.3rd Edition.

Course Outcomes:

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

CO1: Identify the basic concept of robotics, AI and to analyze instrumentation systems and their applications.

CO2: Develop robot setups for specific tasks or applications, including selecting appropriate sensors, actuators, and control systems.

CO3: Analyze the various Robot design process and path planning techniques.

CO4: Apply the basic AI algorithms and carry out an empirical evaluation of different algorithms on problem formalization.

CO5: Buildthe AI in Robotics for robotic perception and decision making using AI techniques.

CO - PO MAPPING

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

Reinforcement Learning

PE1 **Hours of Instruction/week: 3T**
Semester: VII
Course Code:24BEAE11 **No. of credits: 3**

Prerequisite: Machine Learning

Course Learning Objectives:

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

CLO2: To explore the planning and learning with tabular methods

UNIT - I Introduction **9**

Introduction to Reinforcement learning –Examples – Elements of reinforcement learning – Limitations and Scope – An extended example – Multi-armed bandits – k-armed bandit problem – Action – Value methods – the 10-armed testbed – Incremental implementation –Tracking a non-stationary problem – Optimistic initial values – Upper-Confidence – Bound action selection – Associative search.

UNIT - II Markov Decision Process and Model-Based Prediction and Control **9**

Finite Markov Decision Process – The Agent–Environment Interface – Goals and Rewards – Returns and Episodes – Unified Notation for Episodic and Continuing Tasks – Policies and Value Functions – Optimal Policies and Optimal Value Functions – Optimality and Approximation –Dynamic Programming – Policy Evaluation (Prediction) – Policy Improvement – Policy Iteration – Value Iteration – Generalized Policy Iteration – Efficiency of Dynamic Programming – Asynchronous Dynamic Programming.

UNIT - III Model-Free Prediction and Control **9**

Model-free learning – Model-free prediction – Monte Carlo methods – Monte Carlo Prediction – Monte Carlo Estimation of Action Values – Temporal-Difference Learning – TD Prediction – Advantages of TD Prediction Methods – Optimality of TD(0) – n-step Bootstrapping – n-step TD Prediction – n-step Sarsa – Model-free control – Monte Carlo Control – Monte Carlo Control without Exploring Starts – Off policy learning – Importance sampling – Off-policy Monte Carlo Control–Sarsa: On-policy TD Control – Q-learning: Off-policy TD control.

UNIT - IV Planning and Learning with Tabular Methods **9**

Models and planning – Dyna: Integrated Planning – Acting and Learning – When the model is wrong – Prioritized Sweeping – Real-time Dynamic Programming – Monte Carlo Tree Search.

UNIT - V Value Function Approximation **9**

On-policy Prediction with Approximation –Value Function Approximation – The Prediction Objective (VE) – Stochastic-gradient and Semi-gradient Methods – Linear Methods – Least-Squares TD.

Total Hours: **45**

References:

1 Richard S. Sutton 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: Illustrate the basic concepts of reinforcement learning.

CO2: Perform model-based prediction and control using dynamic programming.

CO3: Apply model-free prediction and control.

CO4: Comprehend the use of tabular methods.

CO5: Analyze how a value function can be approximated.

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

Intelligent Multi Agent and Expert Systems

PE1 **Hours of Instruction/week: 3T**

Semester: VII

Course Code:24BEAE12 **No. of credits: 3**

Prerequisite: Artificial Intelligence

Course Learning Objectives (CLOs):

CLO1: To Comprehend the concept of agents, intelligent agent systems, design architectures, agent communication, interaction protocols, key types of possible multi-agent system interaction and agreement

CLO2: To Synthesize multi-agent expert systems to solve small or large scale real life problems

UNIT - I Introduction to Agents and design of Intelligent Agents 9

Agents and Environment – Performance measure – Nature of Environment – Abstract and Concrete Architecture for intelligent agents – Problem solving and planning: Result sharing – Task sharing and Distributed planning – Deductive reasoning agents: Agent – Practical Reasoning Agents: HOMER architecture – Reactive agents: Subsumption architecture.

