ANNAMACHARYA INSTITUTE OF TECHNOLOGY ANDSCIENCES, TIRUPATI (AUTONOMOUS)
B. Tech - Artificial Intelligence & Machine Learning (AI&ML)
AK23-REGULATIONS
(Effective for the batches admitted from 2023-24)

B.Tech I Year I Semester

INDUCTION PROGRAMME

S no	Course Name	Category	L-T-P-C
1	Physical activities--sports, yoga and meditation, plantation	MC	0-0-6-0
2	Career counselling	MC	2-0-2-0
3	Orientation to all branches –career options, tools, etc.	MC	3-0-0-0
4	Orientation on admitted branch—corresponding labs, tools and platforms	EC	2-0-3-0
5	Proficiency modules & productivity tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7	Remedial training in foundation courses	MC	2-1-2-0
8	Human values & professional ethics	MC	3-0-0-0
9	Communication skills –focus on listening, speaking, reading, writing skills	BS	2-1-2-0
10	Concepts of programming	ES	2-0-2-0

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B.Tech I Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P	C			
1	BS	23ABS9903	Engineering Physics	2	1	0	3	30	70	100
2	BS	23ABS9904	Linear Algebra & Calculus	2	1	0	3	30	70	100
3	ES	23AES0201	Basic Electrical & Electronics Engineering	2	1	0	3	30	70	100
4	ES	23AES0301	Engineering Graphics	1	0	4	3	30	70	100
5	ES	23AES0501	Introduction to Programming	2	1	0	3	30	70	100
6	ES	23AES0503	IT Workshop	0	0	2	1	30	70	100
7	BS	23ABS9908	Engineering Physics Lab	0	0	2	1	30	70	100
8	ES	23AES0202	Electrical & Electronics Engineering Workshop	0	0	3	1.5	30	70	100
9	ES	23AES0502	Computer Programming Lab	0	0	3	1.5	30	70	100
10	HM	23AHM9904	NSS/NCC/Scouts & Guides/Community Service	0	0	1	0.5	50	-	50
			Total	**9**	**4**	**15**	**20.5**	**320**	**630**	**950**

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B.Tech I Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P	C			
1	HM	23AHM9901	Communicative English	2	0	0	2	30	70	100
2	BS	23ABS9901	Chemistry	2	1	0	3	30	70	100
3	BS	23ABS9905	Differential Equations &Vector Calculus	2	1	0	3	30	70	100
4	ES	23AES0101	Basic Civil& Mechanical Engineering	2	1	0	3	30	70	100
5	PC	23APC0501	Data Structures	2	1	0	3	30	70	100
6	HM	23AHM9902	Communicative English Lab	0	0	2	1	30	70	100
7	BS	23ABS9906	Chemistry Lab	0	0	2	1	30	70	100
8	ES	23AES0302	Engineering Workshop	0	0	3	1.5	30	70	100
9	PC	23APC0502	Data Structures Lab	0	0	3	1.5	30	70	100
10	HM	23AHM9903	Health and wellness, Yoga and Sports	0	0	1	0.5	50	-	50
			Total	10	4	11	19.5	320	630	950

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B.Tech II Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P	C			
1	BS	23ABS9913	Discrete Mathematics & Graph Theory	2	1	0	3	30	70	100
2	HM	23AHM9905	Universal Human Values	2	1	0	3	30	70	100
3	PC	23APC3001	Artificial Intelligence	2	1	0	3	30	70	100
4	PC	23APC0504	Advanced Data Structures and Algorithms Analysis	2	1	0	3	30	70	100
5	PC	23APC0506	Object-Oriented Programming through JAVA	2	1	0	3	30	70	100
6	PC	23APC0505	Advanced Data Structures and Algorithms Analysis Lab	0	0	3	1.5	30	70	100
7	PC	23APC0507	Object-Oriented Programming through JAVA Lab	0	0	3	1.5	30	70	100
8	SC	23ASC0501	Python Programming	1	0	2	2	30	70	100
			Total	**11**	**5**	**8**	**20**	**240**	**560**	**800**

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B.Tech II Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P	C			
1	ES	23AES0305	Optimization Technique	2	0	0	2	30	70	100
2	BS	23ABS9916	Probability & Statistics	2	1	0	3	30	70	100
3	PC	23APC3301	Machine Learning	2	1	0	3	30	70	100
4	PC	23APC0508	Database Management Systems	2	1	0	3	30	70	100
5	PC	23APC0503	Digital Logic & Computer Organization	2	1	0	3	30	70	100
6	PC	23APC3302	AI&ML Lab	0	0	3	1.5	30	70	100
7	PC	23APC0509	Database Management Systems Lab	0	0	3	1.5	30	70	100
8	SC	23ASC0503	Full Stack Development-1	1	0	2	2	30	70	100
9	ES	23AES0304	Design Thinking & Innovation	2	0	0	2	30	70	100
10	MC	23AMC9901	Environmental Science	2	0	0	-	30	-	30
			Total	**15**	**4**	**8**	**21**	**300**	**630**	**930**
Mandatory Community Service Project Internship of 08 weeks duration during summer vacation										

B.Tech III Year I Semester

S.No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T/CLC	P	C			
1	PC	23APC3303	Deep Learning	2	1	0	3	30	70	100
2	PC	23APC3305	Data Wrangling & Preprocessing	2	1	0	3	30	70	100
3	PC	23APC3307	Natural Language Processing	2	1	0	3	30	70	100
4	ES	23AES0504	Introduction to Quantum Technologies and Applications	2	1	0	3	30	70	100
5	PE-1	23APE3301 23APE3302 23APE3303 23APE3304	1.Data Visualization 2.Soft computing 3.Exploratory Data Analysis with Python 4. Introduction to Reinforcement Learning.	2	1	0	3	30	70	100
6	OE-1	23AOE9915	English for Competitive Examinations	2	1	0	3	25	75	100
7	PC	23APC3304	DL and NLP Lab	0	0	3	1.5	30	70	100
8	PC	23APC3306	Data Wrangling Lab	0	0	3	1.5	30	70	100
9	SC	23ASC9901	Soft skills	1	0	2	2	30	70	100
10	ES	20AES0404	Tinkering Lab	0	0	2	1	30	70	100
11	PR	23APR3301	Community Service Internship	-	-	-	2	100	-	100
			Total	13	6	10	26	395	705	1100

Open Elective – I

S. NO	Course Code	Course Name	Offered by the Dept.
1	23AOE0101	Green Buildings	CIVIL
2	23AOE0102	Construction Technology and Management	
3	23AOE0201	Electrical Safety Practices and Standards	EEE
4	23AOE0301	Sustainable Energy Technologies	ME
5	23AOE0401	Electronic Circuits	ECE
6	23AOE9901	Mathematics for Machine Learning and AI	Mathematics
7	23AOE9906	Materials Characterization Techniques	Physics
8	23AOE9911	Chemistry of Energy Systems	Chemistry
9	23AOE9915	English for Competitive Examinations	Humanities
10	23AOEMB01	Entrepreneurship and New Venture Creation	

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B.Tech III Year II Semester

S.No.	Category	Course code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CL C	P				
1	PC	23APC3308	Advanced Machine Learning	2	1	0	3	30	70	100
2	PC	23APC3309	Explainable AI & Model Interpretability	2	1	0	3	30	70	100
3	PC	23APC3311	AI for Edge Computing	2	1	0	3	30	70	100
4	PE-II	23APE3305 23APE3306 23APE3307 23APE3308	1.Graph Neural Networks 2.Recommender Systems 3.Predictive Analytics 4.Big Data	2	1	0	3	30	70	100
5	PE-III	23APE3309 23APE3310 23APE3311 23APE3312	5.Quantum Computing 6.Computer Vision 7.Social Network Analysis 8.Applied Machine Learning	2	1	0	3	30	70	100
	OE-II		OPEN ELECTIVE-II	2	1	0	3	30	70	100
7	PC	23APC3310	ML Model Optimization Lab	0	0	3	1.5	30	70	100
8	PC	23APC3312	Edge Computing Lab	0	0	3	1.5	30	70	100
9	SC	23ASC3301	Full Stack Development-II	1	0	2	2	30	70	100
10	MC	23AMC9902	Technical Paper Writing & IPR	2	0	0	-	30	-	30
11	SC	23ASC3302	**Workshop**	-	-	-	-	-	-	-
			TOTAL	15	6	8	23	300	630	930

NOTE : Workshop can be conducted either in III-I or III-II and the participation certificate with 90% and above attendance on it shall be submitted to the department/ Exam section before III-II regular exam notification is released.

Open Elective – II

S NO	Course Code	Course Name	Offered by the Dept.
1	23AOE0103	Disaster Management	CIVIL
2	23AOE0104	Sustainability In Engineering Practices	
3	23AOE0202	Renewable Energy Sources	EEE
4	23AOE0302	Automation and Robotics	ME
5	23AOE0402	Digital Electronics	ECE
6	23AOE9902	Advanced Operations Research	Mathematics
7	23AOE9907	Physics Of Electronic Materials And Devices	Physics
8	23AOE9912	Chemistry Of Polymers And Applications	Chemistry
9	23AOE9916	Academic Writing and Public Speaking	Humanities
10	23AOE9903	Mathematical Foundation Of Quantum Technologies	Mathematics

B.Tech IV Year I Semester

S.No.	Category	Course code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P				
1	PC	23APC3313	Generative AI & Prompt Engineering	2	1	0	3	30	70	100
2	HM	23AHMMB02 23AHMMB03 23AHMMB04	**Management Course- II** 1.Business Ethics and Corporate Governance 2.E-Business 3.Management Science	2	0	0	2	30	70	100
3	PE-IV	23APE3313 23APE3314 23APE3315 23APE3316	1.AI for Robotics 2.AI in Cyber security 3.Human Computer Interaction 4.AI for Social Good	2	1	0	3	30	70	100
4	PE-V	23APE3317 23APE3318 23APE3319 23APE3320	5.Smart System 6.Healthcare AI 7.Drone Technology 8.Robotics	2	1	0	3	30	70	100
5	OE-III		Open Elective-III	2	1	0	3	30	70	100
6	OE-IV		Open Elective-IV	2	1	0	3	30	70	100
7	SC	23ASC3302	Prompt Engineering	1	0	2	2	30	70	100
8	MC	23AMC9903	Gender Sensitization	2	0	0	-	30	-	30
9	PR	23APR3302	Evaluation of Industry Internship	-	-	-	2	100		100
			TOTAL	15	5	2	21	340	490	830

Open Elective – III

S NO	Course Code	Course Name	Offered by the Dept.
1	23AOE0105	Building Material and Services	CIVIL
2	23APE0106	Environmental impact assessment	
3	23AOE0203	Smart Grid Technologies	EEE
4	23AOE0303	3D Printing Technologies	ME
5	23APC0412	Microprocessors and Microcontrollers	ECE
6	23AOE9904	Wavelet transforms and its Applications	Mathematics
7	23AOE9908	Smart Materials And Devices	Physics
8	23AOE9913	Green Chemistry And Catalysis For Sustainable Environment	Chemistry
9	23AOE9917	Employability Skills	Humanities
10	23AOE9909	Introduction to Quantum Mechanics	Physics

Open Elective – IV

S NO	Course Code	Course Name	Offered by the Dept.
1	23AOE0106	Geo-Spatial Technologies	CIVIL
2	23AOE0107	Solid Waste Management	
3	23AOE0204	Electric Vehicles	EEE
4	23AOE0304	Total Quality Management	ME
5	23AOE0403	Transducers and Sensors	ECE
6	23AOE9905	Financial Mathematics	Mathematics
7	23AOE9910	Sensors And Actuators For Engineering Applications	Physics
8	23AOE9914	Chemistry Of Nanomaterials and Applications	Chemistry
9	23AOE9918	Literary Vibes	Humanities
10	23AOE0510	Quantum Computing	CSE

B.Tech IV Year II Semester

S.No.	Category	Course code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T/CLC	P				
1	PR	23APR3303	Long term Internship	-	-	-	4	100	-	100
2	PR	23APR3304	Project Work	-	-	-	8	40	160	200
			Total	-	-	**-**	**12**	**140**	**160**	**300**

Minor degree in Artificial Intelligence and Machine Learning

Minor degree in Artificial Intelligence and Machine Learning is offered by **Department of AIML to the** Students of CSE, CSD, CSIT, CIC, ECE, EEE, ME and CE. Under the **AK23 regulations**, Students can earn a **minor degree** by selecting **open-electives** across branches. Students (minimum CGPA of 7.0), if desired, may pursue the minor degree by earning **18 additional credits** beyond the core credit structure.

Courses offered in **AIML** are:

S.No	Courses	Credits
1	Introduction to ML	3
2	Reinforcement Learning	3
3	Deep Learning	3
4	Mathematical Foundations of ML	3
5	ML for Engineering and Science Applications	3
6	Natural Language Processing	3
7	Machine Learning and Deep Learning Foundations and Applications	3
8	AI Concepts and Techniques	3
9	AI: Knowledge Representation And Reasoning	3
10	Reinforcement Learning	3
11	Minor Project in AI Domain (Mandatory)	3

From S.No. 1 to 10, Student can choose any five courses to earn 15 credits and Minor project is mandatory.

HONOURS IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

NOTE: Students can choose a few courses from the following list approved by BOS either 3 credits course based on the availability in SWAYAM-NPTEL portal, and secure minimum of 18 credits on passing the selected courses.

Courses offered are:

S.No.	Courses	Credits
1	Deep Learning for Computer vision	3
2	Programming with generative AI	3
3	Introduction to Large Language Models	3
4	ML to Earth System Science	3
5	Foundations of Virtual Reality	3
6	Games and Information	3
7	Affective Computing	3
8	Foundations and Applications of Machine Learning	3
9	Deep Learning for Computer vision	3

Students can select honor degree or apply for honors degree during **second year second semester**, which can be across disciplines or allied to their major respectively.

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B.Tech I Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P	C			
1	BS	23ABS9903	Engineering Physics	2	1	0	3	30	70	100
2	BS	23ABS9904	Linear Algebra & Calculus	2	1	0	3	30	70	100
3	ES	23AES0201	Basic Electrical & Electronics Engineering	2	1	0	3	30	70	100
4	ES	23AES0301	Engineering Graphics	1	0	4	3	30	70	100
5	ES	23AES0501	Introduction to Programming	2	1	0	3	30	70	100
6	ES	23AES0503	IT Workshop	0	0	2	1	30	70	100
7	BS	23ABS9908	Engineering Physics Lab	0	0	2	1	30	70	100
8	ES	23AES0202	Electrical & Electronics Engineering Workshop	0	0	3	1.5	30	70	100
9	ES	23AES0502	Computer Programming Lab	0	0	3	1.5	30	70	100
10	HM	23AHM9904	NSS/NCC/Scouts & Guides/Community Service	0	0	1	0.5	50	-	50
			Total	**9**	**4**	**15**	**20.5**	**320**	**630**	**950**

Course Code	**ENGINEERING PHYSICS**		L	T/CLC	P	C
23ABS9903			**2**	**1**	**0**	**3**
Regulation: **K23**	Common to I B.Tech ECE, AI&DS, AI&ML, ME, CE (Sem-1) & CSE, CIC, EEE, &CSD (Sem-2)					

Course Outcomes (CO): At the end of the course students will be able to

CO1:**Understand** the intensity variation of light due to interference, diffraction, and polarization.
CO2:**Analyze** the fundamentals of crystallography and X-ray diffraction.
CO3:**Apply** the basic concepts of dielectric and magnetic materials for engineering applications.
CO4:**Analyze** the fundamentals of Quantum mechanics and interpret the nanomaterials for engineering problems.
CO5:**Analyze** the charge carrier dynamics in semiconductors by implementing the equations of state.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	The intensity variation of light due to interference, diffraction, and polarization.			L2
2	**Analyze**	The fundamentals of crystallography and X-ray diffraction.			L4
3	**Apply**	The basic concepts of dielectric and magnetic materials		for engineering applications.	L3
4	**Analyze**	The fundamentals of Quantum mechanics and interpret the nanomaterials		for engineering problems.	L4
5	**Analyze**	The charge carrier dynamics in semiconductors.	By implementing the equations of state.		L4

UNIT I   Wave Optics   10 Hrs

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Newton's Rings, Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit (Qualitative) – Diffraction Grating.

Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT II Crystallography and X-ray diffraction   8 Hrs

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods.

UNIT III Dielectric and Magnetic Materials   8 Hrs

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius-Mossotti equation - Frequency dependence of polarization-Applications of Dielectric materials.

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro, anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials - Applications of magnetic materials.

UNIT IV   Quantum Mechanics and Nanomaterials   12 Hrs

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Nanomaterials: Introduction to Nanomaterials–Significance of nanoscale - Physical, Mechanical, Magnetic, and optical properties of nanomaterials –Synthesis of nanomaterials: Ball Milling, Applications of Nanomaterials.

UNIT V Semiconductors   10 Hrs

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents –

Einstein's equation – Hall effectand its applications – Applications of semiconductors.

Textbooks:
1. A Text book of Engineering Physics, M. N. Avadhanulu, P.G. Kshirsagar & TVS Arun   Murthy, S. Chand Publications, 11th Edition 2019.
2. K.Thyagarajan "Engineering Physics",-Mc Graw Hill Publishing Company Ltd, 2016.
3. Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press (2015)

Reference Books:
1. Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021.
2. Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.
3. Engineering Physics" - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press.2010
4. Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

Web Resources: https://www.loc.gov/rr/scitech/selected-internet/physics.html

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3												
2	3												
3	3			3									
4	3												
5	3			3									

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	15	22.3	3	Understand	L2	PO1	PO1: Apply (L3)	2
2	11	16.4	2	Analyze	L4	PO1	PO1: Apply (L3)	3
3	12	17.9	2	Apply	L3	PO1, PO4	PO1, PO4: Apply (L3)	3
4	13	19.4	2	Analyze	L4	PO1	PO1: Apply (L3)	3
5	16	23.8	3	Analyze	L4	PO1, PO4	PO1, PO4: Apply (L3)	3
	67							

CO1: The intensity variation of light due to interference, diffraction, and polarization.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is lesser than PO1 verb by one level; Therefore, correlation is moderate (2).
CO2: The fundamentals of crystallography.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO2 Action Verb is greater than PO1 verb; Therefore correlation is high (3).
CO3: Apply the basic concepts of dielectric and magnetic materials for engineering applications.
Action Verb: Apply (L3)
PO1 and PO4 Verbs: Apply (L3)
CO3 Action Verb level is equal to PO1 and PO4 verb; Therefore correlation is high (3).
CO4: The fundamentals of Quantum mechanics and interpret the nanomaterials for engineering problems.
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO4 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
CO5: The charge carrier dynamics in semiconductors by implementing the equations of state.
Action Verb: Analyze (L4)
PO1 and PO4 Verb: Apply (L3)
CO5 Action verb is greater than PO1 verb; therefore, the correlation is high (3).

	ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI **(Autonomous)** **ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)**

Year : I   **Semester** : I   **Branch of Study :** Common to All

Subject Code: 23ABS9904	**Subject Name: Linear Algebra &** **Calculus**	**L** **2**	**T/CLC** **1**	**P** **0**	**Credits** **3**

CO	Action Verb	Knowledge Statement	Condition	Criteria
1	**Analyze**	the matrix algebraic techniques	for engineering applications.	
2	**Understand**	the concept of eigen values, eigen vectors and quadratic forms.	-	
3	**Analyze**	the mean value theorems	for real time applications.	
4	**Apply**	the concept of Maxima and Minima	to functions of several variables.	
5	**Apply**	the multivariable integral calculus	for computation of Area and volume.	

Unit I: Matrices   12hrs
Rank of a matrix by Echelon form, Normal form, Cauchy-Binet formula (without proof).Inverse of Non-singular matrices by Gauss-Jordan method, system of linear equations: solving system of Homogeneous and Non-homogeneous equations by Gauss Elimination method, Jacobi and Gauss Seidel Iteration methods.

Unit II: Eigen values, Eigen vectors and Orthogonal Transformation   9hrs
Eigen values, Eigen vectors and their properties, Diagonalization of a matrix, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, Quadratic forms and Nature of the Quadratic forms, Reduction of quadratic form to canonical forms by Orthogonal Transformation.

Unit III: Calculus   9hrs
Mean Value Theorems: Rolle's theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof), problems and applications on the above theorems.

Unit IV: Partial differentiation and Applications(Multi Variable Calculus)   10hrs
Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Directional derivative, Taylor's and Maclaurin's series expansion of functions of two variables, Jacobians, Functional dependence, Maxima and Minima of functions of two variables, method of Lagrange multipliers.

Unit V: Multiple Integrals   10hrs
Double integrals, triple integrals change of order of integration, change of Variables to polar, Cylindrical and Spherical coordinates, Finding areas(by double integrals) and volumes (by double integrals and triple integrals).
Textbooks:
1.   B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2.   Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
 References:
1.   Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass,Pearson Publishers, 2018, 14th Edition.
2.   Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar,Alpha Science International Ltd., 25th Edition(9th reprint).
3.   Advanced Modern Engineering Mathematics, Glyn James, Pearsonpublishers, 2018, 5 th Edition.
4.   Advanced Engineering Mathematics, Micheael Greenberg, , Pearsonpublishers, 9 th edition.
  5.   Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications,2014, Third Edition (Reprint 2021)

Mapping of COs to POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1		3									
2		2									
3		3									
4	3										
5	3										

  (Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	10	14	2	Analyze	L4	PO2	Analyze	3
2	15	21.4	3	Understand	L2	PO2	Apply	2
3	15	21.4	3	Analyze	L4	PO2	Analyze	3
4	16	22.8	3	Apply	L3	PO1	Apply	3
5	14	20	3	Apply	L3	PO1	Apply	3

CO1: Analyze the matrix algebraic techniques that are needed for engineering applications.
Action Verb: Analyze(L4)
PO2 Verbs: Analyze (L4)
CO1 Action Verb is equal toPO2 verb ; Therefore correlation is high (3).

CO2: Understand the concept of eigen values, eigen vectors and quadratic forms.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO2 Action Verb is low level to PO1 verb by one level; Therefore correlation is moderate (2).

CO3: Analyze the mean value theorems for real life problems.
Action Verb: Analyze **(L4)**
PO1 Verb: Analyze (L4)
CO3 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

CO4: Apply the concept of Maxima and Minima of functions of several variables.
Action Verb: Apply (L3)
PO2 Verb: Apply (L3)
        CO4 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).

CO5: Apply the multivariable integral calculus for computation of area and volume.
Action Verb: Apply(L3)
PO1 Verb: Apply (L3)
CO5 Action verb is high level to PO1 verb; therefore the correlation is high (3).

(AUTONOMOUS)
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	Basic Electrical & Electronics Engineering	L	T/CLC	P	C
23AES0201	I-I		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: **Understand** the fundamental laws of A. C circuits and D. C circuits.

CO2: **Understand** operating principles of motors, generators and measuring instruments.

CO3: **Understand** the fundamentals of power generation, costing and safety measures.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
1	Understand	The fundamentals laws of A. C circuits and D. C circuits.		A. C circuits and D. C circuits	L2
2	Understand	Operating principles of motors, generators and measuring instruments.			L2
3	Understand	The fundamentals of Power generation, costing and safety measures.			L2

PART-A
BASIC ELECTRICAL ENGINEERING

UNIT I: DC & AC Circuits

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

UNIT II: Machines and Measuring Instruments

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone Bridge.

UNIT III: Energy Resources, Electricity Bill & Safety Measures

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

TEXTBOOKS:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition 2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013.

2. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

REFERENCE BOOKS:

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition.

2. Principles of Power Systems, V.K. Mehta, S. Chand Technical Publishers, 2020.

3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017.

4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications, 2018, Second Edition.

WEB RESOURCES:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

COURSE OUTCOMES:
After completion of the course, students will be able to:
CO4: **Understand** the fundamental concepts of diodes, transistors and its applications.
CO5: **Analyze** the concepts of rectifiers, power supplies and amplifiers in electronics.
CO6: **Analyze** the concepts of Number Systems, Boolean Functions, Logic Gates and Digital Circuits.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
4	Understand	fundamental concepts of diodes, transistors and its applications			L2
5	Analyze	concepts of rectifiers, power supplies and amplifiers in electronics			L4
6	Analyze	concepts of Number Systems, Boolean Functions, Logic Gates and Digital Circuits			L4

UNIT I: SEMICONDUCTOR DEVICES
Introduction - Evolution of electronics – Vacuum tubes to nano electronics - Characteristics of PN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amplifier.

UNIT II : **BASIC ELECTRONIC CIRCUITS AND INSTRUMENTTAION**
Rectifiers and power supplies: Block diagram description of a DC power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple Zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

UNIT III: **DIGITAL ELECTRONICS**
Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adder, Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only)

Textbooks:
1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
Reference Books:
1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009.

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Justification Table:

CO	CO					Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1	08	30	3	**Understand**	**L2**	PO1, PO2, PO6	PO1: Apply (L3) PO2: Identify (L3) PO6: Thumb Rule	2 2 1
2	08	30	3	**Understand**	**L2**	PO1, PO2, PO6	PO1: Apply (L3) PO2: Analyze(L4) PO6: Thumb Rule	2 1 1
3	10	38	3	**Understand**	**L2**	PO1, PO2, PO6	PO1: Apply (L3) PO2: Analyze(L4) PO6: Thumb Rule	2 1 2
4	08	30	3	Understand	**L2**	PO1, PO2	PO1: Apply (L3) PO2: Review (L2)	2 3
5	08	30	3	Analyze	**L4**	PO1, PO2	PO1: Apply (L3) PO2: Review (L2)	3 3
6	10	38	3	Analyze	**L4**	PO1, PO2	PO1:Apply(L3) PO2:Review (L2)	3 3

CO1: Understand the fundamental laws of AC and DC circuits.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO1 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Identify (L3)
CO1 Action Verb is Less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO6: Using thumb rule, CO1 correlates PO6 as low (1).
CO2: Understand operating principles of motors, generators, MC and MI instruments.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO2 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO2 Action Verb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO6: Using thumb rule, CO2 correlates PO6 as low (1).
CO3: Understand the fundamentals of power generation, costing and safety measures.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO3 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO3 Action Verb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO6: Using thumb rule, CO3 correlates PO6 as medium (2).
CO4: Understand the fundamental concepts of diodes, transistors and its applications
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO4 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO2 Verbs: Review (L2)
CO4 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
CO5: Analyze the concepts of rectifiers, power supplies and amplifiers in electronics.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO5 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
PO2 Verbs: Review (L2)
CO5 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
CO6: Analyze the concepts of Number Systems, Boolean Functions, Logic Gates and Digital Circuits.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO6 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
PO2 Verbs: Review (L2)
CO6 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	Engineering Graphics	L	T/CLC	P	C
23AES0301	I-I		1	0	4	3

Course Outcomes:

After studying the course, student will be able to

- CO: 1 **Apply** the concepts of engineering curves and scales for technical drawing.
- CO: 2 **Understand** the quadrant system to locate the position of points, lines and planes.
- CO: 3 **Analyze** the projection of solids located in quadrant system.
- CO: 4 **Analyze** the sectional views and development of surfaces of regular solids.
- CO: 5 **Apply** orthographic and isometric projections concepts to construct the given object

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	the concepts of engineering curves and scales	for technical drawing		L3
CO2	Understand	the quadrant system to locate the position of points, lines and planes			L2
CO3	Analyze	the projection of solids	located in quadrant system		L4
CO4	Analyze	the sectional views and development of surfaces	of regular solids		L4
CO5	Apply	orthographic and isometric projections concepts to construct the given object			L3

Unit I: Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.

Curves: construction of ellipse, parabola and hyperbola by general, Cycloids, Involutes, Normal and tangent to Curves.

Scales: Plain scales, diagonal scales and vernier scales.

Unit II

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes

Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

Unit III

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

Unit IV

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

Unit V

Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views. **Computer graphics**: Creating 2D&3D drawings of objects including PCB and Transformations using Auto CAD (*Not for end examination*).

Text Books:

1. K. L. Narayana & P. Kannaiah, Engineering Drawing, 3/e, Scitech Publishers
2. N. D. Bhatt, Engineering Drawing, 53/e, Charotar Publishers

Reference Books:
1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
2. Engineering Drawing, M.B. Shah and B.C. Rana, Pearson Education Inc,2009.
3. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, TataMcGraw Hill, 2017.

Mapping of course outcomes with program outcomes

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Engineering Graphics	CO1	3		3							3		2	2
	CO2	2		2							3		2	2
	CO3	2		2							3		2	2
	CO4	3		3							3		2	2
	CO5	3		3							3		2	2

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation Matrix

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	18	24	3	Apply	L3	PO1 PO2 PO10	Apply (L3) Develop (L3) Thumb Rule	3 3 3
2	15	20	2	Understand	L2	PO1 PO2 PO10	Apply (L3) Develop (L3) Thumb Rule	2 2 3
3	15	20	2	Analyze	L4	PO1 PO2 PO10	Apply (L3) Develop (L3) Thumb Rule	3 3 3
4	15	20	2	Analyze	L4	PO1 PO2 PO10	Apply (L3) Develop (L3) Thumb Rule	3 3 3
5	12	16	2	Apply	L3	PO1 PO2 PO10	Apply (L3) Develop (L3) Thumb Rule	3 3 3

Justification Statements:
CO1: Apply the concepts of engineering curves and scales for technical drawing.
Action Verb: Apply (L3)
PO1 Verb: **Apply (L3)**
CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Develop (L3)**
CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO10 Verb: Thumb Rule (TR)
CO1: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)
CO2: Understand the quadrant system to locate the position of points, lines and planes.
Action Verb: Understand (L2)
PO1 Verb: **Apply (L3)**
CO2: Action verb is less than PO1 verb by one level. Therefore, the correlation is medium
(2)PO2 Verb: **Develop (L3)**
CO2: Action verb is less than PO2 verb by one level. Therefore, the correlation is medium (2)
PO10 Verb: Thumb Rule (TR)
CO2: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)
CO3: Analyze the projection of solids located in quadrant system.
Action Verb: Analyze (L4)
PO1 Verb: **Apply (L3)**
CO3: Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Develop (L3)**
CO3: Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO10 Verb: Thumb Rule (TR)

CO3: Engineering graphics involves creating visual representations and technical drawings to communicate

design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO4: Analyze the sectional views and development of surfaces of regular solids

Action Verb: Analyze (L4)

PO1 Verb: **Apply (L3)**

CO4: Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Develop (L3)**

CO4: Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO10 Verb: Thumb Rule (TR)

CO4: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO5: Apply orthographic and isometric projections concepts to construct the given object**.**

Action Verb: Apply (L3)

PO1 Verb: **Apply (L3)**

CO5: Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Develop (L3)**

CO5: Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO10 Verb: Thumb Rule (TR)

CO5: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	INTRODUCTION TO PROGRAMMING	L	T / CLC	P	C
23AES0501	I-I	(Common to All branches of Engineering)	2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO 1: **Understand** the computer Programming concepts and Algorithms.

CO 2: **Analyze** the control structures to implement basic programs.

CO 3: **Understand** the concept of Arrays and string to manipulate the stored data.

CO 4: **Create** the dynamic memory allocation using pointers and structures.

CO 5: **Create** the user defined functions and files for modifying stored data.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the computer Programming concepts and Algorithms.			L2
CO2	Analyze	the control structures		to implement basic programs.	L4
CO3	Understand	the concept of Arrays and string		to manipulate the stored data	L2
CO4	Create	the dynamic memory allocation	using pointers and structures.		L6
CO5	Create	user defined functions and files		for modifying stored data.	L6

UNIT – I	Introduction to Programming and Problem Solving	10 Hrs

History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program- Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting.

Problem solving techniques: Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

UNIT – II	Control Structures	9 Hrs

Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, do- while) Break and Continue.

UNIT – III	Arrays and Strings	9 Hrs

Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings.

UNIT – IV	Pointers & User Defined Data types	9 Hrs

Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, User-defined data types-Structures and Unions.

UNIT – V	Functions & File Handling	9 Hrs

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scope and Lifetime of Variables, Basics of File Handling

Textbooks:

1. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice- Hall, 1988
2. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education, 1996.

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.
2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition
3. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd edition

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	19	25%	3	CO1: Understand	L2	PO1 PO2 PO3	PO1: Apply(L3) PO2: Review(L2) PO3:Develop(L3)	2 3 2
2	10	14%	2	CO2: Analyze	L4	PO1 PO2 PO3 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO3: Develop (L3) PO11: Thumb rule	3 3 3 2
3	19	25%	3	CO3: Understand	L2	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review (L2) PO1: Thumb rule	2 3 2
4	15	20%	2	CO4: Create	L6	PO1 PO2 PO3 PO11	PO1: Apply(L3) PO2: Review (L2) PO3: Develop (L3) PO11: Thumb rule	3 3 3 2
5	12	16%	2	CO5: Create	L6	PO1 PO2 PO3 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO11: Thumb rule	3 3 3 3
	75	100 %						

Justification Statements :

CO1: Understand the computer Programming concepts and Algorithms.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Review (L2)
CO1 Action verb is same as than as PO2 verb by two level. Therefore, the correlation is High (3)
PO3 Verb: Develop (L3)
CO1 Action verb is less than as PO2 verb by one level. Therefore, the correlation is moderate (2)
CO2: Analyze the control structures to implement basic programs**.**
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO2 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO2 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO2 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
Some of the flow of control statements knowledge are used to solve various problems. Therefore, the correlation is moderate (2)
CO3: Understand the concept of Arrays and string to manipulate the stored data.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO3 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2: Review (L2)
CO3 Action verb is Same as PO2 verb. Therefore, the correlation is High (3)
PO11: Thumb rule
For some matrix operations array and string concepts were used Therefore, the correlation is moderate (2)
CO4: Create the dynamic memory allocation using pointers and structures.
Action Verb: Create (L6)
PO1: Apply (L3)
CO4 Action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3)
PO2: Review (L2)
CO4 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some mathematical operations Pointers and structures are used to manipulate the memory references. Therefore, the correlation is moderate (2)

CO5: Create the user defined functions and files for modifying stored data.
Action Verb: Create (L6)
PO1: Apply (L3)
CO5 Action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3)
PO2: Review (L2)
CO5 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO5 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
In today's world file handling techniques were used in most of the areas. Therefore, the correlation is high (3)

Course Code	Year & Sem	IT workshop	L	T/CLC	P	C
23AES0503	I-I	**(Common to AIDS&AIML)**	0	0	2	1

Course Outcomes:

After studying the course, student will be able to

CO1: Understand The Process of Software Installation & Hardware troubleshooting.

CO2: Analyze the network configurations for customizing web pages and search engines.

CO3: Apply the basic editing function, formatting text & objects on a required content.

CO4: Apply the formulas, functions and visualizations to manage the data.

CO5: Understand the libraries and models of chatGPT to generate information.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	The Process of Software Installation & Hardware troubleshooting.			L2
CO2	**Analyze**	the network configurations		for customizing web pages and search engines	L4
CO3	**Apply**	The basic editing function, formatting text & objects		on a required content	L3
CO4	**Apply**	the formulas, functions and visualizations		to manage the data	L3
CO5	**Understand**	The libraries and models of chatGPT		to generate information	L2

List of Experiments

PC Hardware & Software Installation

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.[CO1]

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.[CO1]

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.[CO1]

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva.[CO1]

Task 5: Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva.[CO1]

Internet & World Wide Web

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email. If there is

 no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.[CO2]

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.[CO2]

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student. [CO2]

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms. [CO2]

LaTeX and WORD

Task 1 – Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeXand word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word. [CO3]

Task 2: Using La TeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word. [CO3]

Task 3: Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and

Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes. [CO3]

Task 4: Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word. [CO3]

EXCEL

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources. [CO4]

Task 1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text[CO4]

Task 2: Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, [CO4]

LOOKUP/VLOOKUP

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting[CO4]

POWER POINT

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint. [CO4]

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts. [CO4]

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides. [CO4]

AI TOOLS – ChatGPT

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them. [CO5]

• Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas[CO5]

• Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are. [CO5]

• Ex:Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Reference Books:

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
5. LaTeX Companion, Leslie Lamport, PHI/Pearson.
6. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and Ken Quamme. – CISCO Press, Pearson Education, 3rd edition
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
1	CO1: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	CO2: Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 3 3
3	CO3: Apply	L3	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb rule	3 3 3 2 3 3
4	CO4: Apply	L3	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb rule	3 3 3 2 3 3
5	CO5: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Identify (L3)	2 2

Justification Statements :
CO1: Understand The Process of Software Installation & Hardware troubleshooting
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Review(L2)
CO1 Action verb is same as PO2 verb. Therefore, the correlation is high (3)
CO2: Analyze the network configurations for customizing web pages and search engines
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO2 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: idetify(L3)
CO2 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO2 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Apply (L3)
CO2 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)
CO 3: Apply The basic editing function, formatting text & objects on a required content.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO3 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Review(L2)
CO3 Action verb is less than as PO2 verb. Therefore, the correlation is high(3)
PO3: Develop(L3)
CO3 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO3 Action verb is less than as PO4 verb. Therefore, the correlation is moderate (2)
PO5: Apply (L3)
CO3 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
Documentation and presentation is learning process to find the solution better manner the correlation is high (3)
CO 4: Apply the formulas, functions and visualizations to manage the data.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO4 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)

PO2: idetify(L3)
CO4 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO4 Action verb is less than as PO4 verb by one level. Therefore, the correlation is moderate (2)
PO5: Apply (L3)
CO4 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
Spread sheets in Excel is the trending approach in the current days Therefore, the correlation is high (3)
CO 5: Understand the libraries and models of chatGPT to generate information.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Identify(L3)
CO1 Action verb is same as PO2 verb. Therefore, the correlation is moderate (2)

(Autonomous)
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)
Common to I Sem ECE/ AI&DS/AI&ML/CE/ME & I Sem CSE/CIC/EEE/CSD

Subject Code: 23ABS9908	Subject Name: **Engineering Physics Lab**	L 0	T/CLC 0	P 2	Credits: 1

Course Outcomes

After studying the course, student will be able to

CO1: **Analyze** the properties of light for engineering problems.
CO2: **Evaluate** the crystallite size using X-ray diffraction.
CO3: **Analyze** the basic properties of dielectric and magnetic behavior of the given material.
CO4: **Determine** the mechanical behavior of a given material.
CO5: **Evaluate** the basic parameters of a given semiconductor material.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	The properties of light		for engineering problems.	L4
2	Evaluate	The crystallite size using X-ray diffraction.			L5
3	Analyze	The basic properties of dielectric and magnetic behavior of the given material.			L4
4	Determine	The mechanical behavior of a given material.			L5
5	Evaluate	The basic parameters of a given semiconductor material.			L5

List of Experiments:

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings – CO1.
2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration – CO1.
3. Study the variation of B versus H by magnetizing the magnetic material (B-H curve) – CO3.
4. Determination of wavelength of Laser light using diffraction grating – CO1.
5. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method – CO3.
6. Determination of energy gap of a semiconductor using p-n junction diode – CO5.
7. Determination of the resistivity of semiconductors by four probe methods – CO5.
8. Determination of the crystallite size using X-Ray Diffraction spectra – CO2.
9. Determination of the numerical aperture of a given optical fiber and angle of acceptance – CO1.
10. Verification of Brewster's law – CO1.
11. Determination of acceleration due to gravity and radius of Gyration by using a compound pendulum – CO4.
12. Determination of rigidity modulus of the material of the given wire using Torsional pendulum – CO4.
13. Determination of temperature coefficients of a thermistor – CO5.
14. Determination of dielectric constant using charging and discharging method – CO3.
15. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect – CO5.
16. Sonometer: Verification of laws of stretched string – CO4.
17. Determination of magnetic susceptibility by Kundt's tube method – CO3.
18. Determination of Frequency of electrically maintained tuning fork by Melde's experiment – CO4.