UNIT - II Agent Communication and Interaction Protocols 9

Agent Communications: Knowledge Query and manipulation Language (KQML) – Knowledge Interchange Format (KIF) – Ontology – Coordination protocols – Cooperation Protocols – Contract Net – Blackboard Systems – Negotiation – Multi-agent Belief Maintenance – Market Mechanisms.

UNIT - III Multi-agent Methodologies and Applications 9

Agent Methodologies – Mobile agents – Typical application areas of agent systems: Business Process Management – Distributed Sensing – Information Retrieval and Management – Electronic Commerce – Human-Computer Interfaces – Social Simulation.

UNIT - IV Introduction to Expert System ,Expert System Models 9

Expert Systems: Introduction – Architecture – Production rules and inference – Basic forms of inference: abduction – Deduction – Induction – Rule-based representations (with backward and forward reasoning) – Logic–based representations (with resolution refutation).

UNIT - V Expert System Implementation 9

Implementation Tools: Prolog – CLIPS – Study of existing expert systems: MYCIN – DART and XCON.

Total Hours: **45**

References:

1 Michael Wooldridge. (2009). *An Introduction to Multi Agent Systems*. Wiley. 2nd Edition.

2 G. Weiss. (2013).*Multi-Agent Systems - A Modern Approach to Distributed Artificial Intelligence*. MIT Press. 2nd Edition

3 Dan W. Patterson. (2007*). Introduction to AI & Expert System*. PHI

Course Outcomes:

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

CO1: Describe the notion of an agent, intelligent agent systems characteristics and the structure of agents and design intelligent agents that can effectively cooperate in order to solve problems.

CO2: Apply the concepts of agent communication, interaction protocols, multi-agent interactions and agreements

CO3: Build agents capable of intelligent autonomous actions using appropriate methodologies

CO4: Discuss the concept of expert system, models, production rules, implementation tools and existing system models for developing an expert system

CO5: Develop novel applications using intelligent multi-agent expert systems to solve real life 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	3	3	3	2	2	-	-	-	3	2	-	-
CO4	2	2	2	2	2	-	-	-	1	1	-	-
CO5	3	3	3	3	2	-	-	-	2	2	-	2

Text and Speech Analysis

PE2 **Hours of Instruction/week: 3T**
Semester: VII

Course Code: 24BEAE29 **No. of credits: 3**

Prerequisite: Natural Language Processing

Course Learning Objectives (CLOs):

CLO1: To familiarize the basics of natural language processing

CLO2: To gain knowledge on classification algorithms to text documents, build question-answering and dialogue systems and develop speech recognition system and synthesizer

UNIT - I Natural Language Basics **9**

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model – Bag of N-Grams model – TF–IDF model.

UNIT - II Text Classification **9**

Vector Semantics and Embeddings –Word Embeddings – Word2Vec model – Glove model – Fast Text model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models.

UNIT - III Question Answering And Dialogue Systems **9**

Information retrieval – IR-based question answering – Knowledge-based question answering – language models for QA – Classic QA models – Chatbots – Design of dialogue systems – Evaluating dialogue systems.

UNIT - IV Text-To-Speech Synthesis **9**

Overview– Text normalization – Letter-to-sound – Prosody – Evaluation – Signal processing – Concatenative and parametric approaches – WaveNet and other deep learning based TTS systems.

UNIT - V Automatic Speech Recognition **9**

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

Total Hours: **45**

References:

1. Daniel Jurafsky& James H. Martin.(2022).*Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*.3rdEdition.
2. Dipanjan Sarkar. (2018).*Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data*.APress.
3. Tanveer Siddiqui&Tiwary U S. (2008).*Natural Language Processing and Information Retrieval*,Oxford University Press.
4. Lawrence Rabiner, Biing-Hwang Juang& B. Yegnanarayana (2009.)*Fundamentals of Speech Recognition.* Pearson. 1stEdition
5. Steven Bird, Ewan Klein& Edward Loper.*Natural language processing with Python.* O'Reilly.