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO

Experiments may be conducted in virtual mode.
References: A Textbook of Practical Physics - S. Balasubramanian, M. N. Srinivasan, S. Chand Publishers, 2017.
URL: www.vlab.co.in

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3			3									
2	3			3									
3	3			3									
4	3			3									
5	3			3									

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	9	25	3	Analyze	L4	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
2	6	16	2	Evaluate	L5	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
3	9	25	3	Analyze	L4	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
4	6	16	2	Determine	L5	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
5	6	16	2	Evaluate	L5	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
	36							

CO1: Analyze the properties of light for solving engineering problems.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
   CO1 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
      CO1 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).
CO2: Evaluate the crystallite size using X-ray diffraction.
Action Verb: Evaluate (L5)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)

   CO2 Action Verb is greater than PO1 verb by two levels; Therefore correlation is high (3).
      CO2 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
CO3: Analyze the basic properties of dielectric and magnetic behavior of the given material.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
   CO3 Action Verb level is greater than PO1 action verb by one level; Therefore correlation is high (3).
      CO3 Action Verb level is equal to PO4 action verb; Therefore correlation is high (3).
CO4: Determine the mechanical behavior of a given material using dynamic methods.
Action Verb: Determine (L5)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
      CO4 Action Verb is greater than PO1 verb by two levels; Therefore correlation is high (3).
      CO4 Action Verb is greater than PO4 verb by one level; Therefore correlation is high (3).
CO5: Evaluate the basic parameters of a given semiconductor material.
Action Verb: Evaluate (L5)
PO1 and PO4 Verb: Apply (L3)
   CO5 Action Verb is greater than PO1 verb by two levels; Therefore correlation is high (3).
      CO5 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).

Course Code	Year & Sem	Electrical & Electronics Engineering Workshop	L	T/CLC	P	C
23AES0202	I-I		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: **Understand** the Electrical circuit design, measurement of resistance, power, and power factor.

CO2: **Apply** suitable methods to measure Resistance, power, energy and power factor.

CO3: **Design** suitable methods for magnetization characteristics of D. C shunt generator.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
CO1	Understand	Electrical circuit design; measurement of resistance, power, power factor			L2
CO2	Apply	Suitable methods to measure Resistance, power, energy and power factor.			L3
CO3	Design	Suitable methods for magnetization characteristics of D. C shunt generator.			L6

SYLLABUS:

PART A
ELECTRICAL ENGINEERING LAB

List of experiments:

Verification of Kirchhoff's current law and Voltage law-(CO1).

Verification of Superposition theorem-(CO1).

Measurement of Resistance using Wheat stone bridge-(CO1).

Measurement of Power and Power factor using Single-phase watt-meter-(CO2).

Measurement of Earth Resistance using Megger-(CO2).

Calculation of Electrical Energy for Domestic Premises-(CO2).

Magnetization Characteristics of DC shunt Generator-(CO3).

Reference Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Note: Minimum Six Experiments to be performed.

PART B
ELECTRONICS ENGINEERING LAB

COURSE OUTCOMES:

After completion of the course, students will be able to:

CO4: **Understand** the V-I Characteristics of diodes and its applications.

CO5: **Analyze** the input and output characteristics of BJT and its applications.

CO6: **Analyze** the truth tables of all logic gates and f/f's using IC's.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
CO4	Understand	V-I Characteristics of diodes and its applications.			L2
CO5	Analyze	input and output characteristics of BJT and its applications			L4
CO6	Analyze	Truth tables of all logic gates and f/f's using IC's.			L4

List of Experiments:

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias. (CO4)
2. Plot VI characteristics of Zener Diode and its application as voltage Regulator. (CO4)
3. Implementation of half wave and full wave rectifiers (CO4)
4. Plot Input & Output characteristics of BJT in CE and CB configurations (CO5)
5. Frequency response of CE amplifier. (CO5)
6. Simulation of RC coupled amplifier with the design supplied. (CO5)
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs. (CO6)
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs. (CO6)

Tools Equipment Required: DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROS, and all the required active devices.

References:
1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits - Conventional Flow Version, Pearson Education, 2009.

Note: Minimum Six Experiments to be performed. All the experiments shall be implemented using both Hardware and Software.

Mapping of course outcomes with program outcomes

Mapping of Course outcomes with Program outcomes													
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1		1					1			2	
CO2	3	2		2					1			2	
CO3		3		3					1			2	1
CO4	2	3											
CO5	3	3											
CO6	3	3											
Levels of correlation,viz.,1.Low,2.Moderate,3.High													

Justification Table:

CO	Cos		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Verb	**BTL**			
1	**Understand**	**L2**	PO1, PO2, PO4, PO9	PO1: Apply (L3) PO2: Analyze (L4) PO4: Analyze (L4) PO9: Thumb Rule	2 1 1 1
2	**Apply**	**L3**	PO1, PO2, PO4, PO9	PO1: Apply (L3) PO2: Analyze(L4) PO4: Analyze(L4) PO9: Thumb Rule	3 2 2 1
3	**Design**	**L6**	PO2, PO4, PO9	PO2: Analyze(L4) PO4: Design (L6) PO9: Thumb Rule	3 3 1
4	Understand	**L2**	PO1, PO2	PO1: Apply (L3) PO2: Review (L2)	2 3
5	Analyze	**L4**	PO1, PO2	PO1: Apply (L3) PO2: Review (L2)	3 3
6	Analyze	**L4**	PO1, PO2	PO1:Apply(L3) PO2:Review (L2)	3 3

CO1: Understand the Electrical circuit design, measurement of resistance, power, and power factor.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO1 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO1 Action Verb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO4: Analyze (L4)
CO1 Action Verb is Less than PO4 verb by two level; Therefore, correlation is low (1).
PO9: Using Thumb Rule, CO1 correlates to PO9 as low (1).

CO2: Apply suitable methods to measure Resistance, power, energy and power factor.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action Verb is same as PO1 verb; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO2 Action Verb is Less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO4: Analyze (L4)
CO2 Action Verb is Less than PO4 verb by one level; Therefore, correlation is moderate (2).
PO9: Using Thumb Rule, CO2 correlates to PO9 as low (1).

CO3: Design suitable methods for magnetization characteristics of D. C shunt generator.
Action Verb: Design (L6)
PO2: Analyze (L4)
CO3 Action Verb is greater than PO2 verb by two level; Therefore, correlation is high (3).
PO4: Design (L6)
CO3 Action Verb is same as PO4 verb; Therefore, correlation is high (3).
PO9: Using Thumb Rule, CO3 correlates to PO9 as low (1).

CO4: Understand the V-I Characteristics of diodes and its applications.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO4 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2)
PO2 Verbs: Review (L2)
CO4 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO5: Analyze the input and output characteristics of BJT and its applications.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO5 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
PO2 Verbs: Review (L2)
CO5 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO6: Analyze the truth tables of all logic gates and f/f's using IC's.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO6 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
PO2 Verbs: Review (L2)
CO6 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

Course Code	Year & Sem	COMPUTER PROGRAMMING LAB	L	T/CLC	P	C
23AES0502	I-I	**(Common to All Branches of Engineering)**	0	0	3	1.5

Course Outcomes:
After studying the course, student will be able to
CO1: Understand the basic syntax of C program to build applications.
CO2: Create the control structure for solving complex problems.
CO3: Apply the concepts of arrays, functions, basic concepts of pointers to organize the data.
CO4: Apply the concepts of structures, unions and linked list to manage heterogeneous data .
CO5: Create the file applications for storing and accessing data.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the basic syntax of C program		to build applications	L2
CO2	**Create**	the control structure		for solving complex problems	L6
CO3	**Apply**	the concepts of arrays, functions, basic concepts of pointers		to organize the data	L3
CO4	**Apply**	the concepts of structures, unions and linked list		to manage heterogeneous data	L3
CO5	**Create**	the file applications		for storing and accessing data	L6

List of Experiments:
Exercise 1: Problem-solving using Computers[CO1]
Basic Linux environment and its editors like Vi, Vim & Emacs etc.
Exposure to Turbo C, gcc
Writing simple programs using printf(), scanf()
Exercise 2: Problem-solving using Algorithms and Flow charts.[CO1]
Sum and average of 3 numbers
Conversion of Fahrenheit to Celsius and vice versa
Simple interest calculation
Exercise 3: Variable types and type conversions[CO2]
i)   Finding the square root of a given number
ii) Finding compound interest
iii) Area of a triangle using heron's formulae
iv) Distance travelled by an object
Exercise 4: Operators and the precedence and as associativity[CO2]
i)   Evaluate the following expressions.
a.   A+B*C+(D*E) + F*G
b.   A/B*C-B+A*D/3
c.   A+++B---A
d.   J= (i++) + (++i)
ii) Find the maximum of three numbers using conditional operator
iii) Take marks of 5 subjects in integers, and find the total, average in float
list and perform insertion, deletion, and traversal.
Exercise 5: Branching and logical expressions[CO2]
i)   Write a C program to find the max and min of four numbers using if-else.
ii) Write a C program to generate electricity bill.
iii) Find the roots of the quadratic equation.
iv) Write a C program to simulate a calculator using switch case.
v)   Write a C program to find the given year is a leap year or not.
Exercise 6: Loops, while and for loops[CO2]
i)   Find the factorial of given number using any loop.
ii) Find the given number is a prime or not.
iii) Compute sine and cos series
iv) Checking a number palindrome
Construct a pyramid of numbers.
Exercise 7: 1 D Arrays: searching[CO3]
i)   Find the min and max of a 1-D integer array.

ii) Perform linear search on1D array.
iii) The reverse of a 1D integer array
iv) Find 2's complement of the given binary number.
v) Eliminate duplicate elements in an array.

Exercise 8: 2 D arrays, sorting and Strings[CO3]
i) Addition of two matrices
ii) Multiplication two matrices
iii) Sort array elements using bubble sort
iv) Concatenate two strings without built-in functions
v) Reverse a string using built-in and without built-in string functions

Exercise 9: Pointers, structures and dynamic memory allocation[CO3]
i. Write a C program to find the sum of a 1D array using malloc()
ii. Write a C program to find the total, average of n students using structures
iii. Enter n students data using calloc() and display failed students list
iv. Read student name and marks from the command line and display the student details along   with the total.
v. Write a C program to implement realloc()

Exercise 10: Bitfields, Self-Referential Structures, Linked lists[CO4]
Create and display a singly linked list using self-referential structure.
ii) Demonstrate the differences between structures and unions using a C program.
iii) Write a C program to shift/rotate using bitfields.
iv) Write a C program to copy one structure variable to another structure of the same type.

Exercise 11: Functions, call by value, scope and extent[CO2]
Write a C function to calculate NCR value.
ii) Write a C function to find the length of a string.
iii) Write a C function to transpose of a matrix.
iv) Write a C function to demonstrate numerical integration of differential equations using Euler's method

Exercise 12: Recursion, the structure of recursive calls[CO4]
Write a recursive function to generate Fibonacci series.
ii) Write a recursive function to find the lcm of two numbers.
iii) Write a recursive function to find the factorial of a number.
iv) Write a C Program to implement Ackermann function using recursion.
v) Write a recursive function to find the sum of series.

Exercise 13: Call by reference, dangling pointers[CO4]
i) Write a C program to swap two numbers using call by reference.
ii) Demonstrate Dangling pointer problem using a C program.
iii) Write a C program to copy one string into another using pointer.
v) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

Exercise 14: File handling[CO5]
i) Write a C program to write and read text into a file.
ii) Write a C program to write and read text into a binary file using fread() and fwrite()
iii) Copy the contents of one file to another file.
iv) Write a C program to merge two files into the third file using command-line arguments.
v) Find no. of lines, words and characters in a file
vi) Write a C program to print last n characters of a given file.

Textbooks:
1. Ajay Mittal, Programming in C: A practical approach, Pearson.
2. Byron Gottfried, Schaum' s Outline of Programming with C, McGraw Hill

Reference Books:
1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice- Hall of India
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

Mapping of course outcomes with program outcomes

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

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
1	CO1: understand	L2	PO1 PO2 PO3 PO4	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO4: Analyze(L4)	2 3 2 2
2	CO2: Create	L6	PO1 PO2 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review (L3) PO4: Analyze (L4) PO5: Apply(L3) PO11: Thumb rule	3 3 3 3 2
3	CO3: Apply	L3	PO1 PO2 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review (L3) PO4: Analyze (L4) PO5: Apply(L3) PO11: Thumb rule	3 3 2 3 3
4	CO4: Apply	L3	PO1 PO2 PO3 PO4 PO11	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO4: Analyze (L4) PO11: Thumb rule	3 3 3 2 2
5	CO5: Create	L6	PO1 PO2 PO3 PO4 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO4: Analyze (L4) PO11: Thumb rule	3 3 3 3 3

Justification Statements :
CO1: Understand the basic syntax of C program to build applications.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Review(L2)
CO1 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO3: Develop(L3)
CO1 Action verb is less than PO3 verb by one level. Therefore, the correlation is moderate (2)
PO4: Analyze(L4)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate is (2)

CO2: Create the control structure for solving complex problems.
Action Verb: Create (L6)
PO1: Apply (L3)
CO2 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L3)
CO2 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Apply(L3)

CO2 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (2)

CO3: Apply the concepts of arrays, functions, basic concepts of pointers to organize the data..
Action Verb: Apply (L3)
PO1: Apply (L3)
CO3 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L3)
CO3 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO3 Action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2)

PO5: Apply(L3)

CO3 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

PO11: Thumb rule

For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (3)

CO4: Apply the concepts of structures, unions and linked list to manage heterogeneous data.

Action Verb: Apply (L3)

PO1: Apply (L3)

CO4 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)

PO2: Review (L3)

CO4 Action verb is same level PO2 verb. Therefore, the correlation is high (3)

PO4: Analyze (L4)

CO4 Action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2)

PO5: Apply(L3)

CO4 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

PO11: Thumb rule

For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (2)

CO5: Create the file applications for storing and accessing data.

Action Verb: Create (L6)

PO1: Apply (L3)

CO5 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)

PO2: Review (L3)

CO5 Action verb is same level PO2 verb. Therefore, the correlation is high (3)

PO4: Analyze (L4)

CO5 Action verb is same as PO4 verb. Therefore, the correlation is high (3)

PO5: Apply(L3)

CO5 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

PO11: Thumb rule

For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (3)

Course Code	Year & Sem	NSS/NCC/Scouts & Guides/Community Service	L	T/CLC	P	C
23AHM9904	I-I		0	0	1	0.5

Course Outcomes: After studying the course, students will be able to

CO1: **Understand** the importance of discipline, character and service motto of community.
CO2: **Analyze** the activities need to be done for nature protection
CO3: **Analyze** the social issues in a community and address it through the base camps.

Course Outcomes	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Understand	the importance of discipline, character and service motto		of community	L1
CO2	Analyze	the activities need to be done for nature protection			L4
CO3	Analyze	the social issues in a community and address it through the base camps			L4

UNIT-I

Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.
Activities:
  i) Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills
  ii) Conducting orientations programs for the students –future plans-activities-releasing road map etc.
  iii) Displaying success stories-motivational biopics- award winning movies on societal issues etc.
  iv) Conducting talent show in singing patriotic songs-paintings- any other contribution

UNIT-II

Nature & Care
Activities:
  i) Best out of waste competition.
  ii) Poster and signs making competition to spread environmental awareness.
  iii) Recycling and environmental pollution article writing competition.
  iv) Organizing Zero-waste day.
  v) Digital Environmental awareness activity via various social media platforms.
  vi) Virtual demonstration of different eco-friendly approaches for sustainable living.
  vii) Write a summary on any book related to environmental issues.

UNIT-III

Community Service
Activities:
  i) Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities- experts-etc.
  ii) Mental health, Spiritual Health, HIV/AIDS,
  iii) Conducting consumer Awareness. Explaining various legal provisions etc.
  iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
  v) Any other programmes in collaboration with local charities, NGOs etc.
  vi) Conducting awareness programs on Health-related issues such as General Health,

CORRELATION OF COS WITH THE POS & PSOS:

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-POMAPPING JUSTIFICATION:

Unit No	Course Outcomes		Program Outcome (PO)	PO(s):Action Verb and BTL(forPO1 to PO11)	Level of Correlation (0-3)
	CO's Action Verb	BTL			
1	Understand	L2	PO1 PO2 PO10	Apply(L3) Analyze(L4) Thumb Rule	2 2 2
2	Analyze	L4	PO1 PO2 PO10	Apply(L3) Analyze(L4) Thumb Rule	2 3 3
3	Analyze	L4	PO1 PO2 PO10	Apply(L3) Analyze(L4) Thumb Rule	2 3 3

Justification Statements:

CO1: Understand the importance of discipline, character and service motto of community.
Action Verb: Understand (L2)
  CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
  CO1 Action Verb is less than PO2 verb by one level; Therefore correlation is moderate (2).
  CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO10 as moderate (2).

CO2: Analyze the activities need to be done for nature protection
Action Verb: Analyze (L4)
CO2 Action Verb is greater than PO1 verb by one level; Therefore correlation is moderate (2).
CO2 Action Verb is same as PO2 verb, Therefore correlation is High (3)
CO2 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO10 as moderate (4).

CO3: Analyze the social issues in a community and address it through the base camps
Action Verb: Analyze (L4)
CO3 Action Verb is greater than PO1 verb by one level; Therefore correlation is moderate (2).
CO3 Action Verb is same as PO2 verb, Therefore correlation is High (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
AK23 REGULATIONS
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)
(Effective for the batches admitted from 2023-24)

B.Tech – I Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P	C			
1	HM	23AHM9901	Communicative English	2	0	0	2	30	70	100
2	BS	23ABS9901	Chemistry	2	1	0	3	30	70	100
3	BS	23ABS9905	Differential Equations &Vector Calculus	2	1	0	3	30	70	100
4	ES	23AES0101	Basic Civil& Mechanical Engineering	2	1	0	3	30	70	100
5	PC	23APC0501	Data Structures	2	1	0	3	30	70	100
6	HM	23AHM9902	Communicative English Lab	0	0	2	1	30	70	100
7	BS	23ABS9906	Chemistry Lab	0	0	2	1	30	70	100
8	ES	23AES0302	Engineering Workshop	0	0	3	1.5	30	70	100
9	PC	23APC0502	Data Structures Lab	0	0	3	1.5	30	70	100
10	HM	23AHM9903	Health and wellness, Yoga and Sports	0	0	1	0.5	50	-	50
			Total	**10**	**4**	**11**	**19.5**	**320**	**630**	**950**

Year: I B.Tech	(Common to all branches)				Semester: II	

Subject Code 23AHM9901	Subject Name **COMMUNICATIVE ENGLISH**	L 2	T/CLC 2	P 0	Credit: 2	CLC: 2

Pre-Requisites	Communicative English	Semester	**II**

Course Outcomes (CO): Student will be able to

CO1: Understand reading / listening texts and to write summaries based on global comprehension of these texts.**(Listening & Reading)**

CO2: Apply grammatical structures to formulate sentences and correct word forms.**(Grammar)**

CO3: Analyze discourse markers to speak clearly on a specific topic in formal and informal conversations.(**Speaking**)

CO4: Analyze a coherent paragraph interpreting graphic elements,figure/graph/chart/table**(Read & Write)**

CO5: Create a coherent essay, letter writing, report writing and design a resume.**(Writing)**

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	reading / listening texts and to write summaries based on global comprehension of these texts.			L2
2	Apply	grammatical structures to formulate sentences and correct word forms			L3
3	Analyze	Analyze discourse markers to speak clearly on a specific topic in formal and informal conversations...			L4
4	Analyze	coherent paragraph interpreting a graphic elements.			L4
5	Create	coherent essay, letter writing, report writing and design a resume			L6

UNIT I

Lesson: HUMAN VALUES: Gift of Magi**(Short Story)**

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.

Grammar: Parts of Speech, Basic Sentence Structures-forming questions

Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNIT II

Lesson: NATURE: The Brook by Alfred Tennyson (Poem)

Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts.

Speaking: Discussion in pairs/small groups on specific topics followed by short structure talks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Writing: Structure of a paragraph - Paragraph writing (specific topics) **Grammar:** Cohesive devices - linkers, use of articles and zero article; prepositions. **Vocabulary:** Homonyms, Homophones, Homographs.

UNIT III

Lesson: BIOGRAPHY: Elon Musk

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics   in pairs or   small groups and reporting what is discussed

Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

Writing: Summarizing, Note-making, paraphrasing

Grammar: Verbs - tenses; subject-verb agreement.
Vocabulary: Compound words, Collocations

UNIT IV
Lesson: INSPIRATION: The Toys of Peace by Saki
Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.
Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.
Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.
Writing: Letter Writing: Official Letters, Resumes, Cover letters
Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice
Vocabulary: Words often confused, Jargons

UNIT V
Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay)
Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.
Speaking: Formal oral presentations on topics from academic contexts
Reading: Reading comprehension.
Writing: Writing structured essays on specific topics.
Grammar: Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)
Vocabulary: Idiom and phrases & Phrasal verbs

Textbooks:
1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023 (Units 1,2 & 3)
2. Empowering with Language by Cengage Publications, 2023 (Units 4 & 5)

Reference Books:
1. Dubey, Sham Ji& Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

WEB RESOURCES:
GRAMMAR:
1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/
5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx

VOCABULARY
1. https://www.youtube.com/c/DailyVideoVocabulary/videos
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

Correlation of COs with the POs & PSOs for B.Tech

Course Outcomes COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1									2		
CO2								2	2		
CO3									3		
CO4									3		
CO5									3		

(*3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated)

CO-PO mapping justification:

C O	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	cor r	Verb	BT L			
1	12	22	3	**Understand**	**L2**	PO9	Thumb Rule	2
2	12	22	3	**Apply**	**L3**	PO8,PO9	Thumb Rule	2,2
3	10	18	**2**	**Analyze**	**L4**	PO9	Thumb Rule	3
4	10	18	**2**	**Analyze**	**L4**	PO9	Thumb Rule	3
5	10	18	**2**	**Create**	**L6**	PO9	Thumb Rule	3

CO1: Understand reading / listening text and to write summaries based on global comprehension of these texts.
Action Verb: Understand (L2)
CO1 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).

CO2: Apply grammatical structures to formulate sentences and correct word forms.
Action Verb: Apply (L3)
CO2 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2) & (2)
CO3: Analyze discourse markers to speak clearly on a specific topic in Formal and informal Conversations.
Action Verb: Analyze (L4)
CO3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).
CO4: Analyze a coherent paragraph interpreting graphic elements, figure/graph/chart/table
(Read & Write)
Action Verb: Analyze (L4)
CO4 Action Verb Analyze is of BTL 4. Using Thumb rule, L6 correlates PO6 to PO11 as high (3).
CO5: Create a coherent essay, letter writing, report writing and design a resume.(Writing)
Action Verb: Create (L6)
CO5 Action Verb Create is of BTL 6. Using Thumb rule, L5 correlates PO6 to PO1 as high (3).

Year: I B.Tech	**(**Semester: I **CSE, CIC, CSD& EEE)**	(Semester: II **ECE, AI&DS & AI&ML**)

Subject Code: 23ABS9901	**Subject Name:** Chemistry	L	T/CLC	P	Credits:3
		2	1	0	

Course Outcomes (CO): At the end of the course students will be able to

CO1:Understand the interaction of energy levels between atoms and molecules
CO2:Apply the principle of Band diagrams in the conductors and semiconductors
CO3:Apply the electrochemical principles to the construction of batteries, fuel cells and sensors
CO4:Analyze the preparation and mechanism of plastics, Elastomers and conducting polymers
CO5:Analyze the separation of liquid mixtures using instrumental methods.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the interaction of energy levels		between atoms and molecules	L2
2	**Apply**	principle of Band diagrams	conductors and semiconductors		L3
3	**Apply**	electrochemical principles to the construction of batteries, fuel cells and sensors			L3
4	**Analyze**	preparation and mechanism of plastics, Elastomers and conducting polymers			L4
5	**Analyze**	the separation of liquid mixtures	using instrumental methods		L4

UNIT I: Structure and Bonding Models

Fundamentals of Quantum mechanics, Schrodinger Wave equation, significance of Ψ and Ψ^2, particle in one dimensional box, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of O_2 and CO, etc. π-molecular orbitals of butadiene and benzene, calculation of bond order.

UNIT II: Modern Engineering materials

Semiconductors: Introduction, basic concept, application
Super conductors: Introduction basic concept, applications.
Super capacitors: Introduction, Basic Concept-Classification – Applications.
Nano materials: Introduction, classification, properties and applications of Fullerenes, carbon Nano tubes and Graphines nanoparticles.

UNIT III Electrochemistry and Applications

Electrochemical cell, Nernst equation, cell potential calculations and numerical problems, potentiometry-potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations).
Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with examples.
Primary cells – Zinc-air battery, Secondary cells –lithium-ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygenfuel cell– working of the cells. Polymer Electrolyte Membrane Fuel cells (PEMFC).

UNIT IV Polymer Chemistry

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, with specific examples and mechanisms of polymer formation.
Plastics –Thermo and Thermosetting plastics, Preparation, properties and applications of – PVC, Teflon, Bakelite, Nylon-6,6, carbon fibres.
Elastomers–Buna-S, Buna-N–preparation, properties and applications.
Conducting polymers – polyacetylene, polyaniline, – mechanism of conduction and applications. Bio-Degradable polymers - Poly Glycolic Acid (PGA), Polyl Lactic Acid (PLA).

UNIT V Instrumental Methods and Applications

Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. UV-Visible Spectroscopy, electronic transition, Instrumentation, IR spectroscopies, fundamental modes and selection rules, Instrumentation. Chromatography-Basic Principle, Classification-HPLC: Principle, Instrumentation and Applications.

Textbooks:
1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e,Oxford University Press, 2010.

Reference Books:
1. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
2. J.D. Lee, Concise Inorganic Chemistry, 5th Edition, Wiley Publications, Feb.2008
3. Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2												
2	3												
3	3												
4		3											
5		3											

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours				CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Register (Hrs)	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1	10	10	15.6	2	Understand	L2	PO1	PO1: Apply (L3)	2
2	10	17	26.5	3	Apply	L3	PO1	PO1: Apply (L3)	3
3	10	12	18.7	3	Apply	L3	PO2	PO1: Apply (L3)	3
4	10	13	20.3	3	Analyze	L4	PO2	PO2: Analyze (L4)	3
5	10	12	18.7	3	Analyze	L4	PO1	PO2: Analyze (L4)	3

CO1: Understand the fundamentals of Atoms and Molecules
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
CO2: Apply electrochemical principles to construct batteries
Action Verb: Apply (L3)
PO1 Verbs: Apply (L3)
CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
CO3: Apply electrochemical principles to the construction of batteries, fuel cells and electrochemical sensors
Action Verb: Apply (L3)
PO2 Verb: Apply (L3)
CO3 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).
CO4: Analyze the preparation and mechanism of polymers
Action Verb: Analyze (L4)
PO2 Verb: Analyze (L4)
CO3 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).
CO5: Analyze the identification of individual components
Action Verb: Analyze (L4)
PO1 Verb: Analyze (L4)
CO5 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

	ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI
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	ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Year : I	**Semester** : II	**Branch of Study : Common to all**

Subject Code: 23ABS9905	**Subject Name: Differential Equations & Vector Calculus**	**L** **2**	**T/CLC** **1**	**P** **0**	**Credits** **3**

Course Outcomes (CO): Student will be able to

CO1. **Apply** the concepts of ordinary differential equations of first order and first degree.
CO2. **Apply** the methods of linear differential equations related to various engineering problems.
CO3. **Analyze** the solutions of partial differential equations using Lagrange's method.
CO4. **Understand** the different operators and identities in the vector calculus.
CO5. **Evaluate** the surface integral and volume integral in the vector calculus using various theorems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	The concepts of ordinary differential equations.		of first order and first degree	L3
2	Apply	The methods of linear differential equations related to various engineering problems.			L3
3	Analyze	The solutions of partial differential equations.	Using Lagrange's method		L4
4	Understand	different operators and identities in the vector calculus.			L2
5	Evaluate	the surface integral and volume integral in the vector calculus.	Using various theorems		L5

UNIT I: Linear Differential Equations of first Order and first Degree   9hrs
Linear differential equations-Bernoulli's equations-Exat equations and equations reducible to exact form. Applications: Newton's Law of cooling-Law of natural growth and decay-Electrical circuits.

UNIT II: Equations Reducible to Linear Differential Equations and Applications   9 hrs
Definitions, homogeneous and non-homogeneous , complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and simple Harmonic motion.

UNIT III: Partial Differential Equations   9 hrs
Introduction and formation of partial differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

UNIT IV: Vector differentiation   9 hrs
Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, Directional derivative, del applied to vector point functions-Divergence and Curl, vector identities.

UNIT V: Vector integration   9 hrs
Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

Text Books :
1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2011.

References:
1. Dr.T.K.V.Iyengar, Engineering Mathematics-I,S.Chand publishers
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics,Laxmipublication,2008
4. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education.

Mapping of COs to POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1	3										
2	3										
3		3									
4	2										
5		3									

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	14	20.8	3	Apply	L4	PO1	Apply	3
2	15	22.3	3	Apply	L3	PO1	Apply	3
3	14	20.8	3	Analyze	L4	PO2	Analyze	3
4	9	13.4	2	Understand	L2	PO1	Apply	2
5	15	22.3	3	Evaluate	L5	PO2	Analyze	3

CO1: Apply the concepts of ordinary differential equations of first order and first degree.
Action Verb: Apply(L3)
PO1 Verbs: Apply(L3)
CO1 Action Verb is equal to PO1 verb Therefore correlation is high (3).

CO2: Apply the methods of linear differential equations related to various engineering problems.
Action Verb: Apply (L3)
PO1 Verbs: Apply (L3)
CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

CO3: Analyze the solutions of partial differential equations.
Action Verb: Analyze(L4)
PO2 Verb: Analyze (L4)
CO3 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

CO4: Understand the different operators and identities in the vector calculus.
Action Verb: Understand(L2)
PO1 Verb: Apply(L3)
CO4 Action Verb is low level to PO1 to one level; Therefore correlation is moderate (2).

CO5: Evaluate the surface integral and volume integral in the vector calculus.
Action Verb: Evaluate(L5)
PO2 Verb: Analyze (L4)
CO5 Action verb is high level to PO2 verb; therefore the correlation is high (3).

Course Code	Year & Sem	Basic Civil & Mechanical Engineering	L	T/CLC	P	C
23AES0101	I-II		3	0	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society

CO2: Apply the methods of surveying in finding the measurements on Earth surface

CO3: Understand the importance of transportation, water resources and environmental engineering

CO4: Understand the applications and role of various materials in Mechanical Engineering.

CO5: Understand the different manufacturing processes and the basics of thermal engineering with its applications.

CO6: Understand the working of different mechanical power transmission systems, power plants and applications of robotics.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	Various sub-divisions of Civil Engineering		Role in ensuring better society	L2
CO2	Apply	Methods of surveying	Finding the measurements	On Earth surface	L3
CO3	Understand	Importance of transportation, water resources and environmental engineering			L2
CO4	Understand	applications and role of various materials in Mechanical Engineering			L2
CO5	Understand	different manufacturing processes and the basics of thermal engineering with its applications			L2
CO6	Understand	working of different mechanical power transmission systems, power plants and applications of robotics			L2

BASICS OF CIVIL ENGINEERING (PART-A)

UNIT I

Basics of Civil Engineering:

Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

UNIT II

Surveying: Objectives of Surveying- Horizontal Measurements- Angular Measurements- Introduction to Bearings Levelling instruments used for levelling -Simple problems on levelling and bearings-Contour mapping.

UNIT III

Transportation Engineering: Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering.

Water Resources and Environmental Engineering:

Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting- Water Storage andConveyance Structures (Simple introduction to Dams and Reservoirs).

Textbooks:

1.   Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt.Ltd. Fourth Edition.

2.   Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers.2022. First Edition.

3.   Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition

Reference Books:

1.   Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. FifthEdition

2.   Hydrology and Water Resources Engineering, Santosh Kumar Garg, KhannaPublishers, Delhi. 2016

3.   Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, Khanna Publishers, Delhi 2023. 38th Edition

4.   Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition

5.   Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012

PART-B
BASICS OF MECHANICAL ENGINEERING

UNIT I

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society- Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

UNIT II

Manufacturing Processes: Principles of Casting, Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

Thermal Engineering – working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

UNIT III

Power plants – working principle of Steam, Diesel, Hydro, Nuclear power plants.

Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics - Joints & links, configurations, and applications of robotics.

Textbooks:

1. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India)Pvt. Ltd.
2. A Tear book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications,(India) Pvt. Ltd.
3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd.

Reference Books:

1. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I
2. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak MPandey, Springer publications
3. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt.Ltd.
4. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, TataMcGraw Hill publications (India) Pvt. Ltd.

Mapping of COs to POs

COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2					2						
CO2	3	2				2							
CO3	2	2					2						
CO4	2					2							
CO5	2						2						
CO6	2				2		2						

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Lesson Plan (Hrs)	%	Correlation	Verb	BTL	Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
1	11/33	33	2	Understand	L2	PO1 PO2 PO7	Apply (L3) Analyze (L3) Thumb Rule	2 2 2
2	12/33	34	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
3	11/33	33	2	Understand	L2	PO1 PO2 PO7	Apply (L3) Analyze (L3) Thumb Rule	2 2 2
4	9/30	30	3	Understand	L2	PO1 PO6	Identify-L3 Thumb Rule	2 2
5	12/30	40	3	Understand	L2	PO1 PO7	Identify-L3 Thumb Rule	2 2
6	9/30	30	3	Understand	L2	PO1 PO5 PO7	Apply(Identify)-L3 Apply-L3 Thumb Rule	2 2 2

Justification Statements:

CO1: Understand various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society.

Action Verb: Understand (L2)

PO1 Verb: **Apply (L3)**

CO1 Action verb is not same level as PO1 verb. Therefore, the correlation is medium (2)

PO2 Verb: **Analyze(L4)**

CO1 Action verb is not same level as PO2 verb. Therefore, the correlation is medium (2)

PO7 Verb: **Thumb Rule**

CO1 correlates medium with PO7. Therefore, the correlation is medium (2)

CO2: Apply the methods of surveying in finding the measurements on Earth surface.

Action Verb: **Apply (L3)**

PO1 Verb: **Apply (L3)**

CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Analyze(L4)**

CO2 Action verb is not same level as PO2 verb. Therefore, the correlation is medium (2)

PO6 Verb: **Thumb Rule**

CO2 correlates medium with PO6. Therefore, the correlation is medium (2)

CO3: Understand the importance of transportation, water resources and environmental engineering.

Action Verb: Understand (L2)

PO1 Verb: **Apply (L3)**

CO3 Action verb is not same level as PO1 verb. Therefore, the correlation is medium (2)

PO2 Verb: **Analyze(L4)**

CO3 Action verb is not same level as PO2 verb. Therefore, the correlation is medium (2)

PO7 Verb: **Thumb Rule**

CO3 correlates medium with PO7. Therefore, the correlation is medium (2)

CO4: Understand the applications and role of various materials in Mechanical Engineering.

Action Verb: **Understand (L2)**

PO1 Verb: **Apply (L3)**

CO4 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)

PO3 Verb: **Review-L2**

CO4 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO7 Verb: **Thumb Rule**

CO4 correlates moderately with PO6. Therefore, the correlation is medium (2).

CO5: Understand the different manufacturing processes and the basics of thermal engineering with its applications.

Action Verb: **Understand (L2)**

PO1 Verb: **Apply (L3)**

CO5 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)

PO3 Verb: **Review-L2**

CO5 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO7 Verb: **Thumb Rule**

CO5 correlates moderately with PO6. Therefore, the correlation is medium (2).

CO6: Understand the working of different mechanical power transmission systems, power plants and applications of robotics.

Action Verb: **Understand (L2)**

PO1 Verb: **Apply (L3)**

CO5 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)

PO3 Verb: **Review-L2**

CO5 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO7 Verb: **Thumb Rule**

CO5 correlates moderately with PO6. Therefore, the correlation is medium (2).

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	Data Structures	L	T/CLC	P	C
23APC0501	I-II	(Common to CSE, CIC, CSE(DS), AIML & AIDS)	2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO 1: Understand the concepts of Linear Data Structures to sort the data

CO 2: Apply the Linked list concepts to perform operations on data.

CO 3: Apply the stacks features to manage the memory

CO 4: Analyse various operations of queues, dequeues and their applications.

CO 5: Understand binary search trees and hash tables to facilitate indexed search

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the concepts of Linear Data Structures		to sort the data	L2
CO2	Apply	The Linked list concepts		to perform operations on data.	L3
CO3	Apply	The stacks features		to manage the memory	L3
CO4	Analyse	various operations of queues, dequeues and their applications.			L4
CO5	Understand	The Binary Search Trees and hash tables		to facilitate indexed search	L2

UNIT – I		9 Hrs

Introduction to Linear Data Structures: Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation, Overview of time and space complexity analysis for linear data structures. Searching Techniques: Linear & Binary Search, Sorting Techniques: Bubble sort, Selection sort, Insertion Sort

UNIT – II		9 Hrs

Linked Lists: Singly linked lists: representation and operations, doubly linked lists and circular linked lists, Comparing arrays and linked lists, Applications of linked lists

UNIT – III		9 Hrs

Stacks: Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists, Applications of stacks in expression evaluation, backtracking, reversing list etc.

UNIT – IV		9 Hrs

Queues: Introduction to queues: properties and operations, implementing queues using arrays and linked lists, Applications of queues in breadth-first search, scheduling, etc. Deques: Introduction to deques (double-ended queues), Operations on deques and their applications**.**

UNIT – V		9 Hrs

Trees: Introduction to Trees, Binary Search Tree – Insertion, Deletion & Traversal

Hashing: Brief introduction to hashing and hash functions, Collision resolution techniques: chaining and open addressing, Hash tables: basic implementation and operations, Applications of hashing in unique identifier generation, caching, etc

Textbooks:

1.Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2nd Edition.

2.Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson- Freed, Silicon Press, 2008

Reference Books:

1.Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders

2.C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft

3.Problem Solving with Algorithms and Data Structures" by Brad Miller and David Ranum

4.Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein

5.Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms" by Robert Sedgewick

Online Learning Resources:

www.nptel.ac.in

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	CO						Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL				
1	18	24%	3	CO1: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	14	19%	2	CO2: Apply	L3	PO1 PO2 PO4 PO11	PO1: Apply(L3) PO2: Develop (L3) PO4: Analysis (L4) PO11: Thumb rule	3 3 2 1
3	15	20%	2	CO3: Apply	L3	PO1 PO2 PO4 PO11	PO1: Apply(L3) PO2: Develop (L3) PO4: Analysis (L4) PO11: Thumb rule	3 3 2 2
4	13	18%	2	CO4: Analyse	L4	PO1 PO2 PO3 PO4 PO11	PO1: Apply(L3) PO2: Review (L2) PO3: Develop (L3) PO4: Analysis(L4) PO11: Thumb rule	3 3 3 3 2
5	14	19%	2	CO5: Understand	L2	PO1 PO2 PO3 PO4 PO11	PO1: Apply(L3) PO2: review(L2) PO3: develop(L3) PO4: Interpret(L2) PO11: Thumb rule	2 3 2 3 2
	74	100 %						

Justification Statements :

CO1: Understand the concepts of Linear Data Structures to sort the data
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Review (L2)
CO1 Action verb is same level as PO2. Therefore, the correlation is high (3)
CO2: Apply the Linked list concepts to perform operations on data.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2: Develop (L3)
CO2 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO4: Analysis (L4)
CO2 Action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2)
PO11: Thumb rule
For some of Linear Data Structure applications, array and structure concepts are used to write programs store the data. Therefore, the correlation is low (1)

CO3: Apply the stacks features to manage the memory
Action Verb: Apply (L3)
PO1: Apply (L3)
CO3 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2: Develop (L3)
CO3 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO4: Analysis (L4)
CO3 Action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2)
PO11: Thumb rule
For some of Data Structure applications, stacks concepts are used to write programs to manage programs. Therefore, the correlation is low (1)
CO4: Analyse various operations of queues, dequeues and their applications.
Action Verb: Analyse (L4)
PO1: Apply(L3)
CO4 Action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3)
PO2: Review (L2)
CO4 Action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3)
PO4: Analysis (L4)
CO4 Action verb is greater than PO4 verb by one level. Therefore, the correlation is high (3)
PO11: Thumb rule
For some of Real Time problems Data Structure applications, queues concepts are used to write programs and evaluation the memory operations. Therefore, the correlation is moderate (2)
CO5: Understand binary search trees and hash tables to facilitate indexed search
Action Verb: Create (L6)
PO1: Apply(L3)
CO5 Action verb is greater than PO1 verb by three levels. Therefore, the correlation is high (3)
PO2: Review (L6)
CO5 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO4: Interpret (L2)
CO5 Action verb is greater than PO4 verb by two levels. Therefore, the correlation is high (3)
PO11S: Thumb rule
For some of data manipulations Sorting and File Organization methods are used to solve storage problems. Therefore, the correlation is low (3)

Year: I B.Tech　　　　　　**(Common to all branches)**　　　　Semester: I & II

Subject Code **23AHM9902**	Subject Name **COMMUNICATIVE ENGLISH LAB**	L 0	T/CLC 0	P 2	Credit: 1

Course Outcomes (CO): Student will be able to

CO1: **Understand**-the different aspects of the English language proficiency with emphasis
　 On LSRW skills.
CO2: **Apply** communication skills through various language learning activities.
CO3: **Analyze** the English speech sounds, for better listening and speaking.
CO4: **Evaluate** and exhibit professional is min participating in debates and group discussions.
CO5: **Analyze** the mselves to face interviews in future.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the different aspects of the English language proficiency with emphasis on LSRW skills			L2
2	**Apply**	communication skills through various language learning activities			L3
3	**Analyze**	the English speech sounds, for better listening and speaking.			L4
4	**Evaluate**	and exhibit professionalism in participating in debates and group discussions			L5
5	**Analyze**	themselves to face interviews in future			L4

List of Topics:
1. Vowels & Consonants (CO3)
2. Non Verbal Communication (CO2)
3. Communication Skills(CO2)
4. Role Playor Conversational Practice (CO1,CO2)
5. E-mail Writing (CO1)
6. Just A Minute (CO1,CO2)
7. Group Discussions-methods&practice (CO4)
8. Debates-Methods &Practice (CO4)
9. PPT Presentations/Poster Presentation (CO2)
10. Interviews Skills (CO5)

Suggested Software:
* Walden Infotech
* Young India Films

Reference Books:
1. RamanMeenakshi,Sangeeta-Sharma.*TechnicalCommunication*.OxfordPress.2018.
2. TaylorGrant:*EnglishConversationPractice*,TataMcGraw-HillEducationIndia,2016
3. Hewing's, Martin. Cambridge *AcademicEnglish*(B2).CUP,2012.
4. J.Sethi & P.V.Dhamija. *ACourse in Phonetics and Spoken English*,(2ndEd),Kindle,2013.
Spoken English:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com/
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. https://www.youtube.com/c/ArnelsEverydayEnglish/featured

8. https://www.youtube.com/c/engvidAdam/featured
9. https://www.youtube.com/c/EnglishClass101/featured
10. https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw

   Voice & Accent:
1. https://www.youtube.com/user/letstalkaccent/videos
2. https://www.youtube.com/c/EngLanguageClub/featured
3. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
4. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1										2	
2									2	2	
3										3	
4									3	3	
5										3	

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1				Understand	L2	10	Thumb Rule	2
2				Apply	L3	9,10	Thumb Rule	2,2
3				Analyze	L4	10	Thumb Rule	3
4				Evaluate	L5	9,10	Thumb Rule	3,3
5				Analyze	L4	10	Thumb Rule	3

CO1: Understand the different aspects of the English language proficiency with emphasis on LSRW skills
Action Verb: Understand (L2)
CO1 Action Verb is understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).
CO2: Apply communication skills through various language learning activities.
Action Verb: Apply (L3)
CO2 Action Verb is Apply of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate(2).
CO3: Analyze the English speech sounds, for better listening and speaking.
Action Verb: Analyze (L4)
CO3 Action Verb is Analyze of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).
CO4: Evaluate and exhibit professionalism in participating in debates and group discussions.
Action Verb: Evaluate (L5)
CO4 Action Verb is Evaluate of BTL 5. Using Thumb rule, L5 correlates PO6 to PO11 as high (3).
CO5: Analyze themselves to face interviews in future.
Action Verb: Develop (L4)
CO5 Action Verb is Analyze of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).

	ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI **(Autonomous)** **ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)**

Year: I B.Tech   (Common to EEE, ECE, CSE & allied branches) Semester: I &II

Subject Code: 23ABS9906	**Subject Name:** Chemistry Lab	L 0	T/CLC 0	P 2	Credits:1

Course Objectives: Students are expected to
   Verify the fundamental concepts with experiments.
Course Outcomes: At the end of the course, the students will be able to
CO1: Determine the cell constant and conductance of solutions.
CO2: Prepare advanced polymer Bakelite materials.
CO3: Measure the strength of an acid present in secondary batteries.
CO4: Analyze the UV-Visible spectra of some organic compounds.
CO5: Estimate the unknown solution by volumetric analysis

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Determine**	Cell constant and conductance of solutions.			**L4**
2	**Prepare**	advanced polymer Bakelite materials			**L4**
3	**Measure**	Strength of an acid present in secondary batteries.			**L4**
4	**Analyze**	UV-Visible spectra of some organic compounds.			**L4**
5	**Estimate**	Unknown solution by volumetric analysis.			**L5**

List of Experiments:
1. Measurement of 10Dq by spectrophotometric method(CO1)
2. Conductometric titration of strong acid vs. strong base (CO1)
3. Conductometric titration of weak acid vs. strong base (CO1)
4. Determination of cell constant and conductance of solutions (CO1)
5. Potentiometry - determination of redox potentials and emfs (CO5)
6. Determination of Strength of an acid in Pb-Acid battery (CO3)
7. Preparation of a Bakelite (CO2)
8. Verify Lambert-Beer's law (CO4)
9. Estimation of copper by Iodometry (CO5)
10. Wavelength measurement of sample through UV-Visible Spectroscopy (CO1)
11. Preparation of nanomaterials by precipitation method (CO1)
12. Estimation of Ferrous Iron by Dichrometry (CO5)

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO Experiments may be conducted in virtual mode.
   Reference:

- "Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publicationsby J. Mendham, R.C.Denney, J.D.Barnes and B. Sivasankar

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1				3									
2				3									
3				3									
4				3									
5				3									

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1				**Determine**	**L4**	PO4	PO4: Analyze (L4)	3
2				**Prepare**	**L4**	PO4	PO4: Analyze (L4)	3
3				**Measure**	**L4**	PO4	PO4: Analyze (L4)	3
4				**Analyze**	**L4**	PO4	PO4: Analyze (L4)	3
5				**Estimate**	**L5**	PO4	PO4: Analyze (L5)	3

Justification Statements

CO1: Determine the cell constant and conductance of solutions**.**
Action Verb: Determine **(L4)**
PO4 Verb: Analyze (L4)
CO1 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).
CO2: Prepare advanced polymer Bakelite materials**.**
Action Verb: Prepare **(L4)**
PO4 Verb: Analyze (L4)
CO2 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).
CO3: Measure the strength of an acid present in secondary batteries**.**
Action Verb: Measure **(L4)**
PO4 Verb: Analyze (L4)
CO3 Action Verb is equal to PO4 verb; Therefore, correlation is high (3)
CO4: Analyze the UV-Visible spectra of some organic compounds.
Action Verb: Analyze **(L4)**
PO4 Verb: Analyze (L4)
 CO4 Action Verb is equal to PO4 verb; Therefore, correlation is high (3)
CO5: Estimate the unknown solution by volumetric analysis**.**
Action Verb: Estimate **(L5)**
 PO4 Verb: Analyze (L4)
CO5 Action Verb is greater than PO4; Therefore correlation is high (3).

Course Code	Year & Sem	Engineering Workshop	L	T/CLC	P	C
23AES0302	I-II		0	0	3	1.5

Course Outcomes:
After studying the course, student will be able to
CO1: Apply the wood working skills to prepare different joints.
CO2: Analyze the sheet metal and fitting operations to prepare various components
CO3: Apply the basic electrical engineering knowledge for house wiring practice.
CO4: Apply the Welding process for Lap and Butt Joints.
CO5: Understand the various plumbing pipe joints

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
CO1	Apply	the wood working skills to prepare different joints			L3
CO2	Analyze	the sheet metal and fitting operations to prepare various components			L4
CO3	Apply	the basic electrical engineering knowledge for house wiring practice			L3
CO4	Apply	the Welding process for Lap and Butt joints			L3
CO5	Understand	the various plumbing pipe joints			L2

SYLLABUS

1. **Demonstration**: Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in woodworking and make following joints.
a) Half – Lap joint   b) Mortise and Tenon joint   c) Corner Dovetail joint or Bridlejoint
3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metalworking, Developments of following sheet metal job from GI sheets.
 a) Tapered tray   b) Conical funnel   c) Elbow pipe   d) Brazing
4. **Fitting:** Familiarity with different types of tools used in fitting and do the followingfitting exercises.
a)V-fit   b) Dovetail fit   c) Semi-circular fit   d) Bicycle tire punctureand change of two-wheeler tyre
5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and makethe following connections.
 a) Parallel and series   b) Two-way switch   c) Godown lighting
    d) Tube light   e) Three phase motor   f) Soldering of wires
6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes,Preparation of Green Sand Moulds for given Patterns.
7. **Welding Shop**: Demonstration and practice on Arc Welding and Gas welding.Preparation of Lap joint and Butt joint.
8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe jointswith coupling for same diameter and with reducer for different diameters.
   Textbooks:
1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:
1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, MediaPromoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.

Mapping of COs to POs and PSOs

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3						3			3	3
CO2	3	3	3						3			3	3
CO3	3	3	3						3			3	3
CO4	3	3	3						3			3	3
CO5	2	2	2						2			3	3

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	CO Lesson Plan (Hrs)	%	Correlation	Verb	BTL	Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
1	-	-	3	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	3 3 3 3
2	-	-	3	Analyze	L4	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	3 3 3 3
3	-	-	1	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	3 3 3 3
4	-	-	2	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	3 3 3 3
5	-	-	2	Understand	L2	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	2 2 2 2

Justification Statements:

CO1: Apply the wood working skills to prepare different joints

Action Verb: **Apply** (L3)

PO1 Verb: **Apply** (L3)

CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Review (L2)**

CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO1 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

PO9 Verb: **Thumb Rule**

CO1 Action verb is same level as PO9 verb. Therefore, the correlation is high (3)

CO2: Analyze the sheet metal and fitting operations to prepare various components

Action Verb: **Analyse** (L4)

PO1 Verb: **Apply** (L3)

CO2 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Review (L2)**

CO2 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO2 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)

PO9 Verb: **Thumb Rule**

CO2 Action verb is same level (greater) as PO9 verb. Therefore, the correlation is high (3)

CO3: Apply the basic electrical engineering knowledge for house wiring practice

Action Verb: **Apply** (L3)

PO1 Verb: **Apply** (L3)

CO3 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Review (L2)**
CO3 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO3 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO9 Verb: **Thumb Rule**
CO3 Action verb is same level as PO9 verb. Therefore, the correlation is high (3)

CO4: Apply the Welding process for Lap and Butt Joints

Action Verb: **Apply** (L3)
PO1 Verb: **Apply** (L3)
CO4 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Review (L2)**
CO4 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO4 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO9 Verb: **Thumb Rule**
CO4 Action verb is same level as PO9 verb. Therefore, the correlation is high (3)

CO5: Understand the various plumbing pipe joints.

Action Verb: **Understand (L2)**
PO1 Verb: **Apply** (L2)
CO5 Action verb is less than as PO1 verb. Therefore, the correlation is high (2)
PO2 Verb: **Review (L2)**
CO5 Action verb is less than as PO2 verb. Therefore, the correlation is high (2)
PO3 Verb: **Develop (L3)**
CO5 Action verb is less than as PO3 verb. Therefore, the correlation is high (2)
PO9 Verb: **Thumb Rule**
CO5 Action verb is less than as PO9 verb. Therefore, the correlation is high (2)

Course Code	Year & Sem	Data Structures Lab	L	T/CLC	P	C
23APC0502	I-II	**(Common to CSE, CIC, CSE(DS), AIML & AIDS)**	0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO 1: Apply the sorting and searching techniques using Arrays

CO 2: Develop linked list operations for efficient access to data.

CO 3: Develop stacks and queues to solve real time applications.

CO 4: Develop binary search tree operations using linked list

CO 5: Apply the hashing techniques to organise the data in hash table.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Apply**	sorting and searching algorithm	using arrays		L3
CO2	**Develop**	linked list operations		for efficient access to data.	L6
CO3	**Develop**	stacks and queues		to solve real time applications.	L6
CO4	**Develop**	binary search tree operations	using linked list		L6
CO5	**Apply**	the hashing techniques		to organise the data in hash table.	L3

List of Experiments:

Exercise 1: Array Manipulation[CO1]

i)   Write a program to reverse an array.

ii)   C Programs to implement the Searching Techniques – Linear & Binary Search

iii)   C Programs to implement Sorting Techniques – Bubble, Selection and Insertion Sort

Exercise 2: Linked List Implementation[CO2]

i)   Implement a singly linked list and perform insertion and deletion operations.

ii)   Develop a program to reverse a linked list iteratively and recursively.

iii)   Solve problems involving linked list traversal and manipulation.

Exercise 3: Linked List Applications[CO2]

i)   Create a program to detect and remove duplicates from a linked list.

ii)   Implement a linked list to represent polynomials and perform addition.

iii)   Implement a double-ended queue (deque) with essential operations.

Exercise 4: Double Linked List Implementation[CO2]

i)   Implement a doubly linked list and perform various operations to understand its properties and applications.

ii)   Implement a circular linked list and perform insertion, deletion, and traversal.

Exercise 5: Stack Operations[CO3]

i)   Implement a stack using arrays and linked lists.

ii)   Write a program to evaluate a postfix expression using a stack.

iii)   Implement a program to check for balanced parentheses using a stack.

Exercise 6: Queue Operations[CO3]

i)   Implement a queue using arrays and linked lists.

ii)   Develop a program to simulate a simple printer queue system.

iii)   Solve problems involving circular queues.

Exercise 7: Stack and Queue Applications[CO3]

i)   Use a stack to evaluate an infix expression and convert it to postfix.

ii)   Create a program to determine whether a given string is a palindrome or not.

iii)   Implement a stack or queue to perform comparison and check for symmetry.

Exercise 8: Binary Search Tree CO4]

i)   Implementing a BST using Linked List.

ii)   Traversing of BST.

Exercise 9: Hashing [CO5]

i)   Implement a hash table with collision resolution techniques.

ii)   Write a program to implement a simple cache using hashing.

Textbooks:

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson, 2nd Edition.

2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson- Freed, Silicon

Press, 2008

Reference Books:
1. Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders
2. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft
3. Problem Solving with Algorithms and Data Structures" by Brad Miller and David Ranum
4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
5. Algorithms in C, Parts 1-5 (Bundle): Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms by Robert Sedgewick.

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
1	CO1: Apply	L3	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	3 3
2	CO2: Develop	L6	PO1 PO2 PO4 PO11	PO1: Apply(L3) PO2: Develop (L3) PO4: Design (L6) PO11: Thumb rule	3 3 3 3
3	CO3: Develop	L6	PO1 PO2 PO4 PO11	PO1: Apply(L3) PO2: Develop (L3) PO4: Design (L6) PO11: Thumb rule	3 3 3 3
4	CO4: Develop	L6	PO1 PO2 PO3 PO4 PO11	PO1: Apply(L3) PO2: Review (L2) PO3: Design (L6) PO4: Analysis(L4) PO11: Thumb rule	3 3 3 3 3
5	CO5: Apply	L3	PO1 PO2 PO4 PO11	PO1: Apply(L3) PO2: Review(L2) PO4: Analysis(L4) PO11: Thumb rule	3 3 2 3

Justification Statements :
CO1: Apply the sorting and searching techniques using Arrays
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Review(L2)
CO1 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
CO2: Develop linked list operations for efficient access to data.
Action Verb: Develop (L6)
PO1: Apply (L3)
CO2 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Develop (L6)
CO2 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO4: Design (L6)
CO2 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (3)
CO3: Develop stacks and queues to solve real time applications

Action Verb: Develop (L6)
PO1: Apply (L3)
CO3 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Develop (L3)
CO3 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO4: Design (L6)
CO3 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some of Data Structure applications, stacks concepts are used to manage data in the memory. Therefore, the correlation is high (3)

CO4: Develop binary search tree operations using linked list
Action Verb: Develop (L6)
PO1: Apply(L3)
CO4 Action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3)
PO2: Review (L2)
CO4 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO3: Design (L6)
CO4 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Analysis (L4)
CO4 Action verb is greater than PO4 verb by one level. Therefore, the correlation is high (3)
PO11: Thumb rule
For some of Real Time problems Data Structure applications, queues concepts are used to write programs and evaluation the memory operations. Therefore, the correlation is high (3)

CO5:Apply the hashing techniques to organise the data in hash table.
Action Verb: Apply (L3)
PO1: Apply(L3)
CO5 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L2)
CO5 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO4: Analysis (L4)
CO5 Action verb less than PO4 verb by one level. Therefore, the correlation is moderate (2)
PO11: Thumb rule
For some of data manipulations tree and graphs concepts are used to solve data storage problems. Therefore, the correlation is high (3)

Common to I SEM CSE/CIC/SCD/EEE   &   II SEM   ECE/AI&DS/AI&ML/CE/ME

Course Code: 23AHM9903	**HEALTH AND WELLNESS, YOGA AND SPORTS**	**L** **0**	**T/CLC** **0**	**P** **1**	**C** **0.5**

Course Objectives:
The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

Course Outcomes: After completion of the course the student will be able to
CO1. **Understand** the health & fitness by diet
CO2. **Understand** the importance of yoga.
CO3. **Apply** The yoga practices including Surya Namaskar
CO4. **Understand** the importance of sports.
CO5. **Analyze** various activities that help enhance their health & Positive Personality

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	Health & fitness by diet			**L2**
2	**Understand**	Importance of yoga.			**L2**
3	**Apply**	yoga practices including Surya Namaskar			**L3**
4	**Understand**	Importance of sports			**L2**
5	**Analyze**	Various activities that help enhance their health & Positive Personality			**L4**

UNIT I
Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.
Activities:
i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

UNIT II
Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.
Activities:
Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT III
Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.
Activities:
i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
Practicing general and specific warm up, aerobics
ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Reference Books:
1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning,2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. HumanKinetics, Inc.2014

General Guidelines:
1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as manyas Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

Evaluation Guidelines:
- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each

activity shall be evaluated by the concerned teacher for 15 marks, totalingto 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva in the subject

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1						2	2						
2						2	2						
3						2	2						
4						2	2						
5						3	3						

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours				CO		Program Outcome (PO)	Level of Correlation (0-3)
	Register (Hrs)	Lesson Plan (Hrs)	%	corr	Verb	BTL		
1					Understand	L2	PO6,PO7	2
2					Understand	L2	PO6,PO7	2
3					Apply	L3	PO6,PO7	2
4					Understand	L2	PO6,PO7	2
5					Analyze	L4	PO6,PO7	3

CO-PO mapping justification:
CO1: Understand the health & fitness by diet
Action Verb: Understand (L2)
CO1 Action Verb is **Understand** of BTL 2.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)
CO2: Understand the Importance of yoga
Action Verb: Understand (L2)
CO2 Action Verb is **Understand** of BTL 2.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)
CO3: APPLY
 yoga practices including Surya Namaskar
Action Verb: APPLY (L3)
CO3 Action Verb is APPLY of BTL 2.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)
CO4: .Understand Importance of sports
Action Verb: Understand (L2)
CO4 Action Verb is **Understand** of BTL 2.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)
Action Verb: APPLY (L3)
CO5: Analyze the Various activities that help enhance their health & Positive Personality
Action Verb: Analyze (L4)
CO5 Action Verb is Analyze of BTL 2.Using Thumb rule; L4 correlates PO6 and PO7 as a moderate (2)

ANAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
AK23 REGULATIONS
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)
(Effective for the batches admitted from 2023-24)

B.Tech – II Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P	C			
1	BS	23ABS9913	Discrete Mathematics & Graph Theory	2	1	0	3	30	70	100
2	HM	23AHM9905	Universal Human Values	2	1	0	3	30	70	100
3	PC	23APC3001	Artificial Intelligence	2	1	0	3	30	70	100
4	PC	23APC0504	Advanced Data Structures and Algorithms Analysis	2	1	0	3	30	70	100
5	PC	23APC0506	Object-Oriented Programming Through JAVA	2	1	0	3	30	70	100
6	PC	23APC0505	Advanced Data Structures and Algorithms Analysis Lab	0	0	3	1.5	30	70	100
7	PC	23APC0507	Object-Oriented Programming Through JAVA Lab	0	0	3	1.5	30	70	100
8	SC	23ASC0501	Python Programming	1	0	2	2	30	70	100
			Total	**11**	**5**	**8**	**20**	**240**	**560**	**800**

Course Code	Year & Sem	Discrete Mathematics & Graph Theory	L	T/ CLC	P	C
23ABS9913	II-I	**(Common to CSE,CIC,CSD,AI&DS, AI&ML)**	2	1	**0**	**3**

Course Outcomes:

After studying the course, student will be able to

CO1: **Apply** the concepts of mathematical logic in various engineering fields.
CO2: **Understand** the concepts related to set theory and algebraic structures.
CO3: **Analyze** the theory of elementary combinatorics by using binomial and multinomial theorems.
CO4: **Evaluate** the solutions of homogeneous and inhomogeneous recurrence relations.
CO5: **Apply** the graph theory in solving computer science problems and finite difference approximation**.**

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	the concepts of mathematical logic	in various engineering fields		L3
CO2	Understand	the concepts related to set theory and algebraic structures.			L2
CO3	Analyze	the theory of elementary combinatorics	by using binomial and multinomial theorems		L4
CO4	Evaluate	The solutions of homogeneous and inhomogeneous recurrence relations.			L5
CO5	Apply	The graph theory solving computer science problems.		finite difference approximation.	L3

UNIT – I: Mathematical Logic	9Hrs

Introduction, Statements and Notation, Connectives, Well-formed formulas, Tautology, Duality law, Equivalence, Implication, Normal Forms, Functionally complete set of connectives, Inference Theory of Statement Calculus, Predicate Calculus, Inference theory of Predicate Calculus

UNIT – II: Set theory	9Hrs

The Principle of Inclusion-Exclusion, Pigeon hole principle and its application, Functions : composition of functions, Inverse Functions, Recursive Functions, Lattices and its properties.
Algebraic structures: Algebraic systems-Examples and General Properties, Semi groups , Monoids, groups, sub groups, homomorphism, Isomorphism.

UNIT – III: Elementary Combinatorics	9Hrs

Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutations with Constrained Repetitions, Binomial Coefficients, The Binomial and Multinomial Theorems.

UNIT – IV: Recurrence Relations	9Hrs

Generating Functions of Sequences, Calculating Coefficients of Generating Functions, Recurrence relations, Solving Recurrence Relations by Substitution and Generating functions, The Method of Characteristic roots, Solutions of Inhomogeneous Recurrence Relations.

UNIT – V: Graphs	9Hrs

Basic Concepts, Isomorphism and Sub graphs, Trees and their Properties, Spanning Trees, Directed Trees, Binary Trees, Planar Graphs, Euler's Formula, Multi graphs and Euler Circuits, Hamiltonian Graphs.

Textbooks

1.J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 2002.
2.Kenneth H. Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, 7th Edition, McGraw Hill Education (India) Private Limited

Reference Books

1.Joe L. Mott, Abraham Kandel and Theodore P. Baker, Discrete Mathematics for Computer Scientists & Mathematicians, 2nd Edition, Pearson Education.
2.Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science.
3.Dr.J.Rajendra Prasad,T.Rama Rao and A.Madana Mohan Rao, Mathematical Foundation of Computer

Science

Online Learning Resources:

http://www.cs.yale.edu/homes/aspnes/classes/202/notes.pdf

Mapping of COs to POs

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1				Apply	L3	PO1	Apply (L3)	3
2				Understand	L2	PO1	Apply (L3)	2
3				Analyze	L4	PO2	Analyze (L4)	3
4				Evaluate	L5	PO2	Analyze (L4)	3
5				Apply	L3	PO1	Apply (L3)	3

CO1: .Apply the concepts of mathematical logic in various engineering fields
Action Verb: Apply (L3)
PO1 Verbs: **Apply** (L3)
CO1 Action Verb is equal to PO1 verb . Therefore correlation is high (3).
CO2: Understand the concepts related to set theory and algebraic structures
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO2 Action Verb is one level below to PO1 verb; Therefore correlation is moderate (2).
CO3: .Analyze the theory of elementary combinatorics by using binomial and multinomial theorems.
Action Verb: Analyse (L4)
PO2 Verb: **Analyse** (L4)
CO3 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).
CO4: Evaluate the solutions of homogeneous and inhomogeneous recurrence relations.
Action Verb: Evaluate (L5)
PO2 Verb: Analyze (L4)
CO4 Action Verb is one level high to PO2 verb; Therefore correlation is high (3).
CO5: Apply the graph theory in solving computer science problems and finite difference approximation.
Action Verb: Apply(L3)
PO1 Verb: Apply (L3)
CO5 Action verb is equal to PO1 verb; therefore the correlation is high (3).

Course Code	Year & Sem	Universal Human Values	L	T/ CLC	P	C
23AHM9905	II-I		2	1	**0**	**3**

Course Outcomes:

After studying the course, student will be able to

CO1:**Understand** the essentials of human values, self-exploration, happiness and prosperity for value added education.

CO2:**Analyze** the harmony in the human being as sentient 'I' and the material 'Body' in various aspects.

CO3:**Apply** the nine universal human values in relationships for harmony in the family and orderliness in the society.

CO4:**Evaluate** the interconnectedness of four orders of nature and holistic perception of harmony at all levels of existence.

CO5:**Apply** the holistic understanding of harmony on professional ethics through augmenting universal human order.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the essentials of human values, self-exploration, happiness and prosperity for value added education.			**L2**
2	Analyze	the harmony in the human being as sentient 'I' and the material 'Body' in various aspects.			**L4**
3	Apply	the nine universal human values in relationships for harmony in the family and orderliness in the society.			**L3**
4	Evaluate	the interconnectedness of four orders of nature and holistic perception of harmony at all levels of existence.			**L5**
5	Apply	the holistic understanding of harmony on professional ethics through augmenting universal human order.			**L3**

UNIT – I:	6 lectures and 3 tutorials for practice session

Introduction to Value Education (6 lectures and 3 tutorials for practice session)
Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and   the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session PS1 Sharing about Oneself
Lecture 3: self-exploration as the Process for Value Education
Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT – II:	6 lectures and 3 tutorials for practice session

Harmony in the Human Being (6 lectures and 3 tutorials for practice session)
Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

UNIT – III:	6 lectures and 3 tutorials for practice session

Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)
Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect

Lecture 16: Other Feelings, Justice in Human-to-Human Relationship	
Lecture 17: Understanding Harmony in the Society	
Lecture 18: Vision for the Universal Human Order	
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal	
UNIT – IV:	4 lectures and 2 tutorials for practice session

Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)

Lecture 19: Understanding Harmony in the Nature

Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among
the Four Orders of Nature

Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature

Lecture 21: Realizing Existence as Co-existence at All Levels

Lecture 22: The Holistic Perception of Harmony in Existence

Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence.

| **UNIT – V:** | 6 lectures and 3 tutorials for practice session |

Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)

Lecture 23: Natural Acceptance of Human Values

Lecture 24: Definitiveness of (Ethical) Human Conduct

Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct

Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order

Lecture 26: Competence in Professional Ethics

Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education

Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies

Lecture 28: Strategies for Transition towards Value-based Life and Profession

Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Textbooks

a. The Textbook
R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics,
2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
b. The Teacher's Manual
R R Gaur, R Asthana, G P Bagaria,Teachers' Manual for A Foundation Course in Human Values and
Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books

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

Online Learning Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-
   Introduction%20to%20Value%20Education.pdf

2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-
   Harmony%20in%20the%20Human%20Being.pdf

3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-
   Harmony%20in%20the%20Family.pdf

4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%202023.pdf

5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-
   Harmony%20in%20the%20Nature%20and%20Existence.pdf

6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-
   SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-
   Existence.pdf

7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-

25%20Ethics%20v1.pdf

8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385

9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

CO	Lesson Plan (Hrs)	%	CO Correlation	Verb	BTL	Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
1	7	19.4	2	Understand	2	PO8,PO11	Thumb Rule	2,2
2	8	22.2	3	Analyze	4	PO7,PO8	Thumb Rule	3,3
3	7	19.4	2	Apply	3	PO6,PO7,PO8	Thumb Rule	2,2,2
4	8	22.2	3	Evaluate	5	PO6,PO7,PO8,PO11	Thumb Rule	3,3,3,3
5	7	19.4	2	Apply	3	PO6,PO7,PO8,PO11	Thumb Rule	2,2,2,2

Justification Statements:

CO1: Understand the essentials of human values, self-exploration, happiness and prosperity for value added education.
Action Verb: Understand (L2)
CO1 Action Verb is Understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).
CO2: Analyze the harmony in the human being as sentient 'I' and the material 'Body' in various aspects.
Action Verb: Analyze (L4)
CO2 Action Verb is Analyze of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).
CO3: Apply the nine universal human values in relationships for harmony in the family and orderliness in the society.
Action Verb: Apply (L3)
CO3 Action Verb is Apply of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2)
CO4: Evaluate the interconnectedness of four orders of nature and holistic perception of harmony at all levels of existence.
Action Verb:Evaluate (L5)
CO4 Action Verb is Evaluate of BTL5. Using Thumb rule, L5 correlates PO6 to PO11 as high (3).
CO5: Apply the holistic understanding of harmony on professional ethics through augmenting universal human order.
Action Verb: Apply (L3)
CO5 Action Verb is Apply of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

Course Code	Year & Sem	Artificial Intelligence	L	T/CLC	P	C
23APC3001	II-I	**(Common to AIDS and AIML)**	2	1	**0**	**3**

Course Outcomes:

Student will able to After studying the course, students will be able to

CO1: Understand the basic concepts of artificial intelligence and intelligent agents

CO2: Apply the searching techniques for solving searching problems.

CO3: Apply the techniques for uncertainties and representing the knowledge

CO4: Understand learning methods for implementing logic concepts

CO5: Analyze the architecture and roles of expert systems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the basic concepts of artificial intelligence and intelligent agents			L2
CO2	Apply	the searching techniques		for solving searching problems	L3
CO3	Apply	the techniques for uncertainties and representing the knowledge			L3
CO4	Understand	learning methods		for implementing logic concepts	L2
CO5	Analyze	the architecture and roles of expert systems			L4

UNIT – I		
Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.		
UNIT – II		
Searching- Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Hill climbing, A* ,AO* Algorithms, Problem reduction, Game Playing-Adversial search, Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions.		
UNIT – III		
Representation of Knowledge: Knowledge representation issues, predicate logic- logic programming, semantic nets- frames and inheritance, constraint propagation, representing knowledge using rules, rules based deduction systems. Reasoning under uncertainty, review of probability, Bayes' probabilistic interferences and dempstershafer theory.		
UNIT – IV		
Logic concepts: First order logic. Inference in first order logic, propositional vs. first order inference, unification & lifts forward chaining, Backward chaining, Resolution, Learning from observation Inductive learning, Decision trees, Explanation based learning, Statistical Learning methods, Reinforcement Learning.		
UNIT – V		
Expert Systems: Architecture of expert systems, Roles of expert systems – Knowledge Acquisition Meta knowledge Heuristics. Typical expert systems – MYCIN, DART, XCON: Expert systems shells.		
Textbooks:		
1. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", SecondEdition, Pearson Education.		
2. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill		
Reference Books:		
1. David Poole, Alan Mackworth, Randy Goebel,"Computational Intelligence: a logical approach", Oxford University Press.		
2. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problemsolving", Fourth Edition, Pearson Education.		

3. J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers.
4. Artificial Intelligence, SarojKaushik, CENGAGE Learning.

Online Learning Resources:
1. https://ai.google/
2. https://swayam.gov.in/nd1_noc19_me71/preview

Mapping of course outcomes with program outcomes

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

Correlation matrix

Unit No.	CO						Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlatio n	Co's Action verb	BTL				
1				CO1 :Understand	L2		PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2				CO2 : Apply	L3		PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Analyze (L4) PO3: Develop (L3) PO4: Analyze (L4) PO5:Apply(L3)	3 2 3 2 3
3				CO3 : Apply	L3		PO1 PO2 PO3 PO4 PO5	PO1: Apply (L3) PO2: Identify(L3) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3)	3 3 3 2 3
4				CO4 : Understand	L2		PO2 PO3 PO5 PO11	PO2: Review(L2) PO3: Develop(L3) PO5: Apply(L3) PO11:Thumb Rule	3 2 2 2
5				CO5 :Analyze	L4		PO1 PO2 PO3 PO4 PO5 PO11	PO1:Apply(L3) PO2: Review (L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO11: Thumb Rule	3 3 3 3 2 2

Justification Statements :

CO1: Understand the basic concepts of artificial intelligence and intelligent agents
Action Verb : Understand(L2)
PO1 : Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 : Review(L2)
CO1 Action verb is same level as PO2 verb. Therefore the correlation is high (3)

CO2: Apply the searching techniques for solving searching problems.
Action Verb : Apply (L3)
PO1: Apply(L3)
CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Analyze (L4)
CO2 Action verb is less than PO2 verb by one level. Therefore the correlation is medium(2)
PO3: Develop (L3)
CO2 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is less than PO4 verb by one level. Therefore the correlation is medium(2)
PO5:Apply(L3)
CO2 Action verb is same level as PO5 verb. Therefore the correlation is high (3)

CO3: Apply the techniques for uncertainties and representing the knowledge.
Action Verb : Apply(L3)
PO1: Apply(L3)
CO3 Action verb is same level as PO1 verb . Therefore the correlation is high (3)
PO2: Identify(L3)
CO3 Action verb is same level as PO2 verb . Therefore the correlation is high (3)
PO3: Develop (L3)
CO3 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is medium (2)
PO5:Apply(L3)
CO3 Action verb is same level as PO5 verb. Therefore the correlation is high(3)

CO4: Understand learning methods for implementing logic concepts
Action Verb : Understand(L1)
PO2: Review(L2)
CO4 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is less than one level as PO3 verb. Therefore the correlation is medium (2)
PO4: Apply(L3)
CO4 Action verb is less than one level as PO4 verb. Therefore the correlation is medium (2)
PO11: Thumb rule
Artificial intelligence learning methods are used for developing intelligent agents. Therefore the correlation is medium(2)

CO5: Analyze the architecture and roles of expert systems.
Action Verb : Analyze(L4)
PO1: Apply(L3)
CO5 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Review (L2)
CO5 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO5 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO5 Action verb is same level as PO4 verb. Therefore the correlation is high (3)
PO5:Apply(L3)
CO3 Action verb is less than one level as PO5 verb. Therefore the correlation is medium(2)
PO11: Thumb rule
For developing expert systems some of python program concepts are used to create programs. Therefore the correlation is medium (2)

Course Code	Year & Sem	Advanced Data Structures and Algorithms Analysis	L	T/ CLC	P	C
23APC0504	II-I	(Common to CSE,CIC,CSE(DS),AIDS & AIML)	2	1	**0**	**3**

Course Outcomes:

After studying the course, student will be able to

CO1: **Understand** the asymptotic notations and operations on AVL, B-Trees.

CO2: **Apply** the Trees, Graphs, Divide and conquer method to solve various problems.

CO3: **Apply** the greedy and dynamic programming methods to solve real time problems.

CO4: **Evaluate** the backtracking , branch and bound methods to solve minimization problems.

CO5: **Analyze** the P, NP, NP hard and NP complete problems for solving reduction problems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The asymptotic notations	operations on AVL,B-Trees		L2
CO2	Apply	The Trees, Graphs, Divide and conquer method		to solve various problems	L3
CO3	Apply	The greedy and dynamic programming methods		to solve real time problems.	L3
CO4	Evaluate	The backtracking , branch and bound methods		to solve minimization problems	L5
CO5	Analyze	The P, NP, NP hard , NP complete problems		for solving reduction problems	L4

UNIT – I		9Hrs

Introduction to Algorithm Analysis, Space and Time Complexity analysis, Asymptotic Notations.

Review of Binary Search Trees: Binary Search Tree – Insertion, Deletion & Traversal

AVL Trees – Creation, Insertion, Deletion operations and Applications

B-Trees – Creation, Insertion, Deletion operations and Applications

UNIT – II		9 Hrs

Heap Trees (Priority Queues) – Min and Max Heaps, Operations and Applications Graphs – Terminology, Representations, Basic Search and Traversals, Connected Components and Biconnected Components, applications

Divide and Conquer: The General Method, Quick Sort, Merge Sort, Finding Minimum and Maximum, Strassen's matrix multiplication.

UNIT – III		9 Hrs

Greedy Method: General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees, Single Source Shortest Paths

Dynamic Programming: General Method, Multi Stage graphs, All pairs shortest paths, Single Source Shortest Paths – General Weights (Bellman Ford Algorithm), Optimal Binary Search Trees, 0/1 Knapsack, Travelling Salesperson problem

UNIT – IV		8 Hrs

Backtracking: General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring, 0/1 Knapsack Problem

Branch and Bound: The General Method, 0/1 Knapsack Problem, Travelling Salesperson problem.

UNIT – V		10Hrs

NP Hard and NP Complete Problems: Basic Concepts, Cook's theorem

NP Hard Graph Problems: Clique Decision Problem (CDP), Chromatic Number Decision Problem (CNDP), Traveling Salesperson Decision Problem (TSP)

NP Hard Scheduling Problems: Scheduling Identical Processors, Job Shop Scheduling

Textbooks:

1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta, Dinesh 2nd Edition Universities Press.

2. Computer Algorithms/C++ Ellis Horowitz, SartajSahni, SanguthevarRajasekaran2nd Edition University Press

Reference Books:

1. Data Structures and program design in C, Robert Kruse, Pearson Education Asia

2. An introduction to Data Structures with applications, Trembley & Sorenson, McGraw Hill

3. The Art of Computer Programming, Vol.1: Fundamental Algorithms, Donald E Knuth, Addison-Wesley, 1997.

4. Data Structures using C & C++: Langsam, Augenstein&Tanenbaum, Pearson, 1995

5. Algorithms + Data Structures &Programs:,N.Wirth, PHI

6. Fundamentals of Data Structures in C++: Horowitz Sahni& Mehta, Galgottia Pub.

7. Data structures in Java:, Thomas Standish, Pearson Education Asia.

Online Learning Resources:

1. https://www.tutorialspoint.com/advanced_data_structures/index.asp

2. http://peterindia.net/Algorithms.html

3. Abdul Bari,1. Introduction to Algorithms (youtube.com)

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	CO Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
1	9	20	2	CO1: Understand	L2	PO1 PO2 PO11	PO1: Apply(L3) PO2: Analyze(L4) PO11: Thumb rule	2 1 2
2	9	20	2	CO2: Apply	L3	PO1 PO2 PO4 PO6 PO11	PO1: Apply(L3) PO2: Analyze(L4) PO4: Analyze(L4) PO6: Thumb rule PO11: Thumb rule	3 2 2 2 2
3	9	20	2	CO3: Apply	L3	PO1 PO2 PO3 PO4 PO6 PO11	PO1: Apply(L3) PO2: Analyze(L4) PO3: Develop (L3) PO4: Analyze (L4) PO6: Thumb rule PO11: Thumb rule	3 2 3 2 2 2
4	9	20	2	CO4: Evaluate	L5	PO1 PO2 PO3 PO4 PO6 PO11	PO1: Apply(L3) PO2: Analyze(L4) PO3: Develop (L3) PO4: Analyze (L4) PO6: Thumb rule PO11: Thumb rule	3 3 3 3 2 2
5	9	20	2	CO5: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO11: Thumb rule	2 3 3 3 3 2
	45	100						

Justification Statements:
CO1: Understand the asymptotic notations and operations on AVL, B-Trees.
Action Verb: Understand (L2)
PO1 Verb: Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Analyze (L4)

CO1 Action verb is less than PO2 verb by two level. Therefore, the correlation is low (1)
PO11: Thumb rule
The asymptotic performance of algorithms, To Analyze the behavior of algorithms as their input increases. Therefore the correlation is moderate (2)
CO2: Apply the Trees, Graphs, Divide and conquer method to solve various problems.
Action Verb: Apply (L3)
PO1: Apply(L3)
CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO2 Action verb is less than PO2 verb by one level. Therefore, the correlation is moderate (2)
PO4: Analyze (L4)
CO2 Action verb is lesser than PO4 verb by one level. Therefore, the correlation is moderate (2)
PO6: Thumb rule
Greedy and dynamic programming concepts were applied to solve traffic problems and finding best route o the destination. Therefore, the correlation is moderate (2)
PO11: Thumb rule
Finding optimal solution to a real-world problem is a continuous activity. Therefore, the correlation is moderate (2)
CO3: Apply the greedy and dynamic programming methods to solve real time problems.
Action Verb: Apply (L3)
PO1: Apply(L3)
CO3 Action verb is same level of PO1 verb. Therefore, the correlation is High (3)
PO2: Analyze (L4)
CO3 Action verb is less than of PO2 verb by one level. Therefore, the correlation is moderate (2)
PO3: Develop (L3)
CO3 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO3 Action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2))
PO6 : Thumb rule
backtracking and searching techniques were applied for GPS. Therefore, the correlation is moderate (2)
PO11: Thumb rule
backtracking and searching techniques will give optimal solutions to various problems. Therefore, the correlation is moderate (2)
CO4: Evaluate the backtracking, branch and bound methods to solve minimization problems.
Action Verb: Evaluate (L5)
PO1: Apply(L3)
CO3 Action verb is greater than of PO1 verb . Therefore, the correlation is High (3)
PO2: Analyze (L4)
CO3 Action verb is greater than of PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO3 Action verb is greater than of PO3 verb. Therefore the correlation is high(3)
PO4: Analyze (L4)
CO3 Action verb is greater than of PO4 verb. Therefore the correlation is high(3)
PO6 : Thumb rule
Backtracking and searching techniques were applied for GPS. Therefore, the correlation is moderate (2)
PO11: Thumb rule
Backtracking and searching techniques will give optimal solutions to various problems. Therefore, the correlation is moderate (2)
CO5: Analyze the P, NP, NP hard and NP complete problems for solving reduction problems.
Action Verb : Analyze (L4)
PO1: Apply(L3)
CO5 Action verb is less than of PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2: Analyze (L4)
CO5 Action verb is same level of PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO5 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO5 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Apply(L3)
CO5 Action verb is greater than PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
In research-oriented purpose P, NP concepts can be applied. Therefore, the correlation is moderate (2)

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	Object-Oriented Programming Through JAVA (common to CSE, CIC, CSE(DS), AIDS & AIML)	L	T/CLC	P	C
23APC0506	II-I		2	1	**0**	**3**

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the Java language components and how to apply in applications

CO2: Apply the concepts of OOP's fundamentals like classes, Methods and class libraries to develop applications

CO3: Analyze the concepts of arrays, inheritance and interfaces to develop efficient java applications.

CO4: Evaluate the concepts of packages, file I/O, by using access control, and exception handling mechanisms to solve real world scenarios

CO5: Create the GUI applications by using concepts like multi-threading, Java FX, JDBC

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Understand	the Java language components		How to apply in applications	L2
CO2	Apply	the concepts of OOP's fundamentals	like classes, methods and class libraries	to develop applications	L3
CO3	Analyze	the concepts of arrays, inheritance and interfaces		to develop efficient java applications	L4
CO4	Evaluate	the concepts of packages , file I/O	by using access control, and exception handling mechanisms	to solve real world scenarios	L5
CO5	Create	The GUI applications, JDBC applications	by using concepts like multi-threading, Java FX, JDBC		L6

UNIT – I   **12 Hrs**

Object Oriented Programming: Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

Data Types, Variables, and Operators: Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, Introduction to Operators, Precedence and Associativity of Operators, Assignment Operator (=), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

Control Statements: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

UNIT – II   **12hrs**

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static.

UNIT – III   **19Hrs**

Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Two-dimensional Arrays, Arrays of Varying Lengths, Three-dimensional Arrays, Arrays as Vectors.

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super Class Object Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

UNIT – IV   **19Hrs**

Packages and Java Library: Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class.

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.
Java I/O and File: Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java(Text Book 2)

UNIT – V   **19Hrs**
String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.
Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads.
Java Database Connectivity: Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, ResultSet Interface
Java FX GUI: Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	CO						Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb		BTL			
1	12	13.63%	2	CO1: Understand		L2	PO1 PO2	PO1: Apply(L3) PO2: Analyze(L4)	2 1
2	13	14.77%	2	CO2: Apply		L3	PO2 PO3 PO4 PO5 PO10 PO11	PO2: Review (L2) PO3: Develop (L3) PO4: Analyze(L4) PO5: Apply(L3) PO10: Thumb Rule PO11: Thumb Rule	3 3 2 3 2 2
3	23	26.13%	3	CO3: Analyze		L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Analyze(L4) PO3: Design(L6) PO4: Interpret(L5) PO5: Select(L5)	3 3 1 2 2
4	20	22.72%	3	CO4: Evaluate		L5	PO1 PO2 PO4 PO5	PO1: Apply(L3) PO2: Analyze (L4) PO4: Analyze(L4) PO5: Select(L3)	3 3 3 3
5	20	22.72%	3	CO5: Create		L6	PO2 PO3 PO5 PO10 PO11	PO2: Formulate (L6) PO3: Design (L6) PO5: Create(L6) PO10: Thumb Rule PO11: Thumb rule	3 3 3 3 3
	88	100 %							

Justification Statements:
CO1: Understand the Java language components and how to apply in applications.
Action Verb: Understand(L2)
PO1 Verb: Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)
PO2 Verb: Analyze(L4)
CO1 Action verb is less than PO2 verb by two levels. Therefore, the correlation is low (1)
CO2: Apply the concepts of OOP's fundamentals like classes, Methods and class libraries to develop applications
Action Verb: Apply (L3)
PO2: Review (L2)
CO2 Action verb is same level as PO1 verb. Therefore, the correlation is High (3)
PO3: Develop (L3)

CO2 Action verb is same level as PO3 verb. Therefore, the correlation is High (3)
PO4: Analyze(L4)
CO2 Action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2)
PO5: Apply(L3)
CO2 Action verb is less than PO5 verb by three level. Therefore, the correlation is High (3)
PO10: Thumb Rule
Create some Java programs to solve real world problems. Therefore, the correlation is moderate (2)
PO11: Thumb Rule
Learn java programs to solve. Therefore, the correlation is moderate (2)

CO3: Analyze the concepts of arrays, inheritance and interfaces to develop efficient java applications.
Action Verb: Analyze(L4)
PO1: Apply (L3)
CO3 Action verb is Greater than PO1. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO3 Action verb is same level as PO2. Therefore, the correlation is high (3)
PO3: Design (L6)
CO3 Action verb is less than PO3 verb by two level. Therefore, the correlation is low (1)
PO4: Interpret (L5)
CO3 Action verb is less than PO4 verb by one level. Therefore, the correlation is medium (2)
PO5: Select (L5)
CO3 Action verb is less than PO4 verb by one level. Therefore, the correlation is medium (2)

CO4: Evaluate the concepts of packages, access control, file I/O, and exception handling mechanisms to solve real world scenarios
Action Verb: Evaluate(L5)
PO1: Apply(L3)
CO4 Action verb is Greater than PO1. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO4 Action verb is Greater than PO2. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO4 Action verb is Greater than PO4. Therefore, the correlation is high (3)
PO5: Select (L3)
CO4 Action verb is Greater than PO5. Therefore, the correlation is high (3)

CO5: Create GUI applications by using concepts like multi-threading, Java FX, JDBC
Action Verb: Create (L6)
PO2: Formulate (L6)
CO5 Action verb is same level as PO2. Therefore, the correlation is high (3)
PO3: Design (L6)
CO5 Action verb is same level as PO3. Therefore, the correlation is high (3)
PO5: Create (L6)
CO5 Action verb is same level as PO5. Therefore, the correlation is high (3)
PO10: Thumb Rule
Java is used to design simple and enterprise applications so need for project management. Therefore, the correlation is high (3)
PO11: Thumb Rule
It is a programming language so new version available so we need to learn. Therefore, the correlation is high (3)

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	Advanced Data Structures and Algorithms Analysis Lab (Common to CSE,CIC,AIDS & AIML)	L	T/CLC	P	C
23APC0505	II-I		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the operations on AVL Trees, B-Trees and graph traversals.

CO2: Create the Min, Max Heap using arrays and find BFT, DFT for the graphs.

CO3: Create the sorting techniques for finding the time complexities and use greedy method to find single source shortest path.

CO4: Apply backtracking strategy for finding the N-Queens ,0/1 knapsack problem.

CO5: Apply greedy strategy for job sequencing and using dynamic programming to find 0/1 knapsack problem.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the operations	on AVL Trees, B-Trees and graph traversals		L2
CO2	**Create**	the Min, Max Heap using arrays and find BFT, DFT		for the graphs	L6
CO3	**Create**	the sorting techniques		for finding the time complexities	L6
CO4	**Apply**	backtracking strategy		for finding the N-Queens ,0/1 knapsack problem	L3
CO5	**Apply**	greedy strategy		for job sequencing	L3

List of Experiments:

1. Construct an AVL tree for a given set of elements which are stored in a file. And implement insert and delete operation on the constructed tree. Write contents of tree into a new file using in-order.**(CO1)**

2. Construct B-Tree an order of 5 with a set of 100 random elements stored in array.Implement searching, insertion and deletion operations.**(CO1)**

3. Construct Min and Max Heap using arrays, delete any element and display the content of the Heap.**(CO2)**

4. Implement BFT and DFT for given graph, when graph is represented by

   a) Adjacency Matrix b) Adjacency Lists. **(CO2)**
5. Write a program for finding the bi-connected components in a given graph.**(CO2)**

6. Implement Quick sort and Merge sort and observe the execution time for various input sizes (Average, Worst and Best cases).**(CO2)**

7. Compare the performance of Single Source Shortest Paths using Greedy method when

   the graph is represented by adjacency matrix and adjacency lists.**(CO3)**
8. Implement Job sequencing with deadlines using Greedy strategy.**(CO5)**

9. Write a program to solve 0/1 Knapsack problem Using Dynamic Programming.**(CO4)**

10. Implement N-Queens Problem Using Backtracking.**(CO4)**

11. Use Backtracking strategy to solve 0/1 Knapsack problem.**(CO4)**

12. Implement Travelling Sales Person problem using Branch and Bound approach.**(CO5)**

Reference Books:

1. Fundamentals of Data Structures in C++, Horowitz Ellis, SahniSartaj, Mehta, Dinesh, 2ndEdition, Universities Press

2. Computer Algorithms/C++ Ellis Horowitz, SartajSahni, SanguthevarRajasekaran, 2ndEdition, University Press

3. Data Structures and program design in C, Robert Kruse, Pearson Education Asia

4. An introduction to Data Structures with applications, Trembley& Sorenson, McGraw Hill

Online Learning Resources:

1. http://cse01-iiith.vlabs.ac.in/
2. http://peterindia.net/Algorithms.html

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
1	CO1 : Understand	L2	PO1 PO2 PO8 PO11	PO1: Apply(L3) PO2: Analyze(L4) PO8: Thumb rule PO11: Thumb rule	2 1 1 2
2	CO2 : Create	L6	PO1 PO2 PO5 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO5: Develop (L6) PO11: Thumb rule	3 3 3 2
3	CO3 : Create	L6	PO1 PO2 PO3 PO4 PO8 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO3: Design (L6) PO4: Design (L6) PO8: Thumb rule PO11: Thumb rule	3 3 3 3 1 1
4	CO4 : Apply	L3	PO1 PO2 PO8 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO8: Thumb rule PO11: Thumb rule	3 2 2 2
5	CO5 : Apply	L3	PO1 PO2 PO3 PO4 PO8 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO3: Develop (L3) PO4: Develop (L3) PO8: Thumb rule PO11: Thumb rule	3 2 3 3 1 2

Justification Statements :

CO1: Understand the operations on AVL Trees, B-Trees and graph traversals.

Action Verb : Understand (L2)

PO1 Verb : Apply(L3)

CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)

PO2 Verb : Analyze(L4)

CO1 Action verb is less than PO2 verb by two levels. Therefore the correlation is low (1)

PO8: Thumb rule

Perform operations on AVL trees and B-trees are individual. There fore the correlation is low(1)

PO11 : Thumb rule

Apply different values of operations on AVL Trees, B-Trees and graph traversals is life long. Therefore the correlation is moderate (2)

CO2: Create the Min, Max Heap using arrays and find BFT, DFT for the graphs

Action Verb : Create (L6)

PO1 Verb : Apply(L3)

CO2 Action verb is greater than PO1 verb. Therefore the correlation is high (3)

PO2 Verb : Analyze(L4)

CO2 Action verb is greater than PO2 verb. Therefore the correlation is high (3)

PO5: Develop(L6)

CO2 Action verb is less than PO5 verb by one level. Therefore the correlation is high (3)

PO11: Thumb rule

To Apply the min and max heap on arrays and finding traversals on graphs is lifelong learning. Therefore the

correlation is moderate (2)

CO3: Create the sorting techniques for finding the time complexities and use greedy method to find single source shortest path.

Action Verb : Create (L6)

PO1: Apply(L3)

CO3 Action verb is greater than PO1 verb. Therefore the correlation is high (3)

PO2:Analyze (L4)

CO3 Action verb is greater than PO1 verb. Therefore the correlation is high (3)

PO3: Design (L6)

CO3 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate (2)

PO4: Develop (L6)

CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is moderate (2)

PO8: Thumb rule

Team work or individual work is required to analyze sorting techniques time complexities. Hence the correlation is low (1)

PO11: Thumb rule

To Develop sorting techniques and single source shortest path as life long learning. Therefore the correlation is low (1)

CO4: Apply backtracking strategy for finding the N-Queens ,0/1 knapsack problem

Action Verb : Apply (L3)

PO1: Apply(L3)

CO4 Action verb is same level as PO1 verb. Therefore the correlation is high (3)

PO2: Analyze (L4)

CO4 Action verb is less than PO2 verb by one level. Therefore the correlation is medium (2)

PO8: Thumb rule

Team work/ individual work is required find the N-Queens and 0/1 Knapsack trough backtracking. Hence the correlation is medium (2)

PO11: Thumb rule

To Develop back tracking in N-Queens problem is life long learning. Therefore the correlation is medium (2)

CO5 : Apply greedy strategy for job sequencing and using dynamic programming to find 0/1 knapsack problem.

Action Verb : Apply (L3)

PO1: Apply (L3)

CO5 Action verb is same level as PO1 verb. Therefore the correlation is high (3)

PO2: Analyze (L4)

CO5 Action verb is less than PO2 verb by one level. Therefore the correlation is medium (2)

PO3: Design (L3)

CO5 Action verb is less than PO3 verb. Therefore the correlation is high (3)

PO4: Design (L3)

CO5 Action verb is less than PO4 verb. Therefore the correlation is high (3)

PO8: Thumb rule

Team work / individual work is required applying greedy strategy on job sequencing. Hence the correlation is low (1)

PO11: Thumb rule

To apply dynamic programming for 0/1 knapsack is life long learning. Therefore the correlation is medium (2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	Object-Oriented Programming Through Java Lab (common to CSE,CIC, CSE(DS), AIDS & AIML)	L	T/CLC	P	C
23APC0507	II-I		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the Java syntax, data types, control structures and OOPs principles.

CO2: Apply the problem-solving skills and algorithmic thinking by using OOP concepts

CO3: Apply the fundamental OOP principles to solve programming problems effectively.

CO4: Analyze the Java libraries to implement thread Applications.

CO5: Create graphical user interface (GUI) applications using JavaFX

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The Java syntax, data types, control structures and OOPs principles			L2
CO2	Apply	The problem-solving skills and algorithmic thinking	by using OOP concepts		L3
CO3	Apply	The fundamental OOP principles		to solve programming problems effectively	L3
CO4	Analyze	The Java libraries		to implement thread Applications.	L4
CO5	Create	graphical user interface (GUI) applications	using JavaFX		L6

List of Experiments:

Exercise – 1

a) Write a JAVA program to display default value of all primitive data type of JAVA **(CO1)**

b) Write a java program that display the roots of a quadratic equation ax2+bx=0. Calculate the discriminate D and basing on value of D, describe the nature of root. **(CO2)**

Exercise - 2

a) Write a JAVA program to search for an element in a given list of elements using binary search mechanism. b) Write a JAVA program to sort for an element in a given list of elements using bubble sort. **(CO2)**

c) Write a JAVA program using StringBuffer to delete, remove character. **(CO2)**

Exercise - 3

a) Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method. **(CO2)**

b) Write a JAVA program implement method overloading. **(CO3)**

c) Write a JAVA program to implement constructor**. (CO3)**

d) Write a JAVA program to implement constructor overloading. **(CO3)**

Exercise - 4

a) Write a JAVA program to implement Single Inheritance **(CO3)**

b) Write a JAVA program to implement multi level Inheritance **(CO3)**

c) Write a JAVA program for abstract class to find areas of different shapes **(CO3)**

Exercise - 5

a) Write a JAVA program give example for "super" keyword. **(CO3)**

b) Write a JAVA program to implement Interface. What kind of Inheritance can be achieved? **(CO3)**

c) Write a JAVA program that implements Runtime polymorphism **(CO3)**

Exercise - 6

a) Write a JAVA program that describes exception handling mechanism **(CO4)**

b) Write a JAVA program Illustrating Multiple catch clauses **(CO4)**

c) Write a JAVA program for creation of Java Built-in Exceptions **(CO4)**

d) Write a JAVA program for creation of User Defined Exception **(CO4)**

Exercise - 7

a) Write a JAVA program that creates threads by extending Thread class. First thread display "Good Morning "every 1 sec, the second thread displays "Hello "every 2 seconds and the third display "Welcome" every 3 seconds, (Repeat the same by implementing Runnable) **(CO4)**

b) Write a program illustrating is Alive and join () **(CO4)**

c) Write a Program illustrating Daemon Threads. **(CO4)**

d) Write a JAVA program Producer Consumer Problem **(CO4)**

Exercise – 8

a) Write a JAVA program that import and use the user defined packages **(CO4)**
b) Without writing any code, build a GUI that display text in label and image in an ImageView (use JavaFX) **(CO5)**
c) Build a Tip Calculator app using several JavaFX components and learn how to respond to user interactions with the GUI **(CO5)**

Exercise – 9
a) Write a java program that connects to a database using JDBC **(CO5)**
b) Write a java program to connect to a database using JDBC and insert values into it. **(CO5)**
c) Write a java program to connect to a database using JDBC and delete values from it. **(CO5)**

Textbooks:
1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, DebasisSamanta, MonalisaSarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.
Reference Books:
1. The complete Reference Java, 11th edition, Herbert Schildt,TMH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson
Online Resources:
1. https://nptel.ac.in/courses/106/105/106105191/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547 618816347_shared/overview

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
1	CO1 :Understand	L2	PO2 PO5	PO2: Review(L2) PO5: Apply(L3)	3 2
2	CO2 :Apply	L3	PO2 PO3 PO4 PO5	PO2: Review(L2) PO3: Develop (L3) PO4: Analyze(L4) PO5: Apply(L3)	3 3 2 3
3	CO3: Apply	L3	PO3 PO4 PO5	PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3)	3 2 3
4	CO4: Analyze	L4	PO2 PO3 PO4 PO5 PO8 PO10 PO11	PO2: Analyze (L4) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3) PO8: Thumb Rule PO10: Thumb Rule PO11: Thumb Rule	3 3 3 3 3 3 3
5	CO5 :Create	L6	PO3 PO5 PO8 PO10 PO11	PO3: Design (L6) PO5: Create(L6) PO8: Thumb Rule PO10: Thumb Rule PO11: Thumb Rule	3 3 3 3 3

Justification Statements :
CO1: Understand Java syntax thoroughly, encompassing data types and control structures.
Action Verb : Understand(L2)
PO2: Review(L2)
CO1 Action verb is same PO2 verb. Therefore the correlation is High(3)
PO5: Apply(L3)

CO1 Action verb is less than PO5 verb by one level. Therefore the correlation is moderate (2)

CO2: Develop problem-solving skills and algorithmic thinking, applying OOP concepts to design efficient solutions to various programming challenges.

Action Verb : Apply (L3)

PO2: Review(L2)

CO2 Action verb is greater than PO2 verb. Therefore the correlation is High(3)

PO3: Develop (L3)

CO2 Action verb is same level as PO3 verb. Therefore the correlation is high (3)

PO4: Analyze (L4)

CO2 Action verb is less than PO4 verb by one levels. Therefore the correlation is moderate (2)

PO5: Apply (L3)

CO2 Action verb is same level as PO5 verb. Therefore the correlation is high (3)

CO3: Apply fundamental OOP principles such as encapsulation, inheritance, polymorphism, and abstraction to solve programming problems effectively.

Action Verb : Apply(L3)

PO3: Develop (L3)

CO3 Action verb is same level as PO3 verb. Therefore the correlation is high (3)

PO4: Analyze (L4)

CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is moderate(2)

PO5: Apply (L3)

CO3 Action verb is same as PO5 verb. Therefore the correlation is high(3)

CO4: Analyze the concepts of multithreading and collection frameworks for solving complex programs.

Action Verb :Analyze (L4)

PO2: Analyze (L4)

CO4 Action verb is same PO2 verb. Therefore the correlation is high (3)

PO3: Develop (L3)

CO4 Action verb is greater than PO3 verb. Therefore the correlation is high (3)

PO4: Analyze (L4)

CO4 Action verb is same as PO4 verb. Therefore the correlation is high (3)

PO5: Apply (L3)

CO4 Action verb is greater than PO5 verb. Therefore the correlation is high (3)

PO8: Thumb Rule

It is a programming language we need to collaborate with team. Therefore the correlation is high (3)

PO10: Thumb Rule

By using java to manage enterprise projects in multi-disciplinary environments . Therefore the correlation is high (3)

PO11: Thumb Rule

It is a programming language we need to learn lifelong because new concepts arise. Therefore the correlation is high (3)

CO5: Create GUI based applications using Java FX.

Action Verb : Create (L6)

PO3: Design (L6)

CO5 Action verb is same level as PO3 verb. Therefore the correlation is high (3)

PO5: Create(L6)

CO5 Action verb is same as PO5 verb. Therefore the correlation is high (3)

PO8: Thumb Rule

It is a programming language we need to collaborate with team. Therefore the correlation is high (3)

PO10: Thumb Rule

By using java to manage enterprise and web based projects in multi-disciplinary environments. Therefore the correlation is high (3)

PO11: Thumb Rule

It is a programming language we need to learn lifelong because new concepts arise. Therefore the correlation is high (3)

Course Code	Year & Sem	PYTHON PROGRAMMING	L	T/CLC	P	C
23ASC0501	II-I	**(SKILL ENHANCEMENT COURSE)** **(Common to CSE,CIC,CSE(DS),AIDS & AIML)**	1	0	2	2

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the Basic concepts of python programming to build scripts in IDLE.

CO2: Apply the modularity techniques to invoke user defined functions.

CO3: Apply the concept of Dictionaries, Tuples and sets to perform operations on data.

CO4: Analyze the file concepts and oops paradigms to manage data.

CO5: Apply the concepts of JSON and XML for data processing.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	Basic concepts of python programming		to build scripts in IDLE	L2
CO2	Apply	the modularity techniques		to invoke user defined functions	L3
CO3	Apply	the concept of Dictionaries, Tuples and sets		to perform operations on data.	L3
CO4	Analyze	the file concepts and oops paradigms.		to manage data	L4
CO5	Apply	the concepts of JSON and XML		for data processing	L3

UNIT – I	9Hrs

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupyter Notebook.

Parts of Python Programming Language: Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: if statement, if-else statement, if...elif...else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

 Sample Experiments:
1. Write a program to find the largest element among three Numbers.

2. Write a Program to display all prime numbers within an interval

3. Write a program to swap two numbers without using a temporary variable.

4. Demonstrate the following Operators in Python with suitable examples.

   i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators
   viii) Identity Operators
5. Write a program to add and multiply complex numbers

6. Write a program to print multiplication table of a given number.

UNIT – II	9 Hrs

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

 Sample Experiments:
7. Write a program to define a function with multiple return values.

8. Write a program to define a function using default arguments.

9. Write a program to find the length of the string without using any library functions.

10. Write a program to check if the substring is present in a given string or not.

11. Write a program to perform the given operations on a list:

    i.Addition   ii. Insertion   iii. slicing
12. Write a program to perform any 5 built-in functions by taking any list.

UNIT – III	9 Hrs

Dictionaries: Creating Dictionary, Accessing and Modifying key:value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Using zip() Function, Sets, Set Methods, Frozenset.

Sample Experiments:
13. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.

14. Write a program to count the number of vowels in a string (No control flow allowed).

15. Write a program to check if a given key exists in a dictionary or not.

16. Write a program to add a new key-value pair to an existing dictionary.

17. Write a program to sum all the items in a given dictionary.

UNIT – IV	9 Hrs

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes Vs Data Attributes, Encapsulation, Inheritance, Polymorphism.

Sample Experiments:
18. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.

19. Python program to print each line of a file in reverse order.

20. Python program to compute the number of characters, words and lines in a file.

21. Write a program to create, display, append, insert and reverse the order of the items in the array.

22. Write a program to add, transpose and multiply two matrices.

23. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.

UNIT – V	9Hrs

Introduction to Data Science: Functional Programming, JSON and XML in Python, NumPy with Python, Pandas.

Sample Experiments:
24. Python program to check whether a JSON string contains complex object or not.

25. Python Program to demonstrate NumPy arrays creation using array () function.

26. Python program to demonstrate use of ndim, shape, size, dtype.

27. Python program to demonstrate basic slicing, integer and Boolean indexing.

28. Python program to find min, max, sum, cumulative sum of array

29. Create a dictionary with at least five keys and each key represent value as a list where this list contains at least ten values and convert this dictionary as a pandas data frame and explore the data through the data frame as follows:

   a)   Apply head () function to the pandas data frame

   b)   Perform various data selection operations on Data Frame

30. Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in matplotlib

Reference Books:
1. Gowrishankar S, Veena A., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2ndEdition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

Online Learning Resources/Virtual Labs
1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://www.coursera.org/learn/python?specialization=python#syllabus

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	Lesson plan(Hrs)	%	CO Correlation	Co's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
1	9	20	2	CO1 : Understand	L2	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO5: Apply (L3)	2 3 2 2
2	9	20	2	CO2 : Apply	L3	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3 2 3
3	9	20	2	CO3 : Apply	L3	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3 2 3
4	9	20	2	CO4 : Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze(L4) PO5: Apply (L3) PO11:Thumb Rule	3 3 3 3 3 2

5	9	20	2	CO5 : Apply	L3	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3 2 3
	53	100 %						

Justification Statements:

CO1: Understand the Basic concepts of python programming to build scripts in IDLE.
Action Verb : Understand(L2)
PO1 Verb : Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO2 Verb : Review(L2)
CO1 Action verb is same as PO2 verb. Therefore the correlation is high (3)
PO3 Verb : Develop(L3)
CO1 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate (2)
PO5 Verb : Apply(L3)
CO1 Action verb is less than PO5 verb by one level. Therefore the correlation is moderate (2)

CO2: Apply the modularity techniques to invoke user defined functions.
Action Verb : Apply (L3)
PO1: Apply(L3)
CO2 Action verb is same as PO1 verb. Therefore the correlation is high (3)
PO2 Verb : Review(L2)
CO2 Action verb is greater than PO2 verb. Therefore the correlation high (3)
PO3 Verb : Develop (L3)
CO2 Action verb same as PO3 verb. Therefore the correlation high (3)
PO4 Verb : Analyze(L4)
CO2 Action verb is less than PO4 verb by one level. Therefore the correlation is moderate (2)
PO5 Verb : Apply(L3)
CO2 Action verb is same as PO5 verb. Therefore the correlation is high (3)

CO3: Apply the concept of Dictionaries, Tuples and sets to perform operations on data.
Action Verb : Apply(L3)
PO1: Apply(L3)
CO3 Action verb is same as PO1 verb. Therefore the correlation is high (3)
PO2 Verb : Review(L2)
CO3 Action verb is greater than PO2 verb. Therefore the correlation high (3)
PO3 Verb : Develop (L3)
CO3 Action verb same as PO3 verb. Therefore the correlation high (3)
PO4 Verb : Analyze(L4)
CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is moderate (2)
PO5 Verb : Apply(L3)
CO3 Action verb is same as PO5 verb. Therefore the correlation is high (3)

CO4: Analyze the file concepts and oops paradigms to manage data.
Action Verb: Analyze(L4)
PO1: Apply(L3)
CO3 Action verb is greater than PO1 verb. Therefore the correlation is high (3)
PO2 Verb : Review(L2)
CO3 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO3 Verb : Develop (L3)
CO3 Action verb is greater than PO3 verb. Therefore the correlation is high (3)
PO4 Verb : Analyze(L4)
CO3 Action verb is same as PO4 verb. Therefore the correlation is high (3)
PO5 Verb : Apply(L3)
CO3 Action verb is greater than PO5 verb. Therefore the correlation is high (3)
PO11: Thumb rule
To solve the real time problems oops and file concepts are necessary for data security. Therefore the correlation is medium(2)

CO5: Apply the concepts of JSON and XML for data processing.
Action Verb : Apply(L3)
PO1: Apply(L3)

CO3 Action verb is same as PO1 verb. Therefore the correlation is high (3)

PO2 Verb : Review(L2)

CO3 Action verb is greater than PO2 verb. Therefore the correlation high (3)

PO3 Verb : Develop (L3)

CO3 Action verb same as PO3 verb. Therefore the correlation high (3)

PO4 Verb : Analyze(L4)

CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is moderate (2)

PO5 Verb : Apply(L3)

CO3 Action verb is same as PO5 verb. Therefore the correlation is high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
AK23 REGULATIONS
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)
(Effective for the batches admitted from 2023-24)

B.Tech II Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P	C			
1	ES	23AES0305	Optimization Technique	2	0	0	2	30	70	100
2	BS	23ABS9916	Probability & Statistics	2	1	0	3	30	70	100
3	PC	23APC3301	Machine Learning	2	1	0	3	30	70	100
4	PC	23APC0508	Database Management Systems	2	1	0	3	30	70	100
5	PC	23APC0503	Digital Logic & Computer Organization	2	1	0	3	30	70	100
6	PC	23APC3302	AI&ML Lab	0	0	3	1.5	30	70	100
7	PC	23APC0509	Database Management Systems Lab	0	0	3	1.5	30	70	100
8	SC	23ASC0503	Full Stack Development-1	1	0	2	2	30	70	100
9	ES	23AES0304	Design Thinking & Innovation	2	0	0	2	30	70	100
10	MC	23AMC9901	Environmental Science	2	0	0	-	30	-	30
			Total	**15**	**4**	**8**	**21**	**300**	**630**	**930**
Mandatory Community Service Project Internship of 08 weeks duration during summer vacation										

Year: II   **Semester: II**   **Branch of Study: AIML & DS**

Subject Code	Subject Name	L	T/CLC	P	Credits
23AES0305	Optimization Techniques	2	0	0	2

Course Outcomes:

- CO1:   Apply the mathematical procedure for solving the LPP and transportation models
- CO2:   Apply the algorithms in solving the Transportation and Assignment Problems
- CO3:   Understand the job scheduling and implement sequencing procedure to solve problems related to the n Jobs on m Machines
- CO4:   Apply the decision-making strategies in game theories for managerial applications
- CO5:   Understand the concepts of project planning, scheduling and controlling to execute complex projects using PERT and CPM techniques

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	the mathematical procedure for solving the LPP and transportation models		in industries	L3
CO2	Apply	the algorithms in solving the Transportation and Assignment Problems		in logistic related fields	L3
CO3	Understand	the job scheduling and implement sequencing procedure to solve problems related to the n Jobs on m Machines		in industries	L2
CO4	Apply	the decision making strategies in game theories for managerial applications		in industries	L3
CO5	Understand	the concepts of project planning, scheduling and controlling to execute complex projects using PERT and CPM techniques		in industries	L2

Unit I:

Introduction: Meaning, Nature, Scope & Significance of Optimization - Typical applications. The Linear Programming Problem – Introduction, Formulation of Linear Programming problem, Limitations of L.P.P, Graphical method, Simplex method: Maximization and Minimization model(exclude Duality problems), Big-M method and Two Phase method.

Unit II

Transportation Problem: Introduction, Transportation Model, finding initial basic feasible solutions, Moving towards optimality, Unbalanced Transportation problems, Transportation problems with maximization, Degeneracy. Assignment Problem – Introduction, Mathematical formulation of the problem, Solution of an Assignment problem, Hungarian Algorithm, Multiple Solution, Unbalanced Assignment problems, Maximization in Assignment Model.

Activity: Every student presents their idea in three minutes, every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

Unit III

Sequencing – Job sequencing, Johnsons Algorithm for n Jobs and Two machines, n Jobs and Three Machines, n jobs through m machines, Two jobs and m Machines Problems.

Unit IV

Game Theory: Concepts, Definitions and Terminology, Two Person Zero Sum Games, Pure Strategy Games (with Saddle Point), Principal of Dominance, Mixed Strategy Games (Game without Saddle Point), Significance of Game Theory in Managerial Application.

Unit V

Project Management: Network Analysis – Definition –objectives -Rules for constructing network diagram- Determining Critical Path – Earliest & Latest Times – Floats - Application of CPM and PERT techniques in Project Planning and Control – PERT Vs CPM. (exclude Project Crashing).

Text Books:

1. Operations Research / R. Panneerselvam, PHI Publications.
2. Operations Research / S.D. Sharma-Kedarnath
3. Operations Research /A.M. Natarajan, P. Balasubramani, A. Tamilarasi/Pearson Education.
4. Engineering Optimization: Theory and practice / S.S. Rao, New Age International (P) Limited.

Course Title	Cos	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Optimization Techniques	CO1	3		3									2	2
	CO2	3		3		3							2	2
	CO3	2	2										3	2
	CO4	3		3		3							2	2
	CO5	2	2										3	2

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Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	-	-	-	Apply	L3	PO1 PO3 PSO1 PSO2	Apply (L3) Develop (L3) Thumb Rule Thumb Rule	3 3 2 2
2	-	-	-	Apply	L3	PO1 PO3 PO5 PSO1 PSO2	Apply (L3) Develop (L3) Apply (L3) Thumb Rule Thumb Rule	3 3 3 2 2
3	-	-	-	Understand	L2	PO1 PO2 PSO1 PSO2	Apply (L3) Identify (L3) Thumb Rule Thumb Rule	2 2 3 2
4	-	-	-	Apply	L3	PO1 PO3 PO5 PSO1 PSO2	Apply (L3) Develop (L3) Apply (L3) Thumb Rule Thumb Rule	3 3 3 2 2
5	-	-	-	Understand	L2	PO1 PO2 PSO1 PSO2	Apply (L3) Identify (L3) Thumb Rule Thumb Rule	2 2 3 2

Justification Statements:

CO1: Apply the mathematical procedure for solving the LPP and transportation models.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3).
PO3 Verb: Develop (L3)
CO1: Action verb is same level as PO3 verb. Therefore, the correlation is high (3).

CO2: Apply the algorithms in solving the Transportation and Assignment Problems.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO2: Action verb is same level as PO1 verb. Therefore, the correlation is high (3).
PO3 Verb: Develop (L3)
CO2: Action verb is same level as PO3 verb. Therefore, the correlation is high (3).
PO5 Verb: Apply (L3)
CO2: Action verb is same level as PO5 verb. Therefore, the correlation is high (3).

CO3: Understand the job scheduling and implement sequencing procedure to solve problems related to the n Jobs on m Machines.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is same (lower) level as PO1 verb. Therefore, the correlation is low (2).
PO2 Verb: Identify (L3)
CO1: Action verb is same (lower) level as PO2 verb. Therefore, the correlation is low (2).

CO4: Apply the decision making strategies in game theories for managerial applications.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO2: Action verb is same (lower) level as PO1 verb. Therefore, the correlation is low (2).
PO3 Verb: Develop (L3)
CO2: Action verb is same (lower) level as PO3 verb. Therefore, the correlation is low (2).
PO5 Verb: Apply (L3)
CO2: Action verb is same (lower) level as PO5 verb. Therefore, the correlation is low (2).

CO5: Understand the concepts of project planning, scheduling and controlling to execute complex projects using PERT and CPM techniques.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is same (lower) level as PO1 verb. Therefore, the correlation is low (2).
PO2 Verb: Identify (L3)
CO1: Action verb is same (lower) level as PO2 verb. Therefore, the correlation is low (2).

Course Code	Year & Sem	Probability & Statistics	L	T/CLC	P	C
23ABS9916	II-II		2	1	**O**	**3**

Course Outcomes:

After studying the course, student will be able to

CO1:**Understand** the discrete and continuous data through various statistical methods.
CO2:**Apply** the concepts of probability, Baye's theorem and its applications.
CO3:**Apply** the discrete and continuous probability distributions for random data.
CO4:**Analyze** the techniques for testing of hypothesis for large samples.
CO5:**Analyze** the techniques for testing of hypothesis for small samples.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the discrete and continuous data	through statistical methods.		**L2**
2	Apply	The concepts of probability and its applications			**L3**
3	Apply	The discrete and continuous probability distributions	for random data.		**L3**
4	Analyze	The techniques for testing of hypothesis	for large samples		**L4**
5	Analyze	The techniques for testing of hypothesis	for small samples		**L4**

UNIT – I	Descriptive statistics	10 Hrs

Statistics Introduction, Population vs Sample, Collection of data, primary and secondary data, Measures of Central tendency, Measures of Variability (dispersion), Skewness, Kurtosis.
Correlation and Regression: Correlation coefficient, rank correlation, regression coefficients, method of least squares, regression lines

UNIT - II	Probability	8Hrs

Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation.

UNIT – III	Probability distributions	8Hrs

Probability distributions: Binomial, Poisson and Normal-their properties (Chebyshev`s inequality).Approximation of the binomial distribution to normal distribution.

UNIT – IV	Estimation and Testing of hypothesis, large sample tests	8 Hrs

Estimation-parameters, statistics, sampling distribution, point estimation, maximum likelihood estimation, Formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level of significance, two types of errors and power of the test.
Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems.

UNIT – V	Small sample tests	8Hrs

Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), x2 - test for goodness of fit, x2 - test for independent of attributes.

Textbooks:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.

2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012

Reference Books:

1. S. Ross, a First Course in Probability, Pearson Education India, 2002
2. W. Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968
3. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education.
4. S.Chand ,Probability and Statistics, Dr.T.K.V.Iyengar, Dr.B.Krishna Gandhi, S.Ranganatham, Dr.M.V.S.S.N.Prasad

Mapping of COs to POs

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1				Understand	L2	PO1	Apply (L3)	2
2				Apply	L3	PO1	Apply (L3)	3
3				Apply	L3	PO1	Apply (L3)	3
4				Analyze	L4	PO2	Analyze (L4)	3
5				Analyze	L4	PO2	Analyze (L4)	3

Justification Statements

CO1: Understand the discrete and continuous data through various statistical methods.
Action Verb: Understand (L2)
PO1 Verbs: Apply(L3)
CO1 Action Verb is low level to PO1 verb by one level; Therefore correlation is moderate (2).

CO2: Apply the concepts of probability, Baye's theorem and its applications.
Action Verb: Apply (L3)
PO1 Verbs: Apply(L3)
CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

CO3: Apply the discrete and continuous probability distributions for random data.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO3 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).

CO4: Analyze the techniques for testing of hypothesis for large samples.
Action Verb: Analyze(L4)
PO2 Verb: Analyze(L4)
CO4 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

CO5: Analyze the techniques for testing of hypothesis for small samples.
Action Verb: Analyze(L4)
PO2 Verb: Analyze (L4)
CO5 Action verb is equal to PO2 verb; therefore the correlation is high (3).

Course Code	Year & Sem	Machine Learning	L	T/CLC	P	C
23APC3301	II-II	**(AI & ML)**	2	1	**0**	**3**

Course Outcomes:

After studying the course, students will be able to

CO1: Apply the supervised learning techniques for few machine learning problems.

CO2: Evaluate the hypotheses by comparing its learning algorithms

CO3: Apply the various dimensionality reduction techniques for ML problems

CO4: Analyze the Unsupervised learning methods using clustering methods.

CO5: Understand the concepts of Semi supervised Learning and Reinforcement Learning.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	The supervised learning techniques		for few machine learning problems	L3
CO2	Evaluate	The hypotheses	by comparing its learning algorithms		L5
CO3	Apply	The various dimensionality reduction techniques		for ML problems	L3
CO4	Analyze	The Unsupervised learning methods	using clustering methods.		L4
CO5	Understand	the concepts of Semi supervised Learning and Reinforcement Learning.			L2

UNIT – I		9Hrs

What is Machine Learning?Examples of machine learning applications, **Supervised Learning**: learning a class from examples, Vapnik- Chervonenkis dimension, probably approximately correct learning, noise, learning multiple classes, regression, model selection and generalization, dimensions of a supervised machine learning algorithm.

Decision Tree Learning: Introduction, Decisions Tree representation, Appropriate problems for decision tree learning, the basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, issues in decision tree learning.

UNIT – II		9 Hrs

Evaluating Hypotheses: Motivation, Estimating hypothesis accuracy, basics of sampling theory, a general approach for deriving confidence intervals, differences in error of two hypothesis, comparing learning algorithms.

Bayesian Learning: Introduction, Bayes Theorem, Bayes Theorem and Concept Learning, Maximum Likelihood and least squared error hypothesis, Maximum Likelihood hypothesis for predicting probabilities, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm , Naïve Bayes Classifier , Bayesian Belief Network, EM Algorithm.

UNIT – III		9 Hrs

Dimensionality Reduction: Introduction, Subset selection, principle component analysis, feature embedding, factor analysis, singular value decomposition and matrix factorization, multidimensional scaling, linear discriminant analysis, canonical correlation analysis.

UNIT – IV		8 Hrs

Clustering: Introduction, Mixture densities, K- Means clustering, Expectations- Maximization algorithm, Mixture of latent variable models, supervised learning after clustering, spectral clustering, Hierarchal clustering, Choosing the number of clusters.

UNIT – V		9 Hrs

Semi supervised Learning: What is Semi supervised Learning? , How does Semi supervised Learning works?, Semi supervised Learning applications, Semi supervised Learning examples.

Reinforcement Learning: What is Reinforcement Learning? , How Does Reinforcement Learning Work?, Terminologies used in Reinforcement Learning, How is Reinforcement Learning different from Supervised Learning?, Approaches to Implement Reinforcement Learning Algorithms, Types of Reinforcement Learning, Models for Reinforcement Learning, Applications of reinforcement learning.

Textbooks:

1. Machine Learning – Tom M. Mitchell - McGraw Hill Education, 2017

2. Introduction to Machine learning, Ethem Alpaydin, PHI, 3rd Edition, 2014.

Reference Books:

1. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis Chapman and Hall/CRC; 2nd edition, 2014

2. Machine Learning For Beginners: A Comprehensive Guide To Understand Machine Learning. How It Works And How Is Correlated To Artificial Intelligence And Deep Learning, Chris Neil, Alicex Ltd, 2020

Online Learning Resources:

https://www.youtube.com/watch?v=r4sgKrRL2Ys&list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77

Semi supervised Learning: https://maddevs.io/blog/what-is-semi-supervised-learning/

Reinforcement Learning:

https://www.analyticsvidhya.com/blog/2021/02/introduction-to-reinforcement-learning-for-beginners/

https://www.simplilearn.com/tutorials/machine-learning-tutorial/reinforcement-learning

Mapping of course outcomes with program outcomes

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

Correlation matrix

Unit No.	CO						Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action ve3rb	BTL				
1				CO1: Apply	L3		PO1 PO2 PO3 PO4 PO5 PO6	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule	3 3 3 2 3 2
2				CO2: Evaluate	L5		PO1 PO2 PO3 PO4 PO5 PO8 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO8: Thumb rule PO11: Thumb rule	3 3 3 3 3 3 3
3				CO3: Apply	L3		PO1 PO2 PO3 PO4 PO5 PO6	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule	3 3 3 2 3 2
4				CO4: Analyze	L4		PO1 PO2 PO3 PO4 PO5 PO8 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3) PO8: Thumb rule PO11: Thumb rule	3 3 3 3 3 3 3
5				CO5: Understand	L2		PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO5: Apply(L3)	2 3 2 2

Justification Statements :

CO1: Apply the supervised learning techniques for few machine learning problems

Action Verb : Apply (L3)

PO1 Verb : Apply(L3)

CO1 Action verb is same level of PO1 verb. Therefore, the correlation is High (3)

PO2 Verb : Review(L2)

CO1 Action verb is greater than PO2 verb. Therefore the correlation is High(3)
PO3: Develop (L3)
CO1 Action verb is same level of PO3 verb. Therefore, the correlation is High (3)
PO4: Analyze (L4)
CO1 Action verb is less than PO4 verb by one level. Therefore the correlation is medium(2)
PO5 Verb : Apply(L3)
CO1 Action verb is same level of PO5 verb. Therefore, the correlation is High (3)
PO6: Thumb rule
Some of the machine learning models will provide solutions to current societal problems. Therefore the correlation is medium (2)

CO2: Evaluate the hypotheses by comparing its learning algorithms
Action Verb : Evaluate (L5)
PO1: Apply(L3)
CO2 Action verb is greater level of PO1 verb. Therefore, the correlation is High (3)
PO2 Verb : Review(L2)
CO2 Action verb is greater than PO2 verb. Therefore the correlation is High(3)
PO3: Develop (L3)
CO2 Action verb is greater than PO3 verb. Therefore, the correlation is High (3)
PO4: Analyze (L4)
CO2 Action verb is greater than PO4 verb. Therefore the correlation is High(3)
PO5 Verb : Apply(L3)
CO2 Action verb is greater than PO5 verb. Therefore, the correlation is High (3)
PO8 : Thumb rule
While creating hypothesis one need to follow the ethical principles. Therefore, the correlation is
High (3)
PO11: Thumb rule
In current scenario all machine learning models are updating so one needs to follow the change. Therefore, the correlation is high (3)

CO3: Apply the various dimensionality reduction techniques for ML problems
Action Verb : Apply (L3)
PO1 Verb : Apply(L3)
CO3 Action verb is same level of PO1 verb. Therefore, the correlation is High (3)
PO2 Verb : Review(L2)
CO3 Action verb is greater than PO2 verb. Therefore the correlation is High(3)
PO3: Develop (L3)
CO3 Action verb is same level of PO3 verb. Therefore, the correlation is High (3)
PO4: Analyze (L4)
CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is medium(2)
PO5 Verb : Apply(L3)
CO3 Action verb is same level of PO5 verb. Therefore, the correlation is High (3)
PO6: Thumb rule
Some of the ML dimensionality reduction techniques will reduce complexity and produce high accuracy output. Therefore the correlation is medium (2)

CO4: Analyze the Unsupervised learning methods using clustering methods.
Action Verb : Analyze (L4)
PO1: Apply(L3)
CO4 Action verb is greater level of PO1 verb. Therefore, the correlation is High (3)
PO2 Verb : Review(L2)
CO4 Action verb is greater than PO2 verb. Therefore the correlation is High(3)
PO3: Develop (L3)
CO4 Action verb is greater than PO3 verb. Therefore, the correlation is High (3)
PO4: Analyze (L4)
CO4 Action verb is greater than PO4 verb. Therefore the correlation is High(3)
PO5 Verb : Apply(L3)
CO4 Action verb is greater than PO5 verb. Therefore, the correlation is High (3)
PO8 : Thumb rule
some ethical principles will apply while training a model using discrimination mothods. Therefore, the correlation is High (3)
PO11: Thumb rule
In today's world training a machine is big challenge to the developers, it is a continuous learning process. Therefore, the correlation is high (3)

CO5: Understand the concepts of Semi supervised Learning and Reinforcement Learning.
Action Verb : Understand (L2)
PO1: Apply(L3)
CO5 Action verb is less than one level of PO1 verb. Therefore, the correlation is Medium (2)
PO2 Verb : Review(L2)
CO5 Action verb is same as PO2 verb. Therefore the correlation is High(3)
PO3: Develop (L3)
CO5 Action verb is less than one level of PO3 verb. Therefore, the correlation is Medium (2)
PO5 Verb : Apply(L3)
CO5 Action verb is less than one level of PO3 verb. Therefore, the correlation is Medium (2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, **TIRUPATI**
(AUTONOMOUS)
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	Database Management Systems	L	T/CLC	P	C
23APC0508	II-II	Common to CSE,AIDS,AIML,CSE(DS) & CIC	2	1	**0**	**3**

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the fundamentals of databases to design relational models.
CO2: Apply the E-R model for database design of real world applications.
CO3: Apply the SQL and PL/SQL concepts to formulate queries.
CO4: Analyze normalization methods to enhance database structures
CO5: Analyze the concurrent transactions and recover systems to prevent data loss in system crash.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The fundamentals of databases		To design relational models.	L2
CO2	Apply	the E-R model		for database design of real world applications	L3
CO3	Apply	the SQL and PL/SQL concepts		To formulate queries.	L3
CO4	Analyze	normalization methods		to enhance database structures	L4
CO5	Analyze	the concurrent transactions and recover systems		to prevent data loss in system crash.	L4

UNIT – I		9 Hrs

Introduction: Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.
Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

UNIT – II		9Hrs

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra, Relational Calculus. BASIC SQL:Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update).

UNIT - III		9 Hrs

SQL: Basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions(Date and Time, Numeric, String conversion).Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(updatable and non-updatable), relational set operations.
NoSQL: Introduction and Properties of NoSQL, Different NoSQL Systems, Columnar families, Schema-Less Databases, Materialized Views, Distribution Models, Sharding

UNIT - IV		9 Hrs

Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency Lossless join and dependency preserving decomposition, (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-Codd normal form(BCNF), MVD, Fourth normal form(4NF), Fifth Normal Form (5NF).

UNIT – V		9 Hrs

Transaction Concept: Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.
Introduction to Indexing Techniques: B+ Trees, operations on B+Trees, Hash Based Indexing:

Textbooks:

1. Database Management Systems, 3rd edition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2, 3, 4)

2. Database System Concepts,5th edition, Silberschatz, Korth, Sudarsan,TMH (For Chapter 1 and Chapter 5)

Reference Books:
1. Introduction to Database Systems, 8thedition, C J Date, Pearson.
2. Database Management System, 6th edition, RamezElmasri, Shamkant B. Navathe, Pearson
3. Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

Online Learning Resources:
1. https://nptel.ac.in/courses/106/105/106105175/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0127580666728202 2456_shared/overview

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	CO Lesson plan(Hrs)	%	Correlation	Co''s Action verb	BTL	Program Outcome (PO)	PO(s) :ActionVerb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
1	9	20	2	CO1 :Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	9	20	2	CO2 :Apply	L3	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review(L2) PO11: Thumb rule	3 3 2
3	9	20	2	CO3 :Apply	L3	PO1 PO2 PO3 PO4 PO5 PO7 PO8 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3)PO4: Analyze (L4)PO5: Apply(L3) PO7: Thumb rulePO8: Thumb rule PO11: Thumb rule	3 3 3 2 3 2 2 2
4	9	20	2	CO4 :Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO7	PO1: Apply(L3) PO2: Analyze(L4) PO3: Develop (L3)PO4: Analyze (L4) PO5: Apply(L3) PO7: Thumb rule	3 3 3 3 3 3
5	9	20	2	CO5 :Analyze	L4	PO2 PO3 PO4 PO5 PO7 PO8 PO11	PO2: Analyze(L4) PO3: Develop (L3)PO4: Analyze (L4)PO5: Apply(L3) PO7: Thumb rulePO8: Thumb rule PO11: Thumb rule	3 3 3 3 2 2 2
	45	100%						

Justification Statements:
CO1: Understand the fundamentals of databases to design relational models.
Action Verb: Understand(L2) PO1 Verb : Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO2 Verb: Review(L2)

CO1 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
CO2: Apply the E-R model for database design of real world applications.
Action Verb: Apply (L3)
PO1: Apply(L3)
CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Review (L2)
CO2 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO11: Thumb rule
For some of DB applications, PL/SQL concepts are used to formulate queries. Therefore the correlation is moderate (2)
CO3: Apply the SQL and PL/SQL concepts to formulate queries.
Action Verb: Apply(L3)
PO1: Apply(L3)
CO3 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Review (L2)
CO3 Action verb is higher level as PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO3 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze(L4)
CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is moderate (2)
PO5: Apply(L3)
CO3 Action verb is same level as PO5 verb. Therefore the correlation is high (3)
PO7: Thumb rule
Since ethical principles should be followed to create a database. Therefore the correlation is moderate(2)
PO8 : Thumb rule
Team work is required between DBA and Database designer to create a database. Hence the correlation is moderate (2)
PO11: Thumb rule
For some of DB applications, ER model concepts are used to create designs. Therefore the correlation is moderate(2)
CO4: Analyze normalization methods to enhance database structures
Action Verb: Analyze(L4) PO1: Apply(L3)
CO4 Action verb is greater than PO1 verb . Therefore the correlation is high (3)
PO2: Analyze (L4)
CO4 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is greater than PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO4 Action verb is same as PO4 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO4 Action verb is greater than PO5 verb. Therefore the correlation is high (3)
PO7: Thumb rule
Since ethical principles shall be followed in data manipulation. Therefore the correlation is high(3)
CO5: Analyze the concurrent transactions and recover systems to prevent data loss in system crash.
Action Verb: Analyze (L4) PO2: Analyze (L4)
CO5 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO5 Action verb is greater than PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO5 Action verb is same level as PO4 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO5 Action verb is greater than PO5 verb. Therefore the correlation is high (3)
PO7 : Thumb rule
Since ethical principles should be followed for transaction management. Therefore the correlation is moderate(2)
PO8: Thumb rule
Team work is required for transaction management and recovery of failure transactions. Hence the correlation is moderate (2)
PO11: Thumb rule
In real time transaction management is continuously updating. Therefore the correlation is moderate (2)

Course Code	Year & Sem	DIGITAL LOGIC & COMPUTER ORGANIZATION	L	T/ CLC	P	C
23APC0503	II-II	**(Common to CSE & CIC,AIML&AIDS)**	2	1	**0**	**3**

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the number system concepts, number conversions, logic gates using binary numbers

CO2: Understand the sequential circuits, flip-flops, registers and computer fundamentals to store data.

CO3: Evaluate the Arithmetic operations for understanding execution process

CO4: Analyze the hardware requirements of primary and secondary memories to store the data.

CO5: Apply Input/Output devices and Interfaces to connect multiple devices.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the number system concepts, number conversions, logic gates		using binary numbers	L2
CO2	Understand	the sequential circuits, flip-flops, registers and computer fundamentals			L2
CO3	Evaluate	the Arithmetic operations		for understanding execution process	L5
CO4	Analyze	the hardware requirements of primary and secondary memories		to store the data	L4
CO5	Apply	Input/Output devices and Interfaces			L3

UNIT – I	9Hrs

Data Representation: Binary Numbers, Fixed Point Representation. Floating Point Representation. Number base conversions, Octal and Hexadecimal Numbers, components, Signed binary numbers, Character representation.

Digital Logic Circuits-I: Basic Logic Functions, Logic gates, universal logic gates, Minimization of Logic expressions. K-Map Simplification, Combinational Circuits, Decoders, Multiplexers, dumping.

UNIT – II	9Hrs

Digital Logic Circuits-II: Sequential Circuits, Flip-Flops, Binary counters, Registers, Shift Registers, Ripple counters

Basic Structure of Computers: Computer Types, Functional units, Basic operational concepts, Bus structures, Software, Performance, multiprocessors and multi computers, Computer Generations, Addressing modes, subroutines.

UNIT – III	12Hrs

Computer Arithmetic : Addition and Subtraction of Signed Numbers, Ripple carry adder, Ripple carry multiplier, Design of Fast Adders, Multiplication of Positive Numbers, Signed-operand Multiplication, Fast Multiplication, Integer Division, Floating-Point Numbers and Operations

Processor Organization: Fundamental Concepts, Execution of a Complete Instruction, Multiple-Bus Organization, Hardwired Control and Multi programmed Control

Pipelining: Basic Concepts, Data Hazards, Instruction Hazards, Forms of Parallel Processing

UNIT – IV	9Hrs

The Memory Organization: Memory hierarchy, Semiconductor RAM Memories, Read-Only Memories, Speed, Size and Cost, Cache Memories, Cache mappings, Performance Considerations, Virtual Memories, Memory Management Requirements, Secondary Storage

UNIT – V	9Hrs

Input /Output Organization: Accessing I/O Devices, Interrupts, Processor Examples, Direct Memory Access, Synchronous and Asynchronous bus, Interface Circuits, Standard I/O Interfaces

Textbooks

1. Computer Organization, Carl Hamacher, ZvonkoVranesic, SafwatZaky, 6th edition, McGraw Hill, 2023.

2. Digital Design, 6th Edition, M. Morris Mano, Pearson Education, 2018.

3. Computer Organization and Architecture, William Stallings, 11thEdition, Pearson, 2022.

Reference Books

1. Computer Systems Architecture, M.Moris Mano, 3rdEdition, Pearson, 2017.

2. Computer Organization and Design, David A. Paterson, John L. Hennessy, Elsevier, 2004.

3. Fundamentals of Logic Design, Roth, 5thEdition, Thomson, 2003.

4. Computer Organization & Architecture,William Stallings,11th Edition, Pearson, 2022

Online Learning Resources:
https://nptel.ac.in/courses/106/103/106103068/

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	9	20	2	CO1 : Understand	L2	PO1 PO2 PO3 PO11	PO1: Apply(L3) PO2:Analyze(L4) PO3: Develop(L3) PO11: Thumb rule	2 1 2 1
2	9	20	2	CO2 : Understand	L2	PO1 PO2 PO3 PO11	PO1: Apply(L3) PO2:Review(L2) PO3: Develop (L3) PO11: Thumb rule	2 3 2 1
3	9	20	2	CO3 : Evaluate	L5	PO1 PO2 PO3 PO8 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO3: Design (L6) PO8: Thumb rule PO11: Thumb rule	3 3 2 1 1
4	9	20	2	CO4 : Analyze	L4	PO1 PO2 PO3 PO4	PO1: Apply(L3) PO2: Analyze (L4) PO3: Develop (L3) PO4: Develop (L3)	3 3 3 3
5	9	20	2	CO5 : Apply	L3	PO1 PO4 PO5 PO8 PO11	PO1: Apply(L3) PO4: Analyze (L4) PO5: Apply (L3) PO8: Thumb rule PO11: Thumb rule	3 2 3 2 2
	45	100						

Justification Statements:
CO1: Understand the number system concepts, number conversions, logic gates using binary numbers
Action Verb: Understand(L2)
PO1 Verb: Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Analyze(L4)
CO1 Action verb is less than PO2 verb by two levels. Therefore, the correlation is low (1)
PO3: Develop (L3)
CO1 Action verb is less than PO3 verb . Therefore, the correlation is moderate (2)
PO11: Thumb rule
updating the logical circuits and combinational circuits. Therefore, the correlation is low (1)

CO2: Understand the sequential circuits, flip-flops, registers and computer fundamentals to store data.
Action Verb: Understand(L2)
PO1: Apply(L3)
CO2 Action verb is greater than level PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2: Review(L2)
CO2 Action verb is less than PO2 verb by two level. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO2 Action verb is less than PO3 verb . Therefore, the correlation is moderate (2)
PO11: Thumb rule
Update sequential circuits and registers. Therefore, the correlation is low (1)

CO3: Evaluate the Arithmetic operations for understanding execution process
Action Verb: Evaluate(L5)
PO1: Apply(L3)
CO3 Action verb is higher level than PO1 verb level by two level. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO3 Action verb is less than PO2 verb by one level. Therefore, the correlation is high (3)
PO3: Design (L6)
CO3 Action verb is less than PO3 verb by one level. Therefore, the correlation is moderate (2)
PO8: Thumb rule
Team work is required. Hence the correlation is low (1)
PO11: Thumb rule
Updating the Numbers and execution process. Therefore the correlation is low (1)

CO4: Analyze the hardware requirements of primary and secondary memories to store the data.
Action Verb: Analyze(L4)
PO1: Apply(L3)
CO4 Action verb is less than PO1 by one level. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO4 Action verb is same as PO2 verb. Therefore, the correlation is High (3)
PO3: Develop (L3)
CO4 Action verb is less than PO3 verb by two levels. Therefore, the correlation is High (3)
PO4: Develop (L3)
CO4 Action verb is less than PO4 verb by two levels. Therefore, the correlation is High (3)

CO5: Apply Input/Output devices and Interfaces to connect multiple devices
Action Verb: Apply (L3)
PO1: Apply(L3)
CO5 Action verb is same as PO1. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO5 Action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2)
PO5: Apply(L3)
CO5 Action verb is less than PO5 verb . Therefore, the correlation is high (3)
PO8: Thumb rule
Team work is required to provide the solutions on different numbers. Hence the correlation is moderate (2)
PO11: Thumb rule
Updating the Numbers and execution process. Therefore, the correlation is moderate (2)

Course Code	Year & Sem	AI & ML Lab	L	T/CLC	P	C
23APC3302	II-II	(AI ML)	0	0	3	1.5

Course Outcomes:

After studying the course, students will be able to

CO1: Apply the Python programs for various Learning algorithms using Pandas and Matplotlib.
CO2: Apply the Python programs to implement for various AI searching algorithms.
CO3: Evaluate the procedures for various learning's to machine learning algorithms.
CO4: Analyze the various types of data set for clustering using k-Means algorithm
CO5: Apply the Machine Learning algorithms to solve real world problems

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	the Python programs for various Learning algorithms	using Pandas and Matplotlib		L3
CO2	Apply	the Python programs to implement		for various AI searching algorithms	L3
CO3	Evaluate	the procedures for the various learning		to machine learning	L5
CO4	Apply	various types of data set for clustering	using k-Means algorithm		L3
CO5	Apply	the Machine Learning algorithms		to solve real world problems	L3

List of Experiments:

1. Pandas Library (CO1)
    a) Write a python program to implement Pandas Series with labels.
    b) Create a Pandas Series from a dictionary.
    c) Creating a Pandas Data Frame.
    d) Write a program which makes use of the following Pandas methods
           i) describe () ii) head () iii) tail () iv) info ()
2. Pandas Library: Visualization (CO1)
    a) Write a program which use pandas inbuilt visualization to plot following graphs:
           i. Bar plots ii. Histograms iii. Line plots iv. Scatter plots
3. Write a Program to Implement Breadth First Search using Python. (CO2)
4. Write a program to implement Best First Searching Algorithm (CO2)
5. Write a Program to Implement Depth First Search using Python.(CO3)
6. Write a program to implement the Heuristic Search (CO3)
7. Write a python program to implement A* and AO* algorithm. (Ex: find the shortest path)(CO3)
8. Implement a program for Bias, Variance, and Cross Validation.(CO3)
9. Apply the following Pre-processing techniques for a given dataset. (CO4)
    a. Attribute selection
    b. Handling Missing Values
    c. Discretization
    d. Elimination of Outliers
10. Apply KNN algorithm for classification and regression (CO4)
11. Demonstrate decision tree algorithm for a classification problem and perform parameter tuning for better results(CO4)
12. Demonstrate Naïve Bayes Classification algorithm. (CO5)
13. Implement the K-means algorithm and apply it to the data you selected. Evaluate performance by measuring the sum of the Euclidean distance of each example from its class center. Test the performance of the algorithm as a function of the parameters K(CO5)

Mapping of course outcomes with program outcomes

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

CO3	3	2		3									
CO4	3	3									3	3	
CO5	3	2	3		3						2		

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
1	CO1: Apply	L3	PO1 PO2 PO3 PO5 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO3: Develop(L3) PO5: Apply (L3) PO11: Thumb rule	3 2 3 3 2
2	CO2: Apply	L3	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Analyze (L4) PO3: Develop(L3) PO5: Apply (L3)	3 2 3 3
3	CO3: Evaluate	L5	PO1 PO2 PO4	PO1: Apply(L3) PO2: Formulate (L6) PO4: Analysis (L4)	3 2 3
4	CO4: Analyze	L4	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review (L2) PO11: Thumb rule	3 3 3
5	CO5: Apply	L3	PO1 PO2 PO3 PO5 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO3: Develop(L3) PO5: Apply (L3) PO11: Thumb rule	3 2 3 3 2

Justification Statements :
CO1: Apply the Python programs for various Learning algorithms using Pandas and Matplotlib.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO1 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO1 Action verb is less than as PO2 verb by one level. Therefore, the correlation is moderate (2)
PO3: Develop (L3)
CO1 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO5: Apply (L3)
CO1 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
Using orange to visualize real world solutions the correlation is moderate (2)

CO2: Apply the Python programs to implement for various AI searching algorithms.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO2 Action verb is less than as PO2 verb by one level. Therefore, the correlation is moderate (2)
PO3: Develop (L3)
CO2 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO5: Apply (L3)
CO2 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

CO3: Evaluate the procedures for various learning's to machine learning algorithms.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO3 Action verb is more than PO1 verb. Therefore, the correlation is high (3)
PO2: Formulate (L6)
CO3 Action verb is less than PO2 verb by one level. Therefore, the correlation is moderate(2)
PO4: Analysis (L4)
CO3 Action verb is more than PO4 verb. Therefore, the correlation is high (3)

CO 4: Analyze the various types of data set for clustering using k-Means algorithm
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO4Action verb is more than PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Review (L2)
CO4 Action verb is more than PO2 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
Using orange to visualize real world solutions. Therefore, the correlation is high (3)

CO 5: Apply the Machine Learning algorithms to solve real world problems
Action Verb: Apply (L3)
PO1: Apply (L3)
CO5 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO5 Action verb is less than as PO2 verb by one level. Therefore, the correlation is moderate (2)
PO3: Develop (L3)
CO5 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO5: Apply (L3)
CO5 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
Using orange to visualize real world solutions. Therefore, the correlation is moderate (2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI (AUTONOMOUS)

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	Database Management Systems Lab (Common to CSE,CIC,CSE(DS),AIML)	L	T/CLC	P	C
23APC0509	II-II		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: Apply the DDL, DML&DCL Commands for manipulating the data**.**

CO2: Create queries to manipulate and retrieve data from databases.

CO3: Analyze application programs using PL/SQL

CO4: **Analyze** Procedures, Functions, Cursors, and Triggers to automate tasks and optimize database functionality

CO5: Analyze JDBC concepts for Database connectivity.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Apply**	the DDL, DML&DCL Commands		for manipulating the data.	L3
CO2	**Create**	queries		to manipulate and retrieve data from databases.	L6
CO3	**Analyze**	application programs	using PL/SQL		L4
CO4	**Analyze**	Procedures, Functions, Cursors, and Triggers		to automate tasks and optimize database functionality	L4
CO5	**Analyze**	JDBC concepts		for Database connectivity	L4

List of Experiments:

1. Creation, altering and droping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command. **(CO1)**

2. Queries (along with subQueries) using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSET, Constraints. Example: Select the roll number and name of the student who secured fourth rank in the class. **(CO1)**

3. Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views. **(CO1)**

4. Queries using Conversion functions (to_char, to_number and to_date), string functions Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next_day, add_months, last_day, months_between, least, greatest, trunc, round, to_char, to_date) **(CO2)**

5.

   i. Create a simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found) **(CO2)**

   ii. Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block **(CO2)**

6. Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions. **(CO2)**

7. Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR

Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISE APPLICATION ERROR. **(CO3)**

8. Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES. **(CO3)**

9. Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions. **(CO3)**

10. Develop programs using features parameters in a CURSOR, FOR UPDATECURSOR, WHERE CURRENT of clause and CURSOR variables. **(CO4)**

11. Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers **(CO4)**

12. Create a table and perform the search operation on table using indexing and non indexing techniques. **(CO4)**

13. Write a Java program that connects to a database using JDBC **(CO5)**

14. Write a Java program to connect to a database using JDBC and insert values into it **(CO5)**

15. Write a Java program to connect to a database using JDBC and delete values from it **(CO5)**

References:

1. Oracle: The Complete Reference by Oracle Press

2. Nilesh Shah, "Database Systems Using Oracle", PHI, 2007

3. Rick F Vander Lans, "Introduction to SQL", Fourth Edition, Pearson Education, 2007

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
1	**Apply**	L3	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO5: Apply(L3)	3 2 3 3
2	**Create**	L6	PO2 PO5	PO3:Formulate(L6) PO5:Create(L6)	3 3
3	**Analyze**	L4	PO1 PO2 PO4 PO5	PO1:Apply(L3) PO2:Review(L2) PO4:Design(L6) PO5:Create(L6)	2 1 3 3
4	**Analyze**	L4	PO1 PO2 PO4 PO5	PO1:Apply(L3) PO2:Review(L2) PO4:Design(L6) PO5:Create(L6)	2 1 3 3
5	**Analyze**	L4	PO3 PO5 PO11	PO3:Design(L6) PO5:Create(L6) PO11:Thumb rule	3 3 2

Justification Statements:
CO1: Apply the DDL, DML&DCL Commands for manipulating the data.
Action Verb: Apply(L3)
PO1 Verb: Apply(L3)
CO1 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Review(L2)
CO1 Action verb is less than PO2 verb by one level. Therefore, the correlation is moderate (2)
PO3 Verb: Develop(L3)
CO1 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: Apply(L3)
CO1 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

CO2: Create queries to manipulate and retrieve data from databases.
Action Verb: Create (L6)
PO2 Verb : Formulate(L6)
CO2 Action verb is same as PO2 verb. Therefore, the correlation is high (3)
PO5 Verb: Create(L6)
CO2 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

CO3: Analyze application programs using PL/SQL
Action Verb: Analyze(L4)
PO1 Verb: Apply (L3)
CO3 Action verb is less than PO1 verb. Therefore, the correlation is moderate(2)
PO2 Verb: Review(L2)
CO3 Action verb is less than PO2 verb by two levels. Therefore, the correlation is low(1)
PO4 Verb: Design (L6)
CO3 Action verb is greater than as PO4 verb. Therefore, the correlation is high (3)
PO5 Verb: Create (L6)
CO3 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)

CO4: Analyze Procedures,Functions, Cursors, and Triggers to automate tasks and optimize database functionality
Action Verb: Analyze(L3) PO1 Verb: Apply (L3)
CO4 Action verb is less than PO1 verb. Therefore, the correlation is moderate(2)
PO2 Verb: Review(L2)
CO4 Action verb is less than PO2 verb by two levels. Therefore, the correlation is low(1)
PO4 Verb: Design (L6)
CO4 Action verb is greater than as PO4 verb. Therefore, the correlation is high (3)
PO5 Verb: Create (L6)
CO4 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)

CO5: Analyze JDBC concepts for Database connectivity.
Action Verb: Analyze (L3) PO3 Verb: Design (L6)
CO5 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: Create (L6)
CO5 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)
PO11: Verb:Thumb rule
Database connection is a continuous learning activity for the user, the correlation is moderate(2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	FULL STACK DEVELOPMENT – 1	L	T/CLC	P	C
23ASC0503	II-II	(Skill Enhancement Course) (Common to CSE,CIC,AIDS & AIML)	1	0	2	2

Course Outcomes:
After studying the course, student will be able to
CO 1: Understand the web page and identify basic tags and properties in HTML.
CO 2: Apply the concept of CSS properties to design web pages.
CO 3: Analyze the web pages in real time applications of JavaScript for dynamic web pages.
CO 4: Apply the concepts of objects and methods in JavaScript for solving complex problem
CO 5: Evaluate the web pages for developing applications by using events and forms

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	**Understand**	the web page and identify basic tags and properties in HTML.			L2
CO2	**Apply**	the concept of CSS properties		to design web pages.	L3
CO3	**Analyze**	the web pages in real time applications of JavaScript		for dynamic web pages.	L4
CO4	**Apply**	the concepts of objects and methods in JavaScript		for solving complex problems	L3
CO5	**Evaluate**	the web pages for developing applications by		using events and forms	L5

List of Experiments:

1. Lists, Links and Images**[CO-1]**

a. Write a HTML program, to explain the working of lists.

   Note: It should have an ordered list, unordered list, nested lists and ordered list in anunordered list and definition lists.
b. Write a HTML program, to explain the working of hyperlinks using <a> tag and href, target Attributes.

c. Create a HTML document that has your image and your friend's image with a specific height and width. Also when clicked on the images it should navigate to their respective profiles.

d. Write a HTML program, in such a way that, rather than placing large images on a page,the preferred technique is to use thumbnails by setting the height and width parameters to something like to 100*100 pixels. Each thumbnail image is also a link to a full sized version of the image. Create an image gallery using this technique

2. HTML Tables, Forms and Frames[CO-1]

• Write a HTML program, to explain the working of tables. (use tags: <table>, <tr>, <th>,

   <td> and attributes: border, rowspan, colspan) **[CO-1]**
• Write a HTML program, to explain the working of tables by preparing a timetable. (Note: Use <caption> tag to set the caption to the table & also use cell spacing, cell padding, border, rowspan, colspan etc.). **[CO-1]**

• Write a HTML program, to explain the working of forms by designing Registration form. (Note: Include text field, password field, number field, date of birth field, checkboxes, radio buttons, list boxes using <select>&<option> tags, <text area> and two buttons ie: submit and reset. Use tables to provide a better view). **[CO-1]**

• Write a HTML program, to explain the working of frames, such that page is to be divided into 3 parts on either direction. (Note: first frame image, second frame paragraph, third frame hyperlink.

And also make sure of using "no frame" attribute such that frames tobe fixed). **[CO-1]**

3. HTML 5 and Cascading Style Sheets, Types of CSS[CO-2]

a. Write a HTML program, that makes use of <article>, <aside>, <figure>, <figcaption>,

   <footer>, <header>, <main>, <nav>, <section>, <div>, <span> tags.
b. Write a HTML program, to embed audio and video into HTML web page.

c. Write a program to apply different types (or levels of styles or style specification formats)

   - inline, internal, external styles to HTML elements. (identify selector, property andvalue).

4. Selector forms[CO-2]

a. Write a program to apply different types of selector forms

- Simple selector (element, id, class, group, universal)

- Combinator selector (descendant, child, adjacent sibling, general sibling)

- Pseudo-class selector

- Pseudo-element selector

- Attribute selector

5. CSS with Color, Background, Font, Text and CSS Box Model[CO-2]

a. Write a program to demonstrate the various ways you can reference a color in CSS.

b. Write a CSS rule that places a background image halfway down the page, tilting ithorizontally. The image should remain in place when the user scrolls up or down.

c. Write a program using the following terms related to CSS font and text:

    i. font-size   ii. font-weight   iii. font-style
    iv. text-decoration   v. text-transformation   vi. text-alignment
d. Write a program, to explain the importance of CSS Box model using

    i. Content   ii. Border   iii. Margin   iv. padding

6. Applying JavaScript - internal and external, I/O, Type Conversion[CO-2]

a. Write a program to embed internal and external JavaScript in a web page.

b. Write a program to explain the different ways for displaying output.

c. Write a program to explain the different ways for taking input.

d. Create a web page which uses prompt dialogue box to ask a voter for his name and age.Display the information in table format along with either the voter can vote or not

7. JavaScript Pre-defined and User-defined Objects[CO-3]

a. Write a program using document object properties and methods.

b. Write a program using window object properties and methods.

c. Write a program using array object properties and methods.

d. Write a program using math object properties and methods.

e. Write a program using string object properties and methods.

f. Write a program using regex object properties and methods.

g. Write a program using date object properties and methods.

h. Write a program to explain user-defined object by using properties, methods, accessors, constructors and display.

8. JavaScript Conditional Statements and Loops[CO-4]

a. Write a program which asks the user to enter three integers, obtains the numbers from the user and outputs HTML text that displays the larger number followed by the words "LARGER NUMBER" in an information message dialog. If the numbers are equal, outputHTML text as "EQUAL NUMBERS".

b. Write a program to display week days using switch case.

c. Write a program to print 1 to 10 numbers using for, while and do-while loops.

d. Write a program to print data in object using for-in, for-each and for-of loops

e. Develop a program to determine whether a given number is an 'ARMSTRONG NUMBER' or not. [Eg: 153 is an Armstrong number, since sum of the cube of the digits isequal to the number i.e.,13 + 53+ 33 = 153]

f. Write a program to display the denomination of the amount deposited in the bank in terms of 100's, 50's, 20's, 10's, 5's, 2's & 1's. (Eg: If deposited amount is Rs.163, the output should be 1-100's, 1-50's, 1- 10's, 1-2's & 1-1's)

9. Javascript Functions and Events[CO-5]

a. Design a appropriate function should be called to display

- Factorial of that number

- Fibonacci series up to that number

- Prime numbers up to that number

- Is it palindrome or not

b. Design a HTML having a text box and four buttons named Factorial, Fibonacci, Prime,and Palindrome. When a button is pressed an appropriate function should be called to display

11. Factorial of that number

12. Fibonacci series up to that number

13. Prime numbers up to that number

14. Is it palindrome or not

c. Write a program to validate the following fields in a registration page

i. Name (start with alphabet and followed by alphanumeric and the length should notbe less than 6 characters)

ii. Mobile (only numbers and length 10 digits)

	iii. E-mail (should contain format like xxxxxxx@xxxxxx.xxx)		

Textbooks:
1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.

2. Web Programming with HTML5, CSS and JavaScript, John Dean, Jones & Bartlett Learning, 2019 (Chapters 1-11).

3. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.

Web Links:
1. https://www.w3schools.com/html

2. https://www.w3schools.com/css

3. https://www.w3schools.com/js/

4. https://www.w3schools.com/nodejs

5. https://www.w3schools.com/typescript

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
1	CO1: Understand	L2	PO1 PO2 PO5 PO11	PO1: Apply(L3) PO2: Review(L2) PO5: Apply(L3) PO11: Thumb rule	2 3 2 2
2	CO2: Apply	L3	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review(L2) PO11: Thumb rule	3 3 2
3	CO3: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO09	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO9: Thumb rule	3 3 3 3 3 2
4	CO4: Apply	L3	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO11: Thumb rule	3 3 3 2 3 2
5	CO5: Evaluate	L5	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3)	3 3 3 3 3

Justification Statements:
CO1: Understand the web page and identify basic tags and properties in HTML.
Action Verb : Understand (L2)
PO1 Verb : Apply(L3)
CO1 Action verb is less than PO2 verb by one, Therefore the correlation is moderate (2)
PO2 Verb : Review(L2)

CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO5 Verb : Apply(L2)

CO1 Action verb is less than PO2 verb by one, Therefore the correlation is moderate (2)

PO11: Thumb rule

To make use of HTML elements and tags in application, need to upgrade for long period. Therefore, the correlation is moderate (2)

CO2: Apply the concept of CSS properties to design web pages.

Action Verb : Apply (L3)

PO1: Apply(L3)

CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2: Review(L2)

CO2 Action verb is greater than PO2 verb by one, Therefore the correlation is high (3)

PO11: Thumb rule

The application can be designed specifically all kind of users and web browsers.
Therefore the correlation is moderate (2)

CO 3: Analyze the web pages in real time applications of JavaScript for dynamic web pages.

Action Verb : Analyze (L4)

PO1: Apply(L3)

CO3 Action verb is greater level of PO1 verb. Therefore, the correlation is High (3)

PO2: Review (L2)

CO3 Action verb is greater than level as PO2 verb by one. Therefore, the correlation is high (3)

PO3: Develop (L3)

CO3 Action verb is greater than PO3 verb. Therefore the correlation is high (3)

PO4: Analyze (L4)

CO3 Action verb is same PO4 verb. Therefore the correlation is high (3)

PO5: Apply(L3)

CO3 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO9: Thumb rule

To make web site and web pages should be interactive understand by user, so need to provide proper forms. Therefore, the correlation is moderate (2)

CO4: Apply the concepts of objects and methods in JavaScript for solving complex problem

Action Verb: Apply (L3)

PO1: Apply(L3)

CO4   Action verb is same level of PO1 verb. Therefore the correlation is high (3)

PO2: Review(L2)

CO4 Action verb is greater than PO2 verb. Therefore the correlation is high (3)

PO3: Develop(L2)

CO4 Action verb is greater than PO3 verb. Therefore the correlation is high (3)

PO4: Analyze(L2)

CO4 Action verb is less than of PO4 verb. Therefore the correlation is moderate (2)

PO5: Apply(L3)

CO4 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)

PO11: Thumb rule

The design application needs to upgrade for future specific requirement. Therefore the correlation is moderate (2)

CO 5: Evaluate the web pages for developing applications by using events and forms

Action Verb : Evaluate (L5)

PO1: Apply(L3)

CO5 Action verb is greater than PO1 verb. Therefore the correlation is high (3)

PO2: Review (L2)

CO5 Action verb is greater than PO2 verb. Therefore the correlation is high (3)

PO3: Develop (L3)

CO5 Action verb is greater than PO3 verb. Therefore the correlation is high (3)

PO4: Analyze (L4)

CO5 Action verb is greater than two as PO4 verb. Therefore the correlation is high (3)

PO5: Apply(L3)

CO5 Action verb is greater than PO5 verb. Therefore the correlation is high (3)

Course Code	Year & Sem	Design Thinking & Innovation	L	T/CLC	P	C
23AES0304	II-II		2	0	0	2

Course Outcomes:

After studying the course, student will be able to

CO: 1 **Understand** the concepts and principles of design thinking process.

CO: 2 **Apply** the design thinking techniques for solving problems in various sectors.

CO: 3 **Analyze** the art of innovation & creativity in product development.

CO: 4 **Apply** the design guidelines for produced development.

CO: 5 **Analyze** the design thinking strategies for solving real time business issues.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the concepts and principles of design thinking process.			L1
CO2	Apply	the design thinking techniques for solving problems in various sectors.			L3
CO3	Analyze	the art of innovation & creativity in product development.			L4
CO4	Apply	the design guidelines for produced development.			L3
CO5	Analyze	the design thinking strategies for solving real time business issues.			L4

Unit I:
Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

Unit II
Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development
Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

Unit III
Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations- Creativity to Innovation- Teams for innovation- Measuring the impact and value of creativity.
Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

Unit IV
Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design- Case studies
Activity: Importance of modelling, how to set specifications, Explaining their own product design.

Unit V
Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs- Design thinking for Startups- Defining and testing Business Models and Business Cases- Developing & testing prototypes
Activity: How to market our own product, About maintenance, Reliability and plan for startup.
Text Books:
1. Tim Brown, Change by design, Harper Bollins (2009)
2. Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons.
Reference Books:
1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shrutin N Shetty, Design the Future, Norton Press
3. William Lidwell, Universal Principles of Design- Kritina holden, Jill Butter.
4. Chesbrough. H, The Era of Open Innovation – 2013

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	`PSO1	PSO2
Design Thinking & Innovation	CO1	2		2										2	2
	CO2	2	2	2										2	2
	CO3	2	2	2			1							2	2
	CO4	2	2	2			1							2	2
	CO5	2	2	2			2							2	2

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	11	20.3	L3	Understand	L2	PO1 PO3	Apply (L3) Develop (L3)	2 2
2	10	18.5	L2	Apply	L3	PO1 PO2 PO3	Apply (L3) Identify (L3) Develop (L3)	3 3 3
3	11	20.3	L3	Analyze	L4	PO1 PO2 PO3 PO6	Apply (L3) Identify (L3) Develop (L3) Thumb Rule	3 3 3 1
4	12	22.2	L3	Apply	L3	PO1 PO2 PO3 PO6	Apply (L3) Identify (L3) Develop (L3) Thumb Rule	3 3 3 1
5	10	18.5	L2	Analyze	L4	PO1 PO2 PO3 PO6	Apply (L3) Identify (L3) Develop (L3) Thumb Rule	3 3 3 2
Total	54	100						

Justification Statements:
CO1: Understand the concepts and principles of design thinking process.
Action Verb: Understand (L2)
PO1Verb: **Apply (L3)**
CO1 Action verb is lower than PO1 verb. Therefore, the correlation is medium (2)
PO3 Verb: **Develop (L3)**
CO1 Action verb is lower than PO3 verb. Therefore, the correlation is medium (2)
CO2: Apply the design thinking techniques for solving problems in various sectors.
PO1 Verb: **Apply (L3)**
CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO2 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO2 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
CO3: Analyze the art of innovation & creativity in product development.
Action Verb: **Analyze** (L4)
PO1 Verb: **Apply (L3)**
CO3 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO3 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO3 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)
PO6 Verb: Thumb Rule
As per thumb rule CO3 co-relates slightly with PO6 verb. Therefore, the correlation is high (3)
CO4: Apply the design guidelines for produced development.

Action Verb: Apply (L3)
PO1 Verb: **Apply (L3)**
CO4 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO4 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO4 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO6 Verb: Thumb Rule
As per thumb rule CO4 co-relates slightly with PO6 verb. Therefore, the correlation is high (3)
CO5: Analyze the design thinking strategies for solving real time business issues.
Action Verb: Analyze (L4)
PO1 Verb: **Apply (L3)**
CO5 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO5 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO5 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is low (1)
PO6 Verb: Thumb Rule
As per thumb rule CO5 co-relates moderately with PO6 verb. Therefore, the correlation is high (3)

Course Code	Year & Sem	Environmental Science	L	T/CLC	P	C
23AMC9901	II-II	(common to AIDS&AIML)	2	0	0	0

Course Outcomes:

After studying the course, student will be able to

CO1: **Understand** the multidisciplinary nature of environmental studies, various renewable and nonrenewable resources.

CO2: **Understand** the ecosystem and biodiversity to solve complex environmental problems

CO3: **Apply** the various types of pollution, solid waste management, and related preventive measures

CO4: **Apply** the rainwater harvesting, watershed management, ozone layer depletion, and wasteland reclamation.

CO5: **Understand** the population explosion

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the multidisciplinary nature of environmental studies, various renewable and nonrenewable resources.			**L2**
2	**Understand**	the ecosystem and biodiversity	to solve complex environmental problems		**L2**
3	**Apply**	the various types of pollution, solid waste management, and related preventive measures			**L3**
4	**Apply**	the rainwater harvesting, watershed management, ozone layer depletion, and wasteland reclamation			**L3**
5	**Analyze**	the population explosion and impact of environmental health issues on human being.			**L4**

UNIT – I	

Multidisciplinary Nature of Environmental Studies: Introduction ⯈ Multidisciplinary Nature of Environmental Studies ⯈ Definition, Scope and Importance – Need for Public Awareness.

Natural Resources: Renewable and non-renewable energy resources –Natural resources and associated problems.

Forest resources: Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people.

Water resources: Use and overutilization of surface and sub-surface – 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-pesticides problems, water logging, salinity, case studies.

Energy resources: Renewable and non-renewable energy resources.

UNIT – II	

Ecosystems: Concept of an ecosystem. – Structure and functions of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Biodiversity And Its Conservation : Introduction- Definition:genetic, species and ecosystem diversity – 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-sports of biodiversity – Threats to biodiversity:

habitat loss, poaching of wildlife, man - wildlife conflicts ⯈ Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III	

Environmental Pollution: Definition, Causes, effects and its controlmeasures of: Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, and Thermal pollution and Nuclear hazards.

Solid Waste Management: Causes**,** effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management:

	earthquakes, cyclones, tsunamis, and landslides.				

UNIT – IV			

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, Rainwater harvesting and Watershed Management – Resettlement and rehabilitation of people – Case studies – 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 – Public awareness.

UNIT – V			

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programs. – 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..

Textbooks:

1.Textbook of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, "Environmental Studies", Pearson education
3. S.Azeem Unnisa, "Environmental Studies" Academic Publishing Company
4. K.Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses as
per UGC model syllabus", Scitech Publications (India), Pvt. Ltd.

Reference Books:

1.Deeksha Dave and E.Sai Baba Reddy, "Textbook of Environmental Science", Cengage Publications.
2. M.Anji Reddy, "Text book of Environmental Sciences and Technology", BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, "Environmental Sciences and Engineering", Prentice
hall of India Private limited
5. G.R.Chatwal, "A Text Book of Environmental Studies" Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science,
Prentice hall of India Private limited.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1						2	2						
CO 2							2						
CO 3						2	2						
CO 4						2	2						
CO 5							2						

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours				CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Register (Hrs)	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1	10	12	23	3	Understand	L2	PO6, PO7	Thumb Rule Thumb Rule	2, 2
2	15	15	28	3	Understand	L2	PO7	Thumb Rule	2
3	8	8	15	2	Apply	L3	PO6 PO7	Thumb Rule Thumb Rule	2, 2
4	9	10	19	2	Apply	L3	PO6, PO7	Thumb Rule Thumb Rule	2, 2
5	8	8	15	2	Analyze	L4	PO7	Thumb Rule	2
	50	53	100						

Justification Statements
CO1: Understand the multidisciplinary nature of environmental studies, various renewable
and nonrenewable resources.
Action Verb: Understand (L2)

Using Thumb rule,CO1correlatesPO6 and PO7 as a moderate (2)

CO2: Understand the ecosystem and biodiversity to solve complex environmental problems

Action Verb: Understand (L2)

Using Thumb rule, CO2 correlates PO7 as a moderate (2)

CO3: Apply the various types of pollution, solid waste management, and related preventive measures

Action Verb: APPLY (L3)

Using Thumb rule,CO3 correlates PO6 and PO7 as a moderate (2)

CO4: Apply the rainwater harvesting, watershed management, ozone layer depletion, and wasteland reclamation.

Action Verb: APPLY (L3)

Using Thumb rule,CO4 correlates PO6 and PO7 as a moderate (2)

CO5: Analyze the population explosion and impact of environmental health issues on human being

Action Verb: Analyze (L4)

Using Thumb rule,CO5 correlates PO7 as a moderate (2)

<div align="center">**COMMUNITY SERVICE PROJECT**</div>

<div align="center">**......Experiential learning through community engagement**</div>

Introduction

- Community Service Project is an experiential learning strategy that integrates meaningful community service with instruction, participation, learning and community development.
- Community Service Project involves students in community development and service activities and applies the experience to personal and academic development.
- Community Service Project is meant to link the community with the college for mutual benefit. The community will benefit with the focused contribution of the college students for the village/ local development. The college finds an opportunity to develop social sensibility and responsibility among students and emerge as a socially responsible institution.

Objective

Community Service Project should be an integral part of the curriculum, as an alternative to the 2 months of Summer Internships / Apprenticeships / On the Job Training, whenever there is an exigency when students cannot pursue their summer internships. The specific objectives are;

- To sensitize the students to the living conditions of the people who are around them,
- To help students to realize the stark realities of society.
- To bring about an attitudinal change in the students and help them to develop societal consciousness, sensibility, responsibility and accountability
- To make students aware of their inner strength and help them to find new /out of box solutions to social problems.
- To make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.
- To help students to initiate developmental activities in the community in coordination with public and government authorities.
- To develop a holistic life perspective among the students by making them study culture, traditions, habits, lifestyles, resource utilization, wastages and its management, social problems, public administration system and the roles and responsibilities of different persons across different social systems.

Implementation of Community Service Project

- Every student should put in 6 weeks for the Community Service Project during the summer vacation.
- Each class/section should be assigned with a mentor.
- Specific Departments could concentrate on their major areas of concern. For example, Dept. of Computer Science can take up activities related to Computer Literacy to different sections of people like - youth, women, housewives, etc
- A logbook must be maintained by each of the students, where the activities undertaken/involved to be recorded.
- The logbook has to be countersigned by the concerned mentor/faculty in charge.
- An evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.
- The final evaluation to be reflected in the grade memo of the student.
- The Community Service Project should be different from the regular programs of NSS/NCC/Green Corps/Red Ribbon Club, etc.
- Minor project reports should be submitted by each student. An internal Viva shall also be conducted by a committee constituted by the principal of the college.
- Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training.

<div align="center">**Procedure**</div>

- A group of students or even a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay, to enable them to commute from their residence and return back by evening or so.
- The Community Service Project is a twofold one –
  o First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas. A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers, rather, it could be another primary source of data.
  o Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like –
    - Agriculture
    - Health
    - Marketing and Cooperation
    - Animal Husbandry
    - Horticulture
    - Fisheries
    - Sericulture
    - Revenue and Survey
    - Natural Disaster Management
    - Irrigation
    - Law & Order
    - Excise and Prohibition
    - Mines and Geology
    - Energy
    - Internet
    - Free Electricity
    - Drinking Water

<div align="center">**EXPECTED OUTCOMES**
BENEFITS OF COMMUNITY SERVICE PROJECT TO STUDENTS</div>

Learning Outcomes
- Positive impact on students' academic learning
- Improves students' ability to apply what they have learned in "the real world"
- Positive impact on academic outcomes such as demonstrated complexity of understanding, problem analysis, problem-solving, critical thinking, and cognitive development.
- Improved ability to understand complexity and ambiguity

Personal Outcomes
- Greater sense of personal efficacy, personal identity, spiritual growth, and moral development
- Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills.

Social Outcomes
- Reduced stereotypes and greater inter-cultural understanding
- Improved social responsibility and citizenship skills
- Greater involvement in community service after graduation

Career Development
- Connections with professionals and community members for learning and career opportunities
- Greater academic learning, leadership skills, and personal efficacy can lead to greater opportunity.

Relationship with the Institution
- Stronger relationships with faculty
- Greater satisfaction with college
- Improved graduation rates

BENEFITS OF COMMUNITY SERVICE PROJECT TO FACULTY MEMBERS

- Satisfaction with the quality of student learning
- New avenues for research and publication via new relationships between faculty and community
- Providing networking opportunities with engaged faculty in other disciplines or institutions
- A stronger commitment to one's research.

BENEFITS OF COMMUNITY SERVICE PROJECT TO COLLEGES AND UNIVERSITIES
- Improved institutional commitment.
- Improved student retention
- Enhanced community relations

BENEFITS OF COMMUNITY SERVICE PROJECT TO COMMUNITY
- Satisfaction with student participation
- Valuable human resources needed to achieve community goals.
- New energy, enthusiasm and perspectives applied to community work.
- Enhanced community-university relations.

SUGGESTIVE LIST OF PROGRAMMES UNDER COMMUNITY SERVICE PROJECT

The following the recommended list of projects for Engineering students. The lists are not exhaustive and open for additions, deletions, and modifications. Colleges are expected to focus on specific local issues for this kind of project. The students are expected to carry out these projects with involvement, commitment, responsibility, and accountability. The mentors of a group of students should take the responsibility of motivating, facilitating, and guiding the students. They have to interact with local leadership and people and appraise the objectives and benefits of this kind of project. The project reports shall be placed in the college website for reference. Systematic, Factual, methodical and honest reporting should be ensured.

For Engineering Students

1. Water facilities and drinking water availability
2. Health and hygiene
3. Stress levels and coping mechanisms
4. Health intervention programmes
5. Horticulture
6. Herbal plants
7. Botanical survey
8. Zoological survey
9. Marine products
10. Aqua culture
11. Inland fisheries
12. Animals and species
13. Nutrition
14. Traditional health care methods
15. Food habits
16. Air pollution
17. Water pollution
18. Plantation
19. Soil protection
20. Renewable energy
21. Plant diseases
22. Yoga awareness and practice
23. Health care awareness programmes and their impact
24. Use of chemicals on fruits and vegetables
25. Organic farming
26. Crop rotation
27. Floury culture

28. Access to safe drinking water
29. Geographical survey
30. Geological survey
31. Sericulture
32. Study of species
33. Food adulteration
34. Incidence of Diabetes and other chronic diseases
35. Human genetics
36. Blood groups and blood levels
37. Internet Usage in Villages
38. Android Phone usage by different people
39. Utilisation of free electricity to farmers and related issues
40. Gender ration in schooling lvel- observation.

Complimenting the community service project the students may be involved to take up some awareness campaigns on social issues/special groups. The suggested list of programs

Programs for School Children
1. Reading Skill Program (Reading Competition)
2. Preparation of Study Materials for the next class.
3. Personality / Leadership Development
4. Career Guidance for X class students
5. Screening Documentary and other educational films
6. Awareness Program on Good Touch and Bad Touch (Sexual abuse)
7. Awareness Program on Socially relevant themes.

Programs for Women Empowerment
1. Government Guidelines and Policy Guidelines
2. Women's Rights
3. Domestic Violence
4. Prevention and Control of Cancer
5. Promotion of Social Entrepreneurship

General Camps

1. General Medical camps
2. Eye Camps
3. Dental Camps
4. Importance of protected drinking water
5. ODF awareness camp
6. Swatch Bharath
7. AIDS awareness camp
8. Anti Plastic Awareness
9. Programs on Environment
10. Health and Hygiene
11. Hand wash programmes

Commemoration and Celebration of important days Programs for Youth Empowerment

1. Leadership
2. Anti-alcoholism and Drug addiction
3. Anti-tobacco
4. Awareness on Competitive Examinations
5. Personality Development

Common Programs
1. Awareness on RTI
2. Health intervention programmes
3. Yoga
4. Tree plantation
5. Programs in consonance with the Govt. Departments like –
   i. Agriculture
   ii. Health
   iii. Marketing and Cooperation
   iv. Animal Husbandry
   v. Horticulture

<ol type="i" start="6">
Fisheries
Sericulture
Revenue and Survey
Natural Disaster Management
Irrigation
Law & Order
Excise and Prohibition
Mines and Geology
Energy

Role of Students:
- Students may not have the expertise to conduct all the programmes on their own. The students then can play a facilitator role.
- For conducting special camps like Health related, they will be coordinating with the Governmental agencies.
- As and when required the College faculty themselves act as Resource Persons.
- Students can work in close association with Non-Governmental Organizations like
- Lions Club, Rotary Club, etc or with any NGO actively working in that habitation.
- And also, with the Governmental Departments. If the program is rolled out, the District Administration could be roped in for the successful deployment of the program.
- An in-house training and induction program could be arranged for the faculty and participating students, to expose them to the methodology of Service Learning.

Timeline for the Community Service Project Activity
Duration: 8 weeks

1. Preliminary Survey (One Week)
- A preliminary survey including the socio-economic conditions of the allotted habitation to be conducted.
- A survey form based on the type of habitation to be prepared before visiting the habitation with the help of social sciences faculty. (However, a template could be designed for different habitations, rural/urban.
- The Governmental agencies, like revenue administration, corporation and municipal authorities and village secreteriats could be aligned for the survey.

2. Community Awareness Campaigns (One Week)
- Based on the survey and the specific requirements of the habitation, different awareness campaigns and programmesto be conducted, spread over two weeks of time. The list of activities suggested could be taken into consideration.

3. Community Immersion Programme (Three Weeks)
Along with the Community Awareness Programmes, the student batch can also work with any one of the below-listed governmental agencies and work in tandem with them. This community involvement programme will involve the students in exposing themselves to experiential learning about the community and its dynamics. Programs could be in consonance with the Govt. Departments.

4. Community Exit Report (One Week)
During the last week of the Community Service Project, a detailed report of the outcome of the 8 weeks' works to be drafted and a copy shall be submitted to the local administration. This report will be a basis for the next batch of students visiting that habitation. The same report submitted to the teacher-mentor will be evaluated by the mentor and suitable marks are awarded for onward submission to the University.Throughout the Community Service Project, a daily logbook need to be maintained by the students batch, which should be countersigned by the governmental agency representative and the teacher-mentor, who is required to periodically visit the students and guide them.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
AK23 REGULATIONS
B. Tech - ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
(Effective for the batches admitted from 2023-24)

B.Tech III Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P	C			
1	PC	23APC3303	Deep Learning	2	1	0	3	30	70	100
2	PC	23APC3305	Data Wrangling & Preprocessing	2	1	0	3	30	70	100
3	PC	23APC3307	Natural Language Processing	2	1	0	3	30	70	100
4	ES	23AES0504	Introduction to Quantum Technologies and Applications	2	1	0	3	30	70	100
5	PE-1	23APE3301 23APE3302 23APE3303 23APE3304	1.Data Visualization 2.Soft computing 3.Exploratory Data Analysis with Python 4. Introduction to Reinforcement Learning.	2	1	0	3	30	70	100
6	OE-1	23AOE9915	English for Competitive Examinations	2	1	0	3	25	75	100
7	PC	23APC3304	DL and NLP Lab	0	0	3	1.5	30	70	100
8	PC	23APC3306	Data Wrangling Lab	0	0	3	1.5	30	70	100
9	SC	23ASC9901	Soft skills	1	0	2	2	30	70	100
10	ES	20AES0404	Tinkering Lab	0	0	2	1	30	70	100
11	PR	23APR3301	Community Service Internship	-	-	-	2	100	-	100
			Total	**13**	**6**	**10**	**26**	**395**	**705**	**1100**

Open Elective – I

S. NO	Course Code	Course Name	Offered by the Dept.
1	23AOE0101	Green Buildings	CIVIL
2	23AOE0102	Construction Technology and Management	
3	23AOE0201	Electrical Safety Practices and Standards	EEE
4	23AOE0301	Sustainable Energy Technologies	ME
5	23AOE0401	Electronic Circuits	ECE
6	23AOE9901	Mathematics for Machine Learning and AI	Mathematics
7	23AOE9906	Materials Characterization Techniques	Physics
8	23AOE9911	Chemistry of Energy Systems	Chemistry
9	23AOE9915	English for Competitive Examinations	Humanities
10	23AOEMB01	Entrepreneurship and New Venture Creation	

ANNAMACHARYA INSTITUTE OF TECHNOLOGY ANDSCIENCES:TIRUPATI (AUTONOMOUS)
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	DEEP LEARNING	L	T	P	C
23APC3303	III-I		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: **Understand** the fundamentals of neural networks and deep learning architectures.

CO2: **Analyse** the key optimization techniques for training deep models.

CO3: **Apply** convolutional and recurrent neural networks to real-world tasks.

CO4: **Understand** the transfer learning, generative models, and deep learning frameworks.

CO5: **Analyze** problem-solving skills using deep learning across diverse domains.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the fundamentals of neural networks and deep learning architectures.			L2
CO2	Analyse	the key optimization techniques		for training deep models.	L4
CO3	Apply	convolutional and recurrent neural networks		to real-world tasks.	L3
CO4	Understand	the transfer learning, generative models, and deep learning frameworks.	.		L2
CO5	Analyze	problem-solving skills	using deep learning across diverse domains.		L4

UNIT I: Fundamentals of Neural Networks and Deep Learning

Introduction to Neural Networks and Deep Learning, Biological vsArtificial Neurons, Perceptron and Multilayer PerceptronActivation Functions: Sigmoid, Tanh, ReLU, Leaky ReLU, Forward Propagation and Loss Functions, Gradient Descent, Backpropagation, Optimization Algorithms: SGD, Momentum, RMSProp, Adam, Challenges in Deep Learning: Overfitting, Vanishing/Exploding Gradients

UNIT II: Deep Neural Network Architectures and Training Techniques

Deep Feedforward Neural Networks (DNNs), Batch Normalization and Dropout, Hyperparameter Tuning: Learning Rate, Epochs, Batch Size, Weight Initialization and Early Stopping, K-Fold Cross Validation, Model Evaluation Metrics: Accuracy, Precision, Recall, F1-Score, Introduction to TensorFlow and PyTorch, Implementing Basic DNN using Python

UNIT III: Convolutional Neural Networks (CNNs)

Introduction to CNNs: Architecture and Layers, Convolution Operation, Filters, Feature Maps, Pooling Layers and Non-linearity, CNN for Image Classification, Transfer Learning and Pre-trained Networks (VGG, ResNet, Inception), Fine-tuning and Feature Extraction, Case Study: Object Detection and Image Segmentation, Visualizing CNNs and Activation Maps

UNIT IV: Recurrent Neural Networks (RNNs) and Sequence Models

Introduction to RNNs and Sequence Modeling, Challenges in RNN: Vanishing Gradients, BPTT, Long Short-Term Memory (LSTM) Networks, Gated Recurrent Units (GRU), Bidirectional RNNs, Applications: Text Generation, Sentiment Analysis, Language Modeling, Attention Mechanisms and Transformers (Intro), Sequence-to-Sequence Models for Machine Translation

UNIT V: Advanced Topics and Applications in Deep Learning

Autoencoders and Denoising Autoencoders, Generative Adversarial Networks (GANs): Architecture, Applications, Deep Reinforcement Learning: Basics and Use Cases, Neural Style Transfer, Deep Learning in Healthcare, Finance, and Autonomous Systems, Ethical Issues in Deep Learning: Bias, Fairness, Explainability, Model Compression and Quantization.

Textbooks

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, Deep Learning, MIT Press
2. Josh Patterson and Adam Gibson, Deep Learning: A Practitioner's Approach, O'Reilly Media.
3. Francois Chollet, Deep Learning with Python, Manning Publications

Reference Books

1. Michael Nielsen, Neural Networks and Deep Learning, Free online book.
2. Nikhil Buduma, Fundamentals of Deep Learning, O'Reilly Media.
3. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer.
4. Rajalingappaa Shanmugamani, Deep Learning for Computer Vision, Packt.

Online Courses

1. Deep Learning Specialization – Andrew Ng (Coursera)
2. MIT Deep Learning for Self-Driving Cars (YouTube)
3. Fast.ai – Practical Deep Learning Course
4. Stanford CS231n: Convolutional Neural Networks for Visual Recognition

Mapping of course outcomes with program outcomes

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

Correlation matrix:

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Corre lation	Co's Action verb	BTL			
1				Understand	L2	PO1 PO2 PO3	PO1: Apply(L3) PO2: Develop(L3) PO3: Apply (L3)	3 3 2
2				Analyze	L4	PO1 PO2 PO3	PO1: Apply(L3) PO2: Develop(L3) PO3: Apply(L3)	2 2 2
3				Apply	L3	PO1 PO2 PO3 PO4	PO1: Apply(L3) PO2: Develop(L3) PO3: Analyze(L4) PO4: Apply (L3)	3 3 2 3
4				Understand	L2	PO1 PO2 PO3	PO1: Apply(L3) PO2: Design(L6) PO3: Analyze(L4)	3 3 2
5				Analyze	L4	PO1 PO3 PO5 PO11	PO1: Apply(L3) PO3: Develop(L3) PO5:Create(L6) PO11:ThumbRule	3 2 2 2

Justification Statements:

CO1: **Understand** the fundamentals of neural networks and deep learning architectures.

Action Verb: Understand (L2)

PO1: Apply(L3)

CO1 Action verb is greater than PO1 verb by one level. Therefore the correlation is high (3)

PO2: Develop(L3)

CO1 Action verb is greater than PO2 verb by one level. Therefore the correlation is high (3)

PO3: Apply (L3)

CO1 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate (2)

CO2: **Analyse** the key optimization techniques for training deep models.

Action Verb: Analyse(L4)

PO1: Apply (L3)

CO2 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)

PO2: Develop(L3)

CO2 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)

PO3: Apply (L3)

CO2 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate (2)

CO3: **Apply** convolutional and recurrent neural networks to real-world tasks.

Action Verb: Apply(L3)

PO1: Apply(L3)

CO3 Action verb is more than PO1 verb. Therefore the correlation is high (3)

PO2: Develop(L3)

CO3 Action verb more than PO2 verb. Therefore the correlation is high (3)

PO3: Analyze(L4)

CO3 Action verb less than PO2 verb by one levels. Therefore the correlation is moderate (2)

PO4: Apply (L3)

CO3 Action verb same as PO5 verb. Therefore the correlation is high (3)

CO4: **Understand** the transfer learning, generative models, and deep learning frameworks.

Action Verb: Understand (L2)

PO1: Apply(L3)

CO4 Action verb is greater than PO1 verb by one level. Therefore the correlation is high (3)

PO2: Design(L6)

CO4 Action verb isgreater than PO2 verb by one levels. Therefore the correlation is high (3)

PO3: Analyze(L4)

CO4 Action verb is less than PO3 verbby one levels. Therefore the correlation is moderate (2)

CO5:Analyze problem-solving skills using deep learning across diverse domains.

Action Verb: Analyze (L4)

PO1: Apply(L3)

CO5 Action verb is greater than PO1 verb by one level. Therefore the correlation is is high (3)

PO3:Develop(L3)

CO5 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate (2)

PO5: Create(L6)

CO5 Action verb is less than PO5 verb by one level. Therefore the correlation is moderate (2)

PO11:ThumbRule

We are using the problem solving skills in deep learning   Therefore the correlation is moderate (2)

Course Code	Year & Sem	DATA WRANGLING AND PRE- PROCESSING	L	T	P	C
23APC3305	III-I		2	1	0	3

Course Outcomes:

After Studying the Course Student will able to

CO1: Understand the concepts of Data Wrangling.

CO2: Create Python Packages for Data Wrangling, Relational Databases, and Non-Relational Databases.

CO3: Apply Data Cleaning and Exploration techniques for Datasets.

CO4: Apply Data Preprocessing and Reduction techniques for Datasets.

CO5: Analyze Data Transformation and Web Scraping techniques for Web Pages**.**

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the concepts of Data Wrangling.		CSV, JSON, and XML Formats.	L2
CO2	Create	Python Packages for Data Wrangling, Relational Databases, and Non-Relational Databases.			L3
CO3	Apply	Data Cleaning and Exploration techniques		for Datasets.	L2
CO4	Apply	Data Preprocessing and Reduction techniques		for Datasets.	L5
CO5	Analyze	Data Transformation and Web Scraping techniques		for Web Pages	L6

UNIT – I	Introduction to Data Wrangling	

What Is Data Wrangling, Importance of Data Wrangling, Tasks of Data Wrangling, Data Wrangling Tools, Introduction to Python for Data Wrangling, Python Basics for Data Wrangling, Handling Structured Data: CSV, JSON, and XML Formats, Data Meant to Be Read by Machines.

UNIT – II	Working with Excel Files, PDFs, and Databases	

Installing Python Packages for Data Wrangling, Parsing Excel Files, Programmatic Approaches to PDF Parsing, Converting PDF to Text (pdf miner), Acquiring and Storing Data, Introduction to Databases for Data Wrangling, Relational Databases: MySQL and PostgreSQL, Non-Relational Databases: No SQL and Alternative Data Storage.

UNIT – III	Data Cleaning and Exploration	

Why Clean Data? Basics of Data Cleanup, Identifying and Formatting Data for Clean-Up, Finding Outliers and Bad Data, Removing Duplicates and Fuzzy Matching, Using Regular Expressions (RegEx) for Data Cleaning, Normalization and Standardization of Data, Saving Cleaned Data and Testing with New Data, Data Exploration: Table Functions and Joining Datasets.

UNIT – IV	Data Preprocessing and Reduction	

Data Quality : Why Preprocess Data?, Major Tasks in Data Preprocessing, Handling Missing Values in Data, Identifying and Removing Noisy Data, Data Integration and Entity Identification Problem, Redundancy and Correlation Analysis in Data, Detection and Resolution of Data Conflicts, Tuple Duplication and Its Impact.

UNIT – V	Data Transformation and Web Scraping	

Overview of Data Transformation Strategies, Normalization and Standardization, Discretization by Binning and Histogram Analysis, Clustering, Sampling, and Data Cube Aggregation, Web Scraping: What to Scrape and How, Analyzing and Parsing Web Pages with LXML and XPath, Advanced Web Scraping Using Selenium and Scrapy.

Textbooks:
1. Data Wrangling with Python: Tips and Tools to Make Your Life Easier – Dr. Jacqueline Kazil and Katharine Jarmul, O'Reilly Media.
2. Data Preprocessing for Machine Learning in Python" – M.G. Sumithra, CRC Press.
Reference Books:
1. Web Scraping with Python: Collecting More Data from the Modern Web" – Ryan Mitchell, O'Reilly Media.
2. Data Cleaning and Exploration with Machine Learning" – Michael Walker, Packt Publishing.

Mapping of course outcomes with program outcomes:

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

Correlation matrix

Unit No.	CO						Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb		BTL			
1				Understand		L2	PO1 PO2 PO3	PO1: Apply(L3) PO2: Identify(L3) PO3: Apply (L3)	2 2 2
2				Create		L6	PO1 PO2 PO5	PO1: Apply(L3) PO2: Identify(L3) PO5: Apply(L3	2 2 2
3				Apply		L3	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify(L3) PO3: Apply (L3) PO4: Analyze (L4) PO5: Apply(L3	3 3 3 2 3
4				Apply		L3	PO1 PO2 PO5	PO1: Apply(L3) PO2: Identify(L3) PO5: Apply(L3)	3 3 3
5				Analyze		L4	PO1 PO2 PO5	PO1: Apply(L3) PO2: Identify(L3) PO5: Apply(L3)	2 2 2

Justification Statements:

CO1: Understand the concepts of Data Wrangling.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO2 Verb: Identify (L3)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)
PO3: Apply (L3)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)

CO2: Create Python Packages for Data Wrangling, Relational Databases, and Non-Relational Databases.
Action Verb: Create (L6)
PO1 Verb: Apply (L3)

CO1 Action verb is greater than three levels as PO3 verb. Therefore the correlation is low (1)
PO2 Verb: Identify (L3)
CO1 Action verb is greater than three levels as PO3 verb. Therefore the correlation is low (1)
PO5: Create (L6)
CO1 Action verb is greater than three levels as PO3 verb. Therefore the correlation is low (1)

CO3: Apply Data Cleaning and Exploration techniques for Datasets.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action verb is same PO1 verb level. Therefore the correlation is high (3)
PO2 Verb: Identify (L3)
CO1 Action verb is same PO1 verb level. Therefore the correlation is high (3)
PO3: Apply (L3)
CO1 Action verb is same PO1 verb level. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO1 Action verb less than PO5 verb by one level. Therefore the correlation is low (2)
PO5: Create (L6)
CO1 Action verb less than PO5 verb by three levels. Therefore the correlation is low (1)

CO4: Apply Data Preprocessing and Reduction techniques for Datasets.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action verb is same level PO1 verb . Therefore the correlation is high (3)
PO2 Verb: Identify (L3)
CO1 Action verb is same level PO1 verb . Therefore the correlation is high (3)
PO5: Create (L6)
CO1 Action verb less than PO5 verb by three levels. Therefore the correlation is low (1)

CO5: Analyze Data Transformation and Web Scraping techniques for Web Pages**.**
Action Verb: Analyze **(L4)**
PO1 Verb: Apply (L3)
CO1 Action verb is greater than PO1 verb by one level. Therefore the correlation is moderate (2)
PO2 Verb: Identify (L3)
CO1 Action verb is greater than PO1 verb by one level. Therefore the correlation is moderate (2)
PO5: Create (L6)
CO1 Action verb is less than PO3 verb by two levels. Therefore the correlation is low (1)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY ANDSCIENCES:TIRUPATI (AUTONOMOUS)

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	NATURAL LANGUAGE PROCESSING	L	T	P	C
23APC3307	III-I		2	1	0	3

Course Outcomes

After studying the course, student will be able to

CO1: Understand the morphological processing and the structure of words and documents.

CO2: Analyze the syntactic structures using various parsing algorithms.

CO3: Apply the semantic parsing techniques to interpret natural language text.

CO4: Understand the predicate-argument structures and meaning representation systems.

CO5: Apply the cross-lingual language models and speech recognition techniques in NLP applications

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the morphological processing and the structure of words and documents.			L2
CO2	Analyze	the syntactic structures	using various parsing algorithms.		L4
CO3	Apply	the semantic parsing techniques to interpret natural language text.			L3
CO4	Understand	the predicate-argument structures and meaning representation systems.			L2
CO5	Apply	the cross-lingual language models and speech recognition techniques in NLP applications			L3

UNIT I: Introduction to NLP
Introduction to NLP: Origins and Challenges, Language and Grammar in NLP, Regular Expressions and Finite-State Automata, Tokenization: Text Segmentation and Sentence Splitting, Morphological Parsing: Stemming and Lemmatization, Spelling Error Detection and Correction, Minimum Edit Distance and Applications, Statistical Language Models: Unigram, Bigram, and Trigram Models, Processing Indian Languages in NLP.
UNIT II: Word-Level and Syntactic Analysis
Introduction, Part-of-Speech (POS) Tagging: Rule-Based, Stochastic and Transformation-Based Approaches, Hidden Markov Models (HMM) and Maximum Entropy Models for POS Tagging, Context-Free Grammar (CFG) and Constituency Parsing, Treebanks and Normal Forms for Grammar, Top-Down and Bottom-Up Parsing Strategies, CYK Parsing Algorithm, Probabilistic Context-Free Grammars (PCFGs), Feature Structures and Unification.
UNIT III: Text Classification and Information Retrieval
Naïve Bayes Classifier for Text Classification, Training and Optimization for Sentiment Analysis, Information Retrieval: Basic Concepts and Design Features, Information Retrieval Models: Classical, Non-Classical, and Alternative Models, Cluster Model, Fuzzy Model, and LSTM-Based Information, Retrieval, Word Sense Disambiguation (WSD) Methods: Supervised and Dictionary-Based Approaches.
UNIT IV: Machine Translation and Semantic Processing
Introduction to Machine Translation (MT), Language Divergence and Typology in MT EncoderDecoder Model for Machine Translation, Translating in Low-Resource Scenarios, MT Evaluation Metrics and Techniques, Bias and Ethical Issues in NLP and Machine Translation, Semantic Analysis and First-Order Logic in NLP, Thematic Roles and Selectional Restrictions in Semantics, Word Senses and Relations Between Senses
UNIT V: Speech Processing and Advanced NLP Models
Speech Fundamentals: Phonetics and Acoustic Phonetics, Digital Signal Processing in Speech Analysis, Feature Extraction in Speech: Short-Time Fourier Transform (STFT), Mel-Frequency Cepstral Coefficients (MFCC) and Perceptual Linear Prediction (PLP), Hidden Markov Models (HMMs) in Speech Recognition.

Textbooks (Core Learning Materials)
1. Daniel Jurafsky & James H. Martin – Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education, 2023.
2. Tanveer Siddiqui & U.S. Tiwary – Natural Language Processing and Information Retrieval, Oxford University Press.

Reference Books (Supplementary Learning)
1. T.V. Geetha – Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives, Pearson, 2024.
2. Akshay Kulkarni & Adarsha Shivananda – Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python, Apress, 2019.

Web links and Video Lectures (e-Resources):
1. **https://www.youtube.com/watch?v=M7SWr5xObkA**
2. **https://onlinecourses.nptel.ac.in/noc23_cs45/preview**
3. **https://archive.nptel.ac.in/courses/106/106/106106211/**

Mapping of course outcomes with program outcomes

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

Correlation matrix:

Unit No.	CO						Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Corre lation	Co's Action verb	BT L				
1				Understand	L2	PO1	PO1: Apply(L3)	2
						PO5	PO5: Apply (L3)	2
2				Analyze	L4	PO1	PO1: Apply(L3)	2
						PO2	PO2: Analysis(L4)	3
						PO3	PO3: Develop(L3)	2
3				Apply	L3	PO1	PO1: Apply(L3)	3
						PO2	PO2: Analysis(L4)	2
						PO3	PO3: Develop(L3)	3
						PO5	PO5: Apply (L3)	3
						PO11	PO11: ThumbRule	2
4				Understand	L2	PO1	PO1: Apply(L3)	2
						PO2	PO2: Analysis(L4)	2
						PO3	PO3: Develop(L3)	1
						PO5	PO5: Apply (L3)	2
						PO6	PO6: ThumbRule	2
5				Apply	L3	PO1	PO1: Apply(L3)	3
						PO3	PO3: Develop(L3)	3
						PO5	PO5: Apply (L3)	3
						PO7	PO7: ThumbRule	2
						PO11	PO11:ThumbRule	2

Justification Statements:

CO1: Understand the morphological processing and the structure of words and documents.
Action Verb: Understand (L2)
PO1: Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO5: Apply (L3)
CO1 Action verb is less than PO5 verb by one level. Therefore the correlation is moderate (2)
CO2: Analyze the syntactic structures using various parsing algorithms.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO2 Action verb is Greater than PO1 verb by one level. Therefore the correlation is moderate (2)
PO2: Analysis(L4)
CO2 Action verb is same level as PO2verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO2 Action verb is Greater than PO1 verb by one level PO3 verb. Therefore the correlation is moderate (2)
CO3: Apply the semantic parsing techniques to interpret natural language text.
Action Verb: Apply(L3)
PO1: Apply(L3)
CO3 Action verb is more than PO1 verb. Therefore the correlation is high (3)
PO2: Analysis(L4)
CO3 Action verb is Greater than PO2 verb. Therefore the correlation is moderate (2)
PO3: Develop(L3)
CO3 Action verb more than PO2 verb. Therefore the correlation is high (3)
PO4: Analyze(L4)
CO3 Action verb less than PO2 verb by one levels. Therefore the correlation is moderate (2)
PO5: Apply (L3)
CO3 Action verb same as PO5 verb. Therefore the correlation is high (3)
PO11: Thumb rule
The NLP models are Code generation and completion tools are lifelong learning. Therefore the correlation is Moderate (2)
CO4: Understand the predicate-argument structures and meaning representation systems.
Action Verb: Understand (L2)
PO1: Apply(L3)
CO4 Action verb is less than PO1 verb by one level. Therefore the correlation is Moderate (2)
PO2: Analysis(L4)
CO4 Action verb is less than PO2 verb by two level. Therefore the correlation is Low(1)
PO3: Develop(L3)
CO4 Action verb is less than PO3 verb by one levels. Therefore the correlation is Moderate (2)
PO5: Apply (L3)
CO4 Action verb is less than PO5 verb by two levels. Therefore the correlation is Moderate (2)
PO6: Thumb rule
Since we are developing NLP Models and applications. Therefore the correlation is Moderate (2)
CO5: Apply the cross-lingual language models and speech recognition techniques in NLP applications
Action Verb: Appy (L3)
PO1: Apply(L3)
CO5 Action verb is same as PO1 verb. Therefore the correlation is High (3)
PO3: Develop(L3)
CO5 Action verb is same as PO3 verb. Therefore the correlation is High (3).
PO5: Apply (L3)
CO5 Action verb is same as PO3 verb. Therefore the correlation is High (3).
PO7: ThumbRule
Apply the Ethical Principal for creating the Security tools in NLP. Therefore the correlation is moderate (2)
PO11: ThumbRule
We are using the NLP Tools in lifelong Learning. Therefore the correlation is moderate (2)

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	INTRODUCTION TO QUANTUM TECHNOLOGIES AND APPLICATIONS (Qualitative Treatment)	L	T / CLC	P	C
23AES0504	III-I		2	1	**0**	**3**

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the transition from classical to quantum physics and quantum states**.**

CO2: Understand qubits, quantum systems, and their philosophical significance.

CO3: Analyze quantum computer requirements, system fragility, hardware platforms, and software roles.

CO4: Analyze quantum information, communication, computing, and their future potential.

CO5: Apply quantum applications, industry cases, challenges, and opportunities.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the transition from classical		to quantum physics and quantum states**.**	L2
CO2	**Understand**	qubits, quantum systems, and their philosophical significance			L2
CO3	**Analyze**	quantum computer requirements, system fragility, hardware platforms, and software roles.			L4
CO4	**Analyze**	quantum information, communication, computing, and their future potential.			L4
CO5	**Apply**	quantum applications, industry cases, challenges, and opportunities.			L3

UNIT – I	Introduction to Quantum Theory and Technologies	9 **Hrs**

The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison,Quantum states and measurement: nature of observation,Overview of quantum systems: electrons, photons, atoms,The concept of quantization: discrete energy levels,Why quantum? Strategic, scientific, and technological significance,A snapshot of quantum technologies: Computing, Communication, and Sensing,National and global quantum missions: India's Quantum Mission, EU, USA, China

UNIT – II	Theoretical Structure of Quantum Information Systems	9 **Hrs**

What is a qubit? Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view),Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract,The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences,Philosophical implications: randomness, determinism, and observer role

UNIT – III	Building a Quantum Computer – Theoretical Challenges and Requirements	9 **Hrs**

What is required to build a quantum computer (conceptual overview)?,Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers:

Why maintaining entanglement is difficult,Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual comparison),Superconducting circuits, Trapped ions, Photonics, Visionvs reality: what's working and what remains elusive,The role of quantum software in managing theoretical complexities

UNIT – IV	Quantum Communication and Computing – Theoretical Perspective	9 **Hrs**

Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD),Role of Entanglement in Communication,The Idea of the Quantum Internet – Secure Global Networking,Introduction to Quantum Computing,Quantum Parallelism (Many States at Once),Classical vs Quantum Gates, Challenges: Decoherence and Error Correction,Real-World

Importance and Future Potential		
UNIT – V	**Applications, Use Cases, and the Quantum Future**	**9 Hrs**
Real-world application domains: Healthcare (drug discovery),Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, PsiQuantum,Ethical, societal, and policy considerations, Challenges to adoption: cost, skills, standardization,Emerging careers in quantum: roles, skillsets, and preparation pathways,Educational and research landscape – India's opportunity in the global quantum race		

Textbooks:

1. Michael A. Nielsen, Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
3. Chris Bernhardt, *Quantum Computing for Everyone*, MIT Press, 2019.

Reference Books:

1. David McMahon, *Quantum Computing Explained*, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, *An Introduction to Quantum Computing*, Oxford University Press, 2007.
3. Scott Aaronson, *Quantum Computing Since Democritus*, Cambridge University Press, 2013.
4. **Alastair I.M. Rae**, *Quantum Physics: A Beginner's Guide*, Oneworld Publications, Revised Edition, 2005.
5. **Eleanor G. Rieffel, Wolfgang H. Polak**, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
6. **Leonard Susskind, Art Friedman**, *Quantum Mechanics: The Theoretical Minimum*, Basic Books, 2014.
7. **Bruce Rosenblum, Fred Kuttner**, *Quantum Enigma: Physics Encounters Consciousness*, Oxford University Press, 2nd Edition, 2011.
8. **GiulianoBenenti, GiulioCasati, GiulianoStrini**, *Principles of Quantum Computation and Information, Volume I: Basic Concepts*, World Scientific Publishing, 2004.
9. **K.B. Whaley et al.**, *Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document*, Quantum Flagship, European Commission, 2020.
10. **Department of Science & Technology (DST), Government of India**, *National Mission on Quantum Technologies & Applications – Official Reports and Whitepapers*, MeitY/DST Publications, 2020 onward.

Online Learning Resources**:**

- IBM Quantum Experience and Qiskit Tutorials
- Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
- edX – The Quantum Internet and Quantum Computers
- YouTube – Quantum Computing for the Determined by Michael Nielsen
- Qiskit Textbook – IBM Quantum

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	CO						Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL				
1	9	20	2	CO1: Understand	L2		PO1 PO2 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO11: Thumb	2 1 3

								Rule	
2	9	20	2	CO2: Understand	L2	PO1 PO2 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO11: Thumb Rule	2 1 3
3	9	20	2	CO3: Analyze	L4	PO1 PO2 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO11: Thumb Rule	3 3 3
4	9	20	2	CO4: Analyze	L4	PO1 PO2 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO11: Thumb Rule	3 3 3
5	9	20	2	CO5: Analyze	L4	PO1 PO2 PO11	PO1: Apply(L3) PO2: Apply(L3) PO11: Thumb Rule	3 3 3
	45	100						

Justification Statements:

CO1: Understand the transition from classical to quantum physics and quantum states.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than one level PO1 verb. Therefore, the correlation is moderate (2)
PO2 Verb: Analyze (L4)
CO1 Action verb is less than two level PO2 verb. Therefore, the correlation is low (1)
PO11: Thumb Rule
Quantum physics demands that we accept probability and discreteness at nature's core. Therefore, the correlation is high (3)

CO2: Understand qubits, quantum systems, and their philosophical significance.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO2 Action verb is less than one level PO1 verb. Therefore, the correlation is moderate (2)
PO2: Analyze **(L4)**
CO2 Action verb is less than two level PO2 verb. Therefore, the correlation is low (1)
PO11: Thumb Rule
A qubit is a superposed quantum state that enables powerful new ways to store and process information. Therefore, the correlation is high (3)

CO3: Analyze quantum computer requirements, system fragility, hardware platforms, and software roles.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO3 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO3 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO11: Thumb Rule
Building a quantum computer requires stable qubits, precise control, error correction, and scalability. Therefore, the correlation is high (3)

CO4: Analyze quantum information, communication, computing, and their future potential.
Action Verb: Analyze (L4)

PO1: Apply (L3)
CO4 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO4 Action verb is same as PO2 verb. Therefore, the correlation is high (3)
PO11: Thumb Rule
Quantum communication and computing leverage superposition, entanglement, and no-cloning to enable secure communication and powerful computation. Therefore, the correlation is high (3)

CO5: Analyze quantum applications, industry cases, challenges, and opportunities.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO5 Action verb is same as PO . Therefore, the correlation is high(3)
PO2: Apply(L3)
CO5 Action verb is same as PO2 verb. Therefore, the correlation is high (3)
PO11: Thumb Rule
Quantum technologies enable breakthroughs in healthcare, materials, optimization, and security. Therefore, the correlation is high (3)

Course Code	Year & Sem	Data Visualization	L	T	P	C
23APE3301	**III-I**	**(Professional Elective-II)**	2	1	**0**	**3**

Course Outcomes:

After studying the course, student will be able to

CO1: **Understand** the principles, techniques, and tools of data visualization

CO2: **Apply** the transform data into visual insights using different types of charts and plots.

CO3: **Understand** the cognitive and perceptual foundations of effective data visualization

CO4: **Apply** tools and programming environments (like Python, Tableau, or Power BI) for creating interactive and dynamic visualizations

CO5: **Analyze** real-world datasets and effectively communicate data-driven findings visually

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	The principles, techniques, and tools of data visualization			L2
CO2	**Apply**	The transform data into visual insights	Using different types of charts and plots.		L3
CO3	**Understand**	The cognitive and perceptual foundations of effective data visualization			L2
CO4	**Apply**	Tools and programming environments (like Python, Tableau, or Power BI)	.	For creating interactive and dynamic visualizations	L3
CO5	**Analyze**	Real-world datasets and effectively communicate data-driven findings visually			L4

UNIT I: Introduction to Data Visualization & Perception
Introduction to Data Visualization, Importance and Scope of Data Visualization, Data Types and Sources, Visual Perception: Pre-attentive Processing, Gestalt Principles, Data-Ink Ratio, Data Density, Lie Factor, Visualization Process and Design Principles, Tools Overview: Tableau, Power BI, Python Libraries
UNIT II: Visualization Techniques for Categorical & Quantitative Data
Charts for Categorical Data: Bar Charts, Pie Charts, Column Charts, Charts for Quantitative Data: Histograms, Line Charts, Boxplots, Scatter Plots, Bubble Charts, Heatmaps, Choosing the Right Chart Type, Best Practices in Labeling, Coloring, and Scaling.
UNIT III: Multidimensional, Temporal and Hierarchical Data Visualization
Visualizing Multivariate Data: Parallel Coordinates, Radar Charts, Time-Series Visualization: Time Plots, Animation over Time, Geographic Data Visualization: Maps, Choropleths, Hierarchical Data: Treemaps, Sunburst Charts, Network and Graph Visualization.
UNIT IV: Data Visualization Using Python and Dashboards
Introduction to Matplotlib, Seaborn, and Plotly, Creating Static and Interactive Charts, Pandas Visualization Capabilities, Dashboards with Dash, Streamlit, Power BI, Case Studies: Real-world Dataset Visualization.
UNIT V: Storytelling with Data and Ethical Visualization
Storytelling and Narrative Techniques in Visualization, Dashboards and Reporting, Misleading Visualizations and Bias, Ethical Principles in Data Visualization, Final Project: Create a Storytelling Dashboard with Real Data.

Textbooks:
1. Tamara Munzner, **Visualization Analysis and Design**, CRC Press, 2014.
2. Nathan Yau, **Data Points: Visualization That Means Something**, Wiley, 2013.

Reference Books:
1. Alberto Cairo, **The Truthful Art: Data, Charts, and Maps for Communication**, New Riders, 2016.
2. Cole Nussbaumer Knaflic, **Storytelling with Data: A Data Visualization Guide for Business Professionals**, Wiley, 2015.
3. Claus O. Wilke, **Fundamentals of Data Visualization**, O'Reilly, 2019.
4. Rohan Chopra, **Hands-On Data Visualization with Bokeh**, Packt Publishing, 2019.

Online Learning Resources:
1. NPTEL: Data Visualization - IIT Madras
2. *Coursera: Data Visualization with Python by IBM*

Mapping of course outcomes with program outcomes

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

Correlation matrix:

Unit No.	CO						Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				Understand	L2	PO1 PO2 PO3	PO1: Apply(L3) PO2: Develop(L3) PO3: Apply (L3)	3 3 2
2				Apply	L3	PO1 PO2 PO3	PO1: Apply(L3) PO2: Develop(L3) PO3: Apply(L3)	2 2 2
3				Understand	L2	PO1 PO2 PO3 PO4	PO1: Apply(L3) PO2: Develop(L3) PO3: Analyze(L4) PO4: Apply (L3)	3 3 2 3
4				Apply	L3	PO1 PO2 PO3	PO1: Apply(L3) PO2: Design(L6) PO3: Analyze(L4)	3 3 2
5				Analyze	L4	PO1 PO3 PO5 PO11	PO1: Apply(L3) PO3: Develop(L3) PO5:Create(L6) PO11:ThumbRule	3 2 2 2

Justification Statements:

CO1: Understand the principles, techniques, and tools of data visualization
Action Verb: Understand (L2)
PO1: Apply(L3)
CO1 Action verb is greater than PO1 verb by one level. Therefore the correlation is high (3)
PO2: Develop(L3)
CO1 Action verb is greater than PO2 verb by one level. Therefore the correlation is high (3)
PO3: Apply (L3)
CO1 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate (2)

CO2: Apply the transform data into visual insights using different types of charts and plots

Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO2: Develop(L3)
CO2 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)
PO3: Apply (L3)
CO2 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate (2)

CO3: Understand the cognitive and perceptual foundations of effective data visualization
Action Verb: Understand(L2)
PO1: Apply(L3)
CO3 Action verb is more than PO1 verb. Therefore the correlation is high (3)
PO2: Develop(L3)
CO3 Action verb more than PO2 verb. Therefore the correlation is high (3)
PO3: Analyze(L4)
CO3 Action verb less than PO2 verb by one levels. Therefore the correlation is moderate (2)
PO4: Apply (L3)
CO3 Action verb same as PO5 verb. Therefore the correlation is high (3)

CO4: Apply tools and programming environments (like Python, Tableau, or Power BI) for creating interactive and dynamic visualizations

Action Verb: Apply(L3)
PO1: Apply(L3)
CO4 Action verb is greater than PO1 verb by one level. Therefore the correlation is high (3)
PO2: Design(L6)
CO4 Action verb isgreater than PO2 verb by one levels. Therefore the correlation is high (3)
PO3: Analyze(L4)
CO4 Action verb is less than PO3 verbby one levels. Therefore the correlation is moderate (2)

CO5:Analyze real-world datasets and effectively communicate data-driven findings visually
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO5 Action verb is greater than PO1 verb by one level. Therefore the correlation is is high (3)
PO3:Develop(L3)
CO5 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate (2)
PO5: Create(L6)
CO5 Action verb is less than PO5 verb by one level. Therefore the correlation is moderate (2)
PO11:ThumbRule
We are using the problem solving skills in deep learning   Therefore the correlation is moderate (2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY ANDSCIENCES:TIRUPATI (AUTONOMOUS)

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	Soft Computing (Professional Elective-II)	L	T	P	C
23APE3302	III-I		2	1	0	3

Course Outcomes

After studying the course, student will be able to

CO1: Understand the components and applications of soft computing.
CO2: Apply the fuzzy logic concepts to real-world problems.
CO3: Evaluate the train various neural network models.
CO4: Analyze the genetic algorithms for problem-solving and optimization.
CO5: Create the hybrid systems using soft computing techniques.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the components and applications of soft computing.			L2
CO2	Apply	the fuzzy logic concepts to real-world problems.		to real-world problems	L3
CO3	Evaluate	the train various neural network models.			L5
CO4	Analyze	genetic algorithms for problem-solving and optimization.		for problem-solving and optimization	L4
CO5	Create	the hybrid systems using soft computing techniques	using soft computing techniques		L6

UNIT – I	Introduction to Soft Computing and Fuzzy Logic	

Introduction to Soft Computing: Definition, Components, Differences with Hard Computing, Applications of Soft Computing, Fuzzy Logic: Crisp Sets vs Fuzzy Sets, Membership Functions, Fuzzy Set Operations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems: Mamdani and Sugeno Models, Defuzzification Techniques.

UNIT – II	Artificial Neural Networks – I	

Introduction to Neural Networks: Biological Neurons vs Artificial Neurons, Architecture of Neural Networks: Feed forward, Feedback, Learning Rules: Hebbian, Delta, Perceptron Learning Rule, Single Layer Perceptron and its Limitations, Multi-Layer Perceptron: Back propagation Algorithm, Applications of Neural Networks

UNIT – III	Artificial Neural Networks – II	

Hopfield Networks and Associative Memories, Radial Basis Function Networks, Self-Organizing Maps (SOM), Recurrent Neural Networks (RNNs) – Basic Concepts, Convolutional Neural Networks (CNNs) – Overview and Applications, Practical Use Cases in Image and Pattern Recognition,

UNIT – IV	Genetic Algorithms and Optimization	

Introduction to Genetic Algorithms, GA Operators: Selection, Crossover, Mutation, Fitness Function and Evaluation, Schema Theorem, Elitism, Applications in Function Optimization, Scheduling, and Robotics, Introduction to Particle Swarm Optimization (PSO).

UNIT – V	Hybrid Systems and Advanced Topics	

Security and Privacy in Cloud-based AI, Identity and Access Management (IAM) in Cloud, Cost Management and Billing for AI Services, Ethical Issues and Fairness in Cloud AI, Case Study: AI in Healthcare Cloud Solutions, Case Study: Real-Time Analytics in Financial Cloud Services.

Textbooks:

1. S. N. Sivanandam, S. N. Deepa, ―Principles of Soft Computing‖, Wiley India, 3rd Edition

2. Timothy J. Ross, —Fuzzy Logic with Engineering Applications‖, Wiley, 4th Edition

3. S. Rajasekaran and G. A. Vijayalakshmi Pai, —Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications‖, PHI

Reference Books:

1. Laurene Fausett, —Fundamentals of Neural Networks: Architectures, Algorithms and Applications‖, Pearson

2. David E. Goldberg, —Genetic Algorithms in Search, Optimization and Machine Learning‖, Pearson

3. Simon Haykin, —Neural Networks and Learning Machines‖, Pearson, 3rd Edition 4. Bart Kosko, —Neural Networks and Fuzzy Systems‖, Prentice Hall

Online Learning Resources:

Online Learning Resources: 1. NPTEL – Soft Computing by Prof. S. Sengupta (IIT Kharagpur) 2. Coursera – Neural Networks and Deep Learning (Andrew Ng)

Mapping of course outcomes with program outcomes

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

Correlation Matrix:

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Corre lation	Co's Action verb	BTL			
1				Understand	L2	PO1 PO2 PO3 PO4	PO1:Apply(L3) PO2:Identify(l3) PO3: Apply(L3) PO11:Thumb rule	1 1 1 1
2				Apply	L3	PO1 PO3 PO4 PO5	PO1: Apply(L3) PO3: Apply (L3) PO4: Create(L6) PO5: Apply (L3)	3 3 1 3
3				Evaluate	L5	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3: Design(L6) PO4: Create(L6) PO5: Apply(L3)	1 1 1 1 1
4				Analyze	L4	PO2 PO3 PO4 PO5	PO2: Formulate (L6) PO3: Develop (L6) PO4: Analyze(L4) PO5: Apply(L3)	1 1 3 2
5				Create	L6	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify(L3) PO3:Discuss(L6) PO4:Explain(L5) PO5:create(L6)	3 3 3 2 3

Justification Statements:
CO1: Understand the components and applications of soft computing.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is low (1)
PO2 Verb: Identify (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is low(1)
PO3 verb :Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is low(1)
PO11 verb:Thumb rule
Soft computing helps users to solve real-world problems by providing approximate results that conventional and analytical models cannot solve. It is based on Fuzzy logic. Therefore the correlation is low(1)
CO2: Apply the fuzzy logic concepts to real-world problems.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO3: Apply (L3)
CO2 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO4: Create (L6)
CO2 Action verb is less than PO4 verb by two levels. Therefore the correlation is low (1)
PO4: Apply (L3)
CO2 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
CO3: Evaluate the train various neural network models.
Action Verb: Evaluate(L5)
PO1: Apply (L3)
CO3 Action verb is more than PO1 verb. Therefore the correlation is low (1)
PO2: Identify (L3)
CO3 Action verb is more than PO1 verb. Therefore the correlation is low (1)
PO3: Design(L6)
CO3 Action verb is more than PO1 verb. Therefore the correlation is low (1)
PO4: Create(L6)
CO3 Action verb is less than PO1 verb by one level. Therefore the correlation is low (1)
PO5: Apply(L3)
CO3 Action verb is more than PO1 verb. Therefore the correlation is low (1)
CO4: Analyze the genetic algorithms for problem-solving and optimization.
Action Verb: Analyze (L4)
PO2: Formulate (L6)
CO4 Action verb is less than PO2 verb by two levels. Therefore the correlation is low (1)
PO3: Develop (L6)
CO4 Action verb is less than PO3 verb by two levels. Therefore the correlation is low (1)
PO4: Analyze(L4)
CO4 Action verb is same as PO4 verb . Therefore the correlation is low (3)
PO5: Apply(L3)
CO4 Action verb is more than as PO5 verb. Therefore the correlation is moderate (2)
CO5: Create the hybrid systems using soft computing techniques.
Action Verb: Create (L6)
PO1: Apply(L3)
CO5 Action verb is more than PO1 verb . Therefore the correlation is high (3)
PO2: Identify(L3)
CO5 Action verb is more than PO2 verb . Therefore the correlation is high (3)
PO3:Discuss(L6)
CO5 Action verb is same as PO3 verb. Therefore the correlation is high(3)

PO4:Explain(L5)
CO5 Action verb less than is PO4 verb by one level. Therefore the correlation is moderate (2)
PO5:create(L6)
CO5 Action verb is same as PO5 verb . Therefore the correlation is high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY ANDSCIENCES:TIRUPATI (AUTONOMOUS)

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	Exploratory Data Analysis with Python	L	T	P	C
23APE3303	III-I	(Professional Elective-I)	2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the key concepts of EDA and data processing.

CO2: Apply the exploratory analysis using Python libraries and interpret and interpret results.

CO3: Analyze the handle missing data, outliers and categorical features effectively

CO4: Evaluate the visualizations to support data-driven insights.

CO5: Create the EDA as a foundation for data science workflows.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The key concepts of EDA and data processing			L2
CO2	Apply	The exploratory analysis	Using Python libraries and interpret and interpret results.		L3
CO3	Analyze	The handle missing data, outliers and categorical features effectively			L4
CO4	Evaluate	The visualizations		to support data-driven insights	L5
CO5	Create	The EDA as a foundation		for data science workflows.	L6

UNIT – I	Introduction to EDA and Python Environment	

Introduction to Data Science and EDA, Importance of EDA in Data Science Life Cycle, Setting up Python Environment: Jupyter, Anaconda, VS Code, Introduction to NumPy and Pandas: Arrays, Series, DataFrames, Data loading, viewing, basic operations (info, describe, shape)

UNIT – II	Data Wrangling and Preprocessing	

Handling Missing Data (mean, median, drop, interpolation), Dealing with Duplicates, Outliers, and Anomalies, Encoding Categorical Variables (Label, One-hot), Data Transformation: Scaling, Normalization, Binning, Data Types Conversion and Data Type Casting

UNIT – III	Univariate and Bivariate Analysis	

Measures of Central Tendency and Dispersion, Distribution Plots: Histograms, Boxplots, KDE, Bar Charts, Count Plots, Pie Charts, Bivariate Analysis: Scatter Plots, Pair Plots, Heatmaps, Correlation and Covariance Analysis

UNIT – IV	Data Visualization Techniques	

Visualization with Matplotlib and Seaborn, Customizing Plots: Titles, Legends, Labels, Themes, Advanced Visuals: Violin Plots, Strip Plots, Swarm Plots, Multivariate Visualization and Subplots, Plotly and Interactive Visualizations (basic overview)

UNIT – V	EDA Case Studies and Real-Time Datasets	

Step-by-step EDA on Sample Datasets (Titanic, Iris, Sales, etc.), Outlier Detection Techniques, Feature Engineering Techniques in EDA, EDA Report Generation using Python Notebooks, Preparing Data for Machine Learning Models

Textbooks:

1. Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data, O'Reilly, 2016.
2. Wes McKinney, Python for Data Analysis, 2nd Edition, O'Reilly, 2018.

Reference Books:

1. Joel Grus, Data Science from Scratch, O'Reilly, 2019.
2. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow, 2nd Edition, O'Reilly, 2019. 3. Allen B. Downey, Think Stats: Probability and Statistics for Programmers, O'Reilly, 2014.

Mapping of course outcomes with program outcomes

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

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Corre lation	Co's Action verb	BTL			
1				Understand	L2	PO1 PO2 PO5 PO7 PO11	PO1: Apply(L3) PO2: Identify(L3) PO5: Apply (L3) PO7:Thumb rule PO11:Thumb rule	2 2 2 2 2
2				Apply	L3	PO1 PO2 PO4 PO5	PO1: Apply(L3) PO2: Identify(L3) PO3: Apply (L3) PO5: Apply (L3)	3 3 3 3
3				Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3: Design(L6) PO4: Analyze (L4) PO5: Create(L6)	2 2 1 3 1
4				Evaluate	L5	PO1 PO2 PO3 PO5 PO9	PO1: Apply(L3) PO2: Formulate (L6) PO3: Develop (L6) PO5: Apply(L3) PO9: Thumb rule	3 1 1 3 3
5				Create	L6	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Identify(L3) PO3: Develop (L6) PO5: Apply(L3)	3 3 3 3

Justification Statements:

CO1: Understand the key concepts of EDA and data processing.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO2 Verb: Identify (L3)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)
PO5: Apply (L3)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)
PO7: Thumb rule
EDA is the process of summarizing the main characteristics of data, often with visual methods, to understand patterns, spot anomalies, test hypotheses, and check assumptions.
Therefore the correlation is moderate (2)

PO11: Thumb rule
Data Processing involves preparing the data for analysis or modeling by cleaning, transforming, and formatting it so it is life long process. Therefore the correlation is moderate (2)

CO2: Apply the exploratory analysis using Python libraries and interpret and interpret results.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Identify (L3)
CO2 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
PO3: Apply (L3)
CO2 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO5: Apply (L3)
CO2 Action verb is same level as PO3 verb. Therefore the correlation is high (3)

CO3: Analyze the handle missing data, outliers and categorical features effectively
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO3 Action verb is more than PO1 verb. Therefore the correlation is high (3)
PO2: Identify (L3)
CO3 Action verb more than PO2 verb. Therefore the correlation is high (3)
PO3: Design (L6)
CO3 Action verb less than PO2 verb by two levels. Therefore the correlation is low (1)
PO4: Analyze (L4)
CO3 Action verb is same level as PO4 verb. Therefore the correlation is high (3)
PO5: Create (L6)
CO3 Action verb less than PO5 verb by two levels. Therefore the correlation is low (1)

CO4: Evaluate the visualizations to support data-driven insights.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO4 Action verb is greater than PO1 verb. Therefore the correlation is high (3)
PO2: Formulate (L6)
CO4 Action verb is PO2 verb by two levels. Therefore the correlation is low (1)
PO3: Develop (L6)
CO4 Action verb is PO2 verb by two levels. Therefore the correlation is low (1)
PO5: Apply (L3)
CO4 Action verb is more than PO5 verb. Therefore the correlation is high (3)
PO9: Thumb rule
Since we are developing data science engineering and societal departments.
Therefore the correlation is high (3)

CO5: Create the EDA as a foundation for data science workflows.
Action Verb: Create (L6)
PO1 Verb: Apply (L3)
CO5 Action verb is more than PO1 verb. Therefore the correlation is high (3)
PO2 Verb: Identify (L3)
CO5 Action verb is more than PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L6)
CO5 Action verb is more than PO3 verb. Therefore the correlation is high (3)
PO5: Apply (L3)
CO5 Action verb is more than PO5 verb. Therefore the correlation is high (3)

Course Code	Year & Sem	Introduction to Reinforcement Learning (Professional Elective - I)	L	T	P	C
23APE3304	III-I		2	1	0	3

Course Outcomes:
After studying the course, student will be able to
CO1: Understand the fundamentals of Reinforcement Learning, including agent-environment interaction, rewards, returns, and value functions.
CO2: Apply the dynamic Programming and Monte Carlo techniques to evaluate and improve policies for decision-making problems.
CO3: **Evaluate** the temporal-Difference learning methods such as TD (0), SARSA, Q-Learning, Expected SARSA, n-step returns, and TD (λ) for value function estimation in reinforcement learning.
CO4: Apply the function approximation and deep learning methods, such as DQNs, to solve large-scale or complex RL problems.
CO5: Create the optimize policy-based reinforcement learning algorithms using policy gradient and Actor-Critic architectures.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The fundamentals of Reinforcement Learning including agent-environment interaction, rewards, returns, and value functions			L2
CO2	Apply	Dynamic Programming and Monte Carlo techniques		to evaluate and improve policies for decision-making problems	L3
CO3	Evaluate	Temporal-Difference learning methods such as TD(0), SARSA, Q-Learning, Expected SARSA, n-step returns, and TD(λ)		for value function estimation in reinforcement learning.	L5
CO4	Analyze	the function approximation and deep learning methods, such as DQNs,		to solve large-scale or complex RL problems.	L4
CO5	Create	the optimize policy-based reinforcement learning algorithms	using policy gradient and Actor-Critic architectures.		L6

UNIT – I	Introduction to Reinforcement Learning	

Introduction to Machine Learning and RL, Agent-environment interface, Goals and rewards, Returns: episodic and continuing tasks, Markov Decision Processes (MDP), Value functions: state-value and action-value functions.

UNIT – II	Dynamic Programming and Monte Carlo Methods	

Policy evaluation and improvement, Policy iteration and value iteration, Generalized policy iteration, Monte Carlo prediction and control, On-policy and off-policy MC methods.

UNIT – III	Temporal-Difference Learning and Eligibility Traces	

TD Prediction (TD(0)), SARSA and Q-Learning, Expected SARSA, n-step returns, Eligibility traces, TD(λ) methods.

UNIT – IV	Function Approximation and Deep RL	

Linear and non-linear function approximation, Feature construction, Deep Q Networks (DQN), Experience replay and fixed Q-targets, Double DQN and Dueling DQN, Challenges in deep RL

UNIT – V	Policy Gradient and Actor-Critic Methods	

Policy gradient theorem, REINFORCE algorithm, Variance reduction techniques, Actor-Critic architecture, Proximal Policy Optimization (PPO), Applications in Robotics and Games

Textbooks:

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", 2nd Edition, MIT Press, 2018. (Free online at http://incompleteideas.net/book/the-book2nd.html)

Reference Books:

1. Csaba Szepesvári, "Algorithms for Reinforcement Learning", Morgan & Claypool, 2010.
2. Marco Wiering and Martijn van Otterlo, "Reinforcement Learning: State-of-the-Art", Springer, 2012.
3. David Silver, Reinforcement Learning Lecture Series, University College London (UCL).
4. François-Lavet et al., "An Introduction to Deep Reinforcement Learning", Foundations and Trends® in Machine Learning, 2018.

Mapping of course outcomes with program outcomes

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

Correlation matrix:

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Corre lation	Co's Action verb	BT L			
1				Understand	L2	PO1 PO2 PO7 PO11	PO1:Apply(L3) PO2:Identify(L3) PO7:Thumb rule PO11: Thumb rule	2 2 3 1
2				Apply	L3	PO1 PO2 PO3 PO4 PO5 PO6	PO1:Apply(L3) PO2:Identify(L3) PO3: Design(L6) PO4:Analyze(L4) PO5:Apply(L3) PO6:Thumb rule	3 3 1 1 3 3
3				Evaluate	L5	PO2 PO3 PO4 PO5 PO10	PO2: Identify(L3) PO3:Formulate(L6) PO4: Analyze(L4) PO5:Create(L6) PO10:Thumb rule	1 2 2 1 1
4				Analyze	L4	PO1 PO2 PO3 PO4	PO1: Apply(L3) PO2: Analyze(L4) PO3: Design(L6) PO4: Analyze(L4)	2 3 1 3
5				Create	L6	PO1 PO3 PO5 PO6 PO8 PO10	PO1: Apply(L3) PO3: Design(L6) PO5: Create(L6) PO6: Thumb rule PO8: Thumb rule PO10: Thumb rule	3 3 3 3 3 3

Justification Statements:

CO1: Understand the fundamentals of Reinforcement Learning, including agent-environment interaction, rewards, returns, and value functions.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO2: Identify (L3)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)
PO7: Thumb rule
The agent takes actions within the environment, and the environment responds with rewards and new states. The agent's goal is to maximize its cumulative returns over time. Therefore the correlation is high (3)

> **PO11: Thumb rule**
> The value functions estimate the long-term desirability of states or state-action pairs.
Therefore the correlation is low (1).

CO2: Apply the dynamic Programming and Monte Carlo techniques to evaluate and improve policies for decision-making problems.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Identify (L3)
CO2 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
PO3: Design (L6)
CO1 Action verb is less than PO3 verb by two levels. Therefore the correlation is low (1)
PO4: Analyze (L4)
CO1 Action verb is less than PO4 verb by one level. Therefore the correlation is low (1)
PO5: Apply (L3)
CO2 Action verb is same level as PO5 verb. Therefore the correlation is high (3)
PO6: Thumb rule
Dynamic programming (DP) and Monte Carlo (MC) methods are both used in reinforcement learning, but they differ in their approach to learning. Therefore the correlation is high (3).

CO3: **Evaluate** the temporal-Difference learning methods such as TD (0), SARSA, Q-Learning, Expected SARSA, n-step returns, and TD (λ) for value function estimation in reinforcement learning.
Action Verb: Evaluate (L5)
PO2: Identify (L3)
CO3 Action verb is more than PO2 verb. Therefore the correlation is low (1)
PO3: Formulate (L6)
CO3 Action verb less than PO3 verb by two levels . Therefore the correlation is moderate (2)
PO4: Analyze (L4)
CO3 Action verb is more than PO4 verb. Therefore the correlation is moderate (2)
PO5: Create (L6)
CO3 Action verb less than PO5 verb by two levels .Therefore the correlation is low (1)
PO10: Thumb rule

State-Action-Reward-State-Action. It's an on-policy method that updates the action-value function based on the actual action taken by the agent, the reward received, and the next action the agent takes. Therefore the correlation is low (1)

CO4: Apply the function approximation and deep learning methods, such as DQNs, to solve large-scale or complex RL problems.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO4 Action verb is greater than PO1 verb. Therefore the correlation is moderate (2)
PO2: Analyze (L4)
CO4 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
PO3: Design (L6)
CO4 Action verb is less thanPO3 verb by two levels. Therefore the correlation is low (1)

PO4: Analyze (L4)
CO4 Action verb is same as PO4 verb. Therefore the correlation is high (3)

CO5: Create the optimize policy-based reinforcement learning algorithms using policy gradient and Actor-Critic architectures.
Action Verb: Create(L6)
PO1 Verb: Apply (L3)
CO5 Action verb is greater than PO1 verb. Therefore the correlation is high (3)
PO3 Verb: Design (L6)
CO5 Action verb is same as PO3 verb. Therefore the correlation is high (3)
PO5 Verb: Create(L6)
CO5 Action verb is same as PO5 verb. Therefore the correlation is high (3)
PO6 Verb: Thumb rule
Instead of learning a value function to evaluate states or state-action pairs, policy-based methods directly adjust the policy parameters to maximize cumulative reward. Therefore the correlation is high (3).
PO8 Verb: Thumb rule
The policy is typically represented by a parameterized function and the algorithm optimizes these parameters. Therefore the correlation is high (3).
PO10 Verb: Thumb rule
In an actor-critic setup, the actor might be updated based on the error calculated by the critic, guiding the actor to choose better actions. Therefore the correlation is high (3).

Course Code	Year & Sem	English For Competitive Examinations (Open Elective-1)	L	T	P	C
23AOE9915	III-I		2	1	0	3

Course Outcomes (CO)

Student will be able to	
CO1	Understand the basics of English grammar to develop proficiency in language skills.
CO2	Apply the grammatical structures in sentences for an effective communication
CO3	Apply the use of various concepts in grammar and vocabulary in everyday use and competitive exams
CO4	Analyze unfamiliar passages to draw logical conclusions, thereby enhancing reading comprehension and vocabulary skills
CO5	Create effective writing forms like essays and precise writing by using grammar and structure rules

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the basics of English grammar to develop proficiency in language skills.			L2
2	**Apply**	the grammatical structures in sentences for an effective communication			L3
3	**Analyze**	the use of various concepts in grammar and vocabulary in everyday use and competitive exams		in everyday use and competitive exams	L3
4	**Understand**	Analyze unfamiliar passages to draw logical conclusions, thereby enhancing reading comprehension and vocabulary skills			L4
5	**Evaluate**	effective writing forms like essays and precise writing by using grammar and structure rules.	by using grammar and structure rules.		L6

UNIT - I	GRAMMAR-1	9 Hrs

Nouns-classification-errors-Pronouns-types-errors-Adjectives-types-errors-Articles-definite-indefinite-
Degrees of Comparison-Adverbs-types- errors-Conjunctions-usage-
repositions-usage-Tag Questions, types-identifying errors- Practice

UNIT - II	GRAMMAR-2	9 Hrs

Verbs-tenses- structure-usages- negatives- positives- time adverbs-Sequence of tenses--If Clause-Voice-active voice and passive voice- reported Speech-Agreement- subject and verb-Modals-Spotting Errors-Practices

UNIT - III	VERBAL ABILITY	9 Hrs

Sentence completion-Verbal analogies-Word groups-Instructions-Critical reasoning-Verbal deduction-
Select appropriate pair-Reading Comprehension-Paragraph-Jumbles-Selecting the proper statement by reading a given paragraph.

UNIT - IV	READING COMPREHENSION AND VOCUBULARY	9 Hrs

Competitive Vocabulary :Word Building – Memory techniques-Synonyms, Antonyms, Affixes-Prefix &Suffix-One word substitutes-Compound words-Phrasal Verbs-Idioms and Phrases-Homophones-Linking Words-Modifiers-Intensifiers - Mastering Competitive Vocabulary- Cracking the unknowing passage-speed reading techniques- Skimming & Scanning-types of answering–Elimination methods

UNIT - V	WRITING FOR COMPETITIVE EXAMINATIONS	9 Hrs

Punctuation- Spelling rules- Word order-Sub Skills of Writing- Paragraph meaning-salient features-types - Note-making, Note-taking, summarizing-precise writing- Paraphrasing-Expansion of proverbs-Essay writing-types

Textbooks:

1.Wren & Martin, English for Competitive Examinations, S.Chand & Co, 2021
2.Objective English for Competitive Examination, Tata McGraw Hill, New Delhi, 2014.

Reference Books:

1.Hari Mohan Prasad, Objective English for Competitive Examination, Tata McGraw Hill, New Delhi, 2014.
2.Philip Sunil Solomon, English for Success in Competitive Exams, Oxford 2016
3.Shalini Verma , Word Power Made Handy, S Chand Publications
4.Neira, Anjana Dev & Co. Creative Writing: A Beginner's Manual. Pearson Education India, 2008.
5.Abhishek Jain,Vocabulary Learning Techniques Vol.I&II,RR Global Publishers 2013.
6.Michel Swan, Practical English Usage,Oxford,2006.

Online Learning Resources:

1.https://www.grammar.cl/english/parts-of-speech.html
2.https://academicguides.waldenu.edu/writingcenter/grammar/partsofspeech
3.https://learnenglish.britishcouncil.org/grammar/english-grammar-reference/active- passive-voice
4.https://languagetool.org/insights/post/verb-tenses/
5.https://www.britishcouncil.in/blog/best-free-english-learning-resources-british-council
https://www.careerride.com/post/social-essays-for-competitive-exams-586.aspx

Mapping of course outcomes with program outcomes

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

(*3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated)

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
1	CO1: Understand			Thumb Rule	
2	CO2: Apply			Thumb Rule	
3	CO3: Analyze			Thumb Rule	
4	CO4: Apply			Thumb Rule	
5	CO5: Evaluate			Thumb Rule	

Justification Statements:

CO1: Understand the basics of English grammar to develop proficiency in language skills.
Action Verb: Understand (L2)
CO1 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).

CO2: Apply the grammatical structures in sentences for an effective communication.
CO2 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2)

CO3: Apply the use of various concepts in grammar and vocabulary in everyday use and competitive exams
CO3 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

CO4: Analyze unfamiliar passages to **draw** logical conclusions, thereby **enhancing** reading comprehension and vocabulary skills
Action Verb: Analyze (L4)
CO4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).

CO5: Create effective writing forms like essays and precise writing by using grammar and structure rules.
Action Verb: Create(L6)
CO5 Action Verb Create is of BTL 6. Using Thumb rule, L5 correlates PO6 to PO11 as high (3).

Course Code	Year & Sem	DL & NLP LAB	L	T	P	C
23APC3304	III-I	*(Professional Core)*	0	0	3	1.5

COURSE OUTCOMES:

After studying the course, student will be able to

CO1: Apply the supervised and unsupervised DL algorithms on various datasets.

CO2: Analyze the textual data for NLP applications.

CO3: Create the machine learning pipelines using tools like scikit-learn and NLP libraries.

CO4: Create the basic NLP applications such as chatbots, sentiment analyzers, and translators.

CO5: Evaluate the models using appropriate metrics and improve them using tuning techniques.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	the supervised and unsupervised ML algorithms		on various datasets.	L3
CO2	Analyze	the textual data		For NLP applications.	L4
CO3	Create	he machine learning pipelines		using tools like scikit-learn and NLP libraries.	L6
CO4	Create	the basic NLP applications		such as chatbots, sentiment analyzers, and translators.	L6
CO5	Evaluate	the models		using appropriate metrics and improve them using tuning techniques.	L5

List of Experiments

1. Implement a basic Perceptron using Python and classify binary data.
2. Build and train a Multilayer Perceptron (MLP) using TensorFlow/Keras on the MNIST dataset.
3. Experiment with different activation functions (ReLU, sigmoid, tanh) and observe effects on learning.
4. Implement Convolutional Neural Networks (CNN) for image classification on CIFAR-10 dataset.
5. Implement Recurrent Neural Networks (RNN) and LSTMs for sentiment analysis on IMDB dataset.
6. Evaluate model using metrics such as precision, recall, F1-score, ROC curves.
7. Preprocess textual data: Tokenization, Lemmatization, Stopword removal.
8. Build a Naïve Bayes classifier for SMS/email spam detection.
9. Implement a sentiment analysis model using logistic regression.
10. Apply TF-IDF and Bag of Words on a corpus and analyze vector results.
11. Implement Word2Vec/GloVe embeddings for text similarity tasks.
12. Develop a basic chatbot using NLTK / Transformers (e.g., BERT).
13. Train a Bi-LSTM for sequence labeling tasks (e.g., POS tagging).
14. Mini Project: Build and deploy a full-stack NLP application.

Software/Tools Required:

Python (3.7+), Jupyter Notebook/Google Colab

Libraries: scikit-learn, pandas, NumPy, NLTK, spaCy, gensim, TensorFlow/Keras, Hugging Face Transformers

IDE: VS Code or Jupyter Lab

Online platforms (optional): Hugging Face Spaces, Colab, Kaggle.
Textbooks & Reference Books:
Jurafsky & Martin, Speech and Language Processing, 3rd Edition Draft, Pearson.
Steven Bird, Ewan Klein, and Edward Loper, Natural Language Processing with Python, O'Reilly.
Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly, 2022.
Sebastian Raschka, Python Machine Learning, Packt Publishing.
Delip Rao and Brian McMahan, Natural Language Processing with PyTorch, O'Reilly.

Mapping of course outcomes with program outcomes

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

Correlation Matrix

Unit No.	CO						Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan (Hrs)	%	Correlation	Co's Action verb		BTL			
1				CO1:Apply		L3	PO1 PO2	PO1: Apply(L3) PO2: Identify(L3)	3 3
2				CO2:Analyze		L4	PO1 PO2 PO4 PO11	PO1: Apply(L3) PO2: Identify (L3) PO4: Analyze (L4) PO11: Thumb rule	2 2 3 1
3				CO3:Create		L6	PO1 PO2 PO4	PO1: Apply(L3) PO2: Analyze (L4) PO4: Analysis (L4)	1 1 1
4				CO4:Create		L6	PO1 PO2 PO4 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO3: Analysis(L4) PO11: Thumb rule	3 2 2 2
5				CO5:Evaluate		L5	PO1 PO2 PO4 PO11	PO1: Apply(L3) PO2: Identify(L3) PO3: Analysis(L4) PO11: Thumb rule	1 1 2 2

Justification Statements:

CO1: Apply the supervised and unsupervised DL algorithms on various datasets.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
    CO1 Action verb is same as PO1 verb . Therefore, the correlation is High (3)
PO2 Verb: Identify (L3)
    CO1 Action verb is same as PO2 verb. Therefore, the correlation is High (3)

CO2: Analyze the textual data for NLP applications.

Action Verb: Analyze (L4)
PO1: Apply (L3)
   CO2 Action verb is same level as PO1 verb. Therefore, the correlation is medium (2)
PO2: Identify (L3)
   CO2 Action verb is same level as PO2 verb. Therefore, the correlation is medium (2)
PO4: Analyze (L4)
   CO2 Action verb is same as PO4 verb . Therefore, the correlation is High (3)
PO12: Thumb rule
 For use some training NLP models. Therefore, the correlation is low (1)

CO3: Create the machine learning pipelines using tools like scikit-learn and NLP libraries.
Action Verb: Creating (L6)
PO1: Apply (L3)
   CO3 Action verb is less than PO1 verb by two level. Therefore, the correlation is low (1)
PO2: Analyze (L4)
   CO3 Action verb is less than PO2 verb by two level. Therefore, the correlation is low (1)
PO4: Analysis (L4)
   CO3 Action verb is less than PO4 verb by two level. Therefore, the correlation is low (1)

CO4: Create the basic NLP applications such as chatbots, sentiment analyzers, and translators.
Action Verb: Creating (L6)
PO1: Apply(L3)
   CO4 Action verb is less than PO1 verb by two levels. Therefore, the correlation is medium (2)
PO2: Identify (L3)
   CO4 Action verb is less than PO2 verb by two levels. Therefore, the correlation is medium (2)
PO3: Design (L6)
   CO4 Action verb is same as PO3 verb by . Therefore, the correlation is high (3)
PO4: Analysis (L4)
   CO4 Action verb is less than PO4 verb by two level. Therefore, the correlation is medium (2)
PO11: Thumb rule
   For use the NLP models and tools life long learning. Therefore, the correlation is medium (2)

CO5: Evaluate the models using appropriate metrics and improve them using tuning techniques.
Action Verb: Evaluate (L5)
PO1: Apply(L3)
   CO5 Action verb is less than PO1 verb by two levels. Therefore, the correlation is low(1)
PO2: Identity (L3)
   CO5 Action verb is less than PO2 verb by two levels. Therefore, the correlation is low(1)
PO4: Analysis (L4)
   CO5 Action verb is less than PO4 verb by one levels. Therefore, the correlation is medium (2)
PO12: Thumb rule
   For use to Natural language processing is the life long learning techniques . Therefore, the correlation is medium (2)

Course Code	Year & Sem	DATA WRANGLING LAB	L	T	P	C
23APC3306	III-I	(Professional Core)	0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: Apply data cleaning operations using Python and related libraries.

CO2: Evaluate missing, duplicate, and inconsistent data in real-world datasets.

CO3: Analyze Integrate and transform data from heterogeneous sources.

CO4: Apply exploratory analysis and reshape datasets as per analytical needs.

CO5: Apply preprocessing techniques to make data suitable for machine learning models

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	data cleaning operations	using Python and related libraries.		L3
CO2	Evaluate	missing, duplicate, and inconsistent data in real-world datasets.			L5
CO3	Analyze	Integrate and transform data from heterogeneous sources.			L4
CO4	Apply	exploratory analysis and reshape datasets as per analytical needs.			L3
CO5	Apply	preprocessing techniques		to make data suitable for machine learning models.	L3

List of Experiments (with Cognitive Levels):

1. Load and explore datasets using Pandas: Shape, info, describe, data types
2. Handle missing data using techniques: fillna, dropna, interpolation
3. Detect and remove duplicate and inconsistent records in real datasets
4. Data type conversions and formatting (e.g., date time parsing, string manipulation)
5. Merge, join, and concatenate multiple datasets
6. Normalize and standardize numerical features using sklearn
7. Apply label encoding and one-hot encoding to categorical variables
8. Perform data binning, transformation, and discretization
9. Web scraping using BeautifulSoup or Selenium to extract tabular data
10. Read and write data using CSV, Excel, JSON, and SQLite/SQLAlchemy
11. Visualize data quality and outliers using seaborn/matplotlib
12. Mini Project: Real-world data wrangling and cleaning pipeline for an open dataset

Software/Tools Required:

• Python (3.7+), Jupyter Notebook / Google Colab

- pandas, NumPy, seaborn, matplotlib
- scikit-learn (for preprocessing utilities)
- BeautifulSoup, requests, Selenium (for web scraping)
- SQLAlchemy / SQLite (for basic data import/export)

Textbooks & Reference Books:
- Wes McKinney, Python for Data Analysis, 3rd Edition, O'Reilly, 2022
- Hadley Wickham, R for Data Science (for concepts, applicable to Python too)
- Jake VanderPlas, Python Data Science Handbook, O'Reilly
- Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly
- Joel Grus, Data Science from Scratch, O'Reilly

Mapping of course outcomes with program outcomes

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

Correlation matrix

Unit No.	CO						Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				Apply	L3	PO4	PO4: Analyze (L4)	2
						PO5	PO5: Apply(L3)	3
						PO6	PO6:Thumb rule	2
2				Evaluate	L5	PO4	PO4: Analyze (L4)	2
						PO5	PO5: Apply(L3)	1
						PO6	PO6:Thumb rule	3
3				Analyze	L4	PO4	PO4: Analyze (L4)	3
						PO5	PO5: Apply(L3)	2
						PO6	PO6:Thumb rule	3
4				Apply	L3	PO4	PO4: Analyze (L4)	2
						PO5	PO5: Apply(L3)	3
						PO6	PO6:Thumb rule	3
5				Apply	L3	PO4	PO4: Analyze (L4)	2
						PO5	PO5: Apply(L3)	2
						PO6	PO6:Thumb rule	2
						PO11	PO11: Thumb rule	3

Justification Statements:

CO1: Apply data cleaning operations using Python and related libraries.
Action Verb: Apply **(L3)**
PO4: Analyze (L4)
CO1 Action verb is greater than PO4 verb by one level. Therefore the correlation is moderate (2)

PO5: Apply(L3)

CO1 Action verb is same PO5 verb level. Therefore the correlation is high (3)

PO6: Thumb rule

Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to health, safety. Therefore the correlation is moderate (3)

CO2: Evaluate missing, duplicate, and inconsistent data in real-world datasets.

Action Verb: Create (L6)

PO4: Analyze (L4)

CO1 Action verb is greater than PO4 verb by two levels. Therefore the correlation is moderate (1)

PO5: Apply(L3)

CO1 Action verb is greater than PO5 verb by three levels. Therefore the correlation is moderate (1)

PO6: Thumb rule

Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to health, safety. Therefore the correlation is high (3)

CO3: Analyze Integrate and transform data from heterogeneous sources.

Action Verb: Apply (L3)

PO4: Analyze (L4)

CO1 Action verb is less than PO4 verb by one level. Therefore the correlation is moderate (2)

PO5: Apply(L3)

CO1 Action verb is same PO5 verb level. Therefore the correlation is high (3)

PO6: Thumb rule

Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to health, safety. Therefore the correlation is moderate (2)

CO4: Apply exploratory analysis and reshape datasets as per analytical needs.

Action Verb: Apply (L3)

PO4: Analyze (L4)

CO1 Action verb is less than PO4 verb by one level. Therefore the correlation is moderate (2)

PO5: Apply(L3)

CO1 Action verb is same PO5 verb level. Therefore the correlation is high (3)

PO6: Thumb rule

Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to health, safety. Therefore the correlation is moderate (2)

CO5: Apply preprocessing techniques to make data suitable for machine learning models.

Action Verb: Analyze **(L4)**

PO4: Analyze (L4)

CO1 Action verb is same PO4 verb level. Therefore the correlation is high (3)

PO5: Apply(L3)

CO1 Action verb is greater than PO5 verb by one level. Therefore the correlation is moderate (2)

PO6: Thumb rule

Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to health, safety. Therefore the correlation is high (3)

PO011: Thumb rule

The preparation and ability for independent and life-long learning, adaptability to new and emerging technologies and critical thinking in the broadest context of technological change. Therefore the correlation is high (3)

Course Code	Year & Sem	Soft Skills	L	T	P	C
23ASC9901	**III-I**		**1**	**0**	**2**	**2**

Course Outcomes:

Pre-Requisites	SOFT SKILLS	Semester	**II**

Course Outcomes (CO): Student will be able to

CO1: Understand the various techniques of soft skills and communication skills.
CO2: Analyze the listening and thinking skills to enhance professional development.
CO3: Apply the critical thinking skills in problem solving and decision making through Discussions.
CO4: Evaluate the emotional intelligence and stress management for individuals and groups.
CO5: Apply the corporate etiquette atmosphere to enhance professional behavior in workplace environment.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the various techniques of soft skills and communication skills.			**L2**
2	Analyze	the listening and thinking skills to enhance professional development.			**L4**
3	Apply	the critical thinking skills in problem solving and decision making through Discussions .			**L3**
4	Evaluate	the emotional intelligence and stress management to control in themselves and others.			**L5**
5	Apply	the corporate etiquette atmosphere to enhance processional behavior in workplace environment.			**L3**

UNIT I   Soft Skills & Communication Skills

 Soft Skills - Introduction, Need - Mastering Techniques of Soft Skills – Communication Skills - Significance, process, types - Barriers of communication - Improving techniques.

Activities:
Intrapersonal Skills- Narration about self- strengths and weaknesses- clarity of thought – self-expression – articulating with felicity.
(The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes and literary sources)
Interpersonal Skills- Group Discussion – Debate – Team Tasks - Book and film Reviews by groups - Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.
Verbal Communication- Oral Presentations- Extempore- brief addresses and speeches- convincing-negotiating- agreeing and disagreeing with professional grace.
Non-verbal communication – Public speaking – Mock interviews – presentations with an objective to identify non- verbal clues and remedy the lapses on observation.

UNIT II   Critical Thinking

Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking - Positive thinking - Reflection

Activities:
Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues –placing the problem – finding the root cause - seeking viable solution – judging with rationale –

evaluating the views of others - Case Study, Story Analysis

UNIT III Problem Solving & Decision Making
Meaning & features of Problem Solving – Managing Conflict – Conflict resolution – Team building - Effective decision making in teams – Methods & Styles

Activities:
Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision.
Case Study & Group Discussion

UNIT IV Emotional Intelligence & Stress Management
Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips

Activities:
Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations.
Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation, Organizing Debates

UNIT V Corporate Etiquette
Etiquette- Introduction, concept, significance - Corporate etiquette - meaning, modern etiquette, benefits - Global and local culture sensitivity - Gender Sensitivity - Etiquette in interaction- Cell phone etiquette - Dining etiquette - Netiquette - Job interview etiquette -Corporate grooming tips -Overcoming challenges

Activities
Providing situations to take part in the Role Plays where the students will learn about bad and good manners and etiquette - Group Activities to showcase gender sensitivity, dining etiquette etc. - Conducting mock job interviews - Case Study - Business Etiquette Games

Prescribed Books:
1. Mitra Barun K, Personality Development and Soft Skills, Oxford University Press, Pap/Cdr edition 2012
2. Dr Shikha Kapoor, Personality Development and Soft Skills: Preparing for Tomorrow, I K International Publishing House, 2018

Reference Books:
1. Sharma, Prashant, Soft Skills: Personality Development for Life Success, BPB Publications 2018.
2. Alex K, Soft Skills S.Chand & Co, 2012 (Revised edition)
3. Gajendra Singh Chauhan & Sangeetha Sharma, Soft Skills: An Integrated Approach to Maximise Personality Published by Wiley, 2013
4. Pillai, Sabina & Fernandez Agna, Soft Skills and Employability Skills, Cambridge University Press, 2018
5. Soft Skills for a Big Impact (English, Paperback, Renu Shorey) Publisher: Notion Press
6. Dr. Rajiv Kumar Jain, Dr. Usha Jain, Life Skills (Paperback English) Publisher : Vayu Education of India, 2014

Online Learning Resources:
1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ
3. https://youtu.be/-Y-R9hDl7lU
4. https://youtu.be/gkLsn4ddmTs
5. https://youtu.be/2bf9K2rRWwo
6. https://youtu.be/FchfE3c2jzc

7. https://www.businesstrainingworks.com/training-resource/five-free-business-etiquette-training-games/
8. https://onlinecourses.nptel.ac.in/noc24_hs15/preview
9. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

Correlation of COs with the POs & PSOs for B.Tech

Course Title	Course Outcomes COs	Programme Outcomes(POs)											
		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12
Soft Skills Lab	CO1										2		
	CO2									3	3		
	CO3									2			
	CO4									3			
	CO5									2	2		

*3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO6to PO12)	Level of Correlation (0-3)
	(Approx. Hrs)	%	corr	Verb	BTL			
1			CO1	**UNDERSTAND**	L2	PO10	Thumb rule	2
2			CO2	**ANALYZE**	L4	PO9, PO10	Thumb rule	3,3
3			**CO3**	**APPLY**	L3	PO9	Thumb rule	2
4			**CO4**	**EVALUATE**	L5	PO9	Thumb rule	3
5			**CO5**	**Apply**	L3	PO9, PO10	Thumb rule	2,2

CO1: Understand the various techniques of soft skills and communication skills.
Action Verb: Understand (L2)
CO1 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).
CO2: Analyze the listening and thinking skills to enhance professional development.
Action Verb: Analyze **(L4)**
CO2 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO12 as high (3)
CO3: Apply the critical thinking skills in problem solving and decision making through Discussions .
Action Verb: Apply (L3)
CO3 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO12 as moderate (2).
CO4: Evaluate the emotional intelligence and stress management to control themselves and others.
Action Verb: Evaluate **(L5)**
CO4 Action Verb Evaluate is of BTL 5. Using Thumb rule, L2 correlates PO6 to PO12 as high(3).
CO5:Apply the corporate etiquette atmosphere to enhance processional behavior in workplace environment.
Action Verb: Create e (L3)
CO5 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO12 as moderate (2).

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	Tinkering Lab	L	T	P	C
23AES0404	**III-I**		**0**	**0**	**2**	**1**

The aim of tinkering lab for engineering students is to provide a hands-on learning environment where students can explore, experiment, and innovate by building and testing prototypes. These labs are designed to demonstrate practical skills that complement theoretical knowledge.

Course Outcomes: After studying the course, student will be able to
  CO1: Develop arduino/ESP32 programming for basic circuits using breadboard/Tinkercad
  CO2: **Analyze** the LDR interfacing circuits with arduino / ESP32 controllers.
  CO3: **Analyze** the control of traffic light circuit, sensor-based servomotor and mobile app-based LED.
  CO4: Design a walking robot and rocket using 3-Dimensional (3D) printing Technology.
  CO5: **Create** a prototype for soil moisture monitor and redesign a motor bike using Design Thinking steps.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Develop**	Arduino/ESP32 programming for basic circuits	breadboard/Tinkercad		L3
CO2	**Analyze**	The LDR interfacing circuits	Arduino / ESP32		L4
CO3	**Analyze**	The control of traffic light circuit, sensor-based servomotor and mobile app-based LED			L4
CO4	**Design**	A walking robot and rocket	3D Printing Technology		L6
CO5	**Create**	A prototype for soil moisture monitor and redesign a motor bike	Design Thinking steps		L6

These labs bridge the gap between academia and industry, providing students with the practical experience. Some students may also develop entrepreneurial skills, potentially leading to start-ups or innovation-driven careers. Tinkering labs aim to cultivate the next generation of engineers by giving them the tools, space, and mind-set to experiment, innovate, and solve real-world challenges.

List of experiments**:**
  1) Make your own parallel and series circuits using breadboard for any application of your choice. **