Course Outcomes:

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

CO1: Explain existing and emerging deep learning architectures for text and speech processing

CO2: Apply deep learning techniques for NLP tasks, language modelling and machine translation

CO3: Explain coreference and coherence for text processing

CO4: Build question-answering systems, chatbots and dialogue systems

CO5: Apply deep learning models for building speech recognition and text-to-speech systems

CO - PO MAPPING

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

Artificial Intelligence in Cyber Security

PE 2
Semester: VII **Hours of Instruction/week: 3T**
Course Code: 24BEAE30 **No. of credits: 3**

Prerequisite: Computer Networks

Course Learning Objectives (CLOs):

CLO1: To introduce the concepts, techniques, and applications of artificial intelligence in the field of cyber security**.**

CLO2: To learn how AI can be leveraged to detect, prevent, and respond to various cyber threats**.**

UNIT - I Introduction to Artificial Intelligence in Cyber Security 9

Overview of AI and its applications in cyber security- Challenges and opportunities of AI for cyber security - Ethical considerations and implications - Anomaly detection- Intrusion detection systems(IDS) - intrusion prevention systems (IPS) -Feature selection and extraction for cyber security.

UNIT - II Deep Learning Fundamentals for Malware Analysis 9

Introduction to neural networks and deep learning- Convolutional neural networks (CNNs) for image-based cyber security tasks- Recurrent neural networks (RNNs) for sequence-based cyber security tasks- Malware detection using deep learning techniques-Behavior-based analysis and static analysis of malware- Malware classification and clustering using deep learning models.

UNIT - III Natural Language Processing (NLP) for Cyber security 9

Introduction to NLP and its applications in cyber security - Text-based cyber threat detection and sentiment analysis- Named entity recognition- text classification for cyber security- Adversarial attacks and defences- Adversarial examples and their impact on cyber security systems- Techniques for adversarial training and robust model development.

UNIT - IV AI for Network Security and Threat Intelligence 9

AI-based network traffic analysis and anomaly detection, Network intrusion detection and prevention using AI techniques- AI-enabled network security operations and management- AI-driven threat intelligence and information sharing- Threat hunting and detection using AI algorithms- AI-powered threat intelligence platforms and tools- AI for security incident detection and response- Automated incident triage and handling using AI- Security orchestration, automation and response (SOAR) systems.

UNIT - V Explainable AI for Cyber security Based On Security Analytics and Visualization 9

Explain ability and interpretability in AI models for cyber security- Interpretable machine learning algorithms and techniques- Ethical considerations in deploying AI models in cyber security- AI-powered security analytics and visualization techniques- Visualization of cyber security data and insights- Real-time monitoring and alerting using AI-based analytics- AI-driven user and entity behavior modelling and analysis- Detection of insider threats using AI techniques- User and Entity Behavior Analytics (UEBA) platforms and applications in cyber security.

Total Hours: **45**

References:

1 Stuart Russell and Peter Norvig. (2016). *Artificial Intelligence a Modern Approach*. 3rd Edition. Pearson Education Limited.

2 John Wiley & Sons.(2021). *Artificial Intelligence for Dummies*. Inc. 2nd Edition

Course Outcomes:

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

CO1: Learn the evolution, principles, and benefits of AI with cyber security.

CO2: Explore convolutional neural networks (CNNs) and their applications in image-based cyber security tasks, such as malware detection and threat identification in visual data.

CO3: Analyze techniques for text-based cyber threat detection using NLP, including the use of machine learning models to classify and identify malicious content.

CO4: Investigate AI-driven threat intelligence and information sharing mechanisms and analyze vast amounts of data to identify emerging threats, vulnerabilities, and attack patterns.

CO5: Explore ethical considerations in deploying AI for cyber security based on security analytics and visualization.

CO - PO MAPPING

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

Block Chain Technology

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

Course Code: 24BEAE31 **No. of credits: 3**

Prerequisite: Computer Networks

Course Learning Objectives (CLOs):

CLO1: To familiarize the types and applications of Block chain

CLO2: To analyze various block chain based application.

UNIT - I Introduction to Block chain 9

Introduction to Block chain – History –Definition – Block chain Categories – Public – Private – Consortium – Block chain Network and Nodes – Peer-to-Peer Network – Mining Mechanism – Generic elements of Block chain – Features of Block chain and Types of Block chain.

UNIT - II Block chain Architecture 9

Bitcoin – Block chain – Block chain Architecture – Block – Hash – Distributer P2P – Structure of Block chain – 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 – Block chain 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 – Block chain as – a-Service – Initial Coin Offering (ICO): Project setup for ICO implementation – Token contracts – Token sale contracts – Contract security and testing the code.

UNIT - V Distributed Storage IPFS and Swarm 9

Ethereum Virtual Machine – Swarm and IPFS: Installing IPFS – Hosting our frontend: Serving your frontend using IFPS – Serving your frontend using Swarm – IPFS file uploader project: Project setup the web page.

Total Hours: **45**

References:

1 Imran Bashir. (2018).*Mastering Block chain: Distributed Ledger Technology, decentralization, and smart contracts explained.* Packt Publishing Ltd.2nd Edition.

2 Bellaj Badr, Richard Horrocks, Xun (Brian) Wu. (2018). *Block chain 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 Gold feder. (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 Block chain.

CO2: Identify the familiarity with cryptography and Consensus algorithms.

CO3: Create and deploy projects using Web3j.

CO4: Implement an ICO on Ethereum.

CO5: Design block chain 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

Text, Web and Social Media Analytics

PE2

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

Course Code: 24BEAE32 **No. of credits: 3**

Prerequisite: Natural Language Processing

Course Learning Objectives (CLOs):

CLO1:	To provide an overview of common text mining and social media data analytic activities
CLO2:	To enable students to solve complex real-world problems for sentiment analysis and Recommendation systems

UNIT - I Introduction to Text Mining, Web-Mining 9

Text Representation – Tokenization – Stemming, stop words – TF-IDF – Feature Vector Representation – NER – N-gram modeling – Inverted indices and Boolean queries. PLSI – Query optimization – page ranking.

UNIT - II Web Usage Web content Mining 9

Web Crawling – Crawler Algorithms – Implementation Issues – Evaluation – Session & visitor Analysis – Visitor Segmentation – Analysis of Sequential & Navigational Patterns – Predictions based on web user transactions.

UNIT -III Introduction to Social Media Network 9

Essentials of Social graphs – Social Networks – Models – Information Diffusion in Social Media.

UNIT - IV Mining Social Media 9

Behavioral Analytics – Influence and Homophily – Recommendation in Social Media.

UNIT - V Sentimental Mining 9

Sentiment classification feature based opinion mining – Comparative sentence and relational mining – Opinion spam.

Total Hours: **45**

References:

1. Bing Liu.(2011).*Web Data Mining-Exploring Hyperlinks, Contents, and Usage Data*. Springer, 2nd Edition.
2. Reza Zafarani, Mohammad Ali Abbasi and Huan Liu.(2014).*Social Media Mining - An Introduction.* Cambridge University Press.
3. Bing Liu.(2012). *Sentiment Analysis and Opinion Mining*. Morgan & Claypool Publishers.
4. Matthew A.Russell. (2013). *Mining the social web.*O'Reilly Media. 2nd Edition.

Course Outcomes:

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

CO1: Interpret the terminologies, metaphors and perspectives of social media analytics.

CO2: Apply state of the art web mining tools and libraries on realistic data sets as a basis for business decisions and applications

CO3: Perform social network analysis to identify important social actors, subgroups and network properties in social media sites.

CO4: Analyze the solutions to the emerging problems with social media such as behavior analytics and recommendation systems

CO5: Design new solutions to opinion extraction, sentiment classification and data summarization problems.

CO - PO MAPPING

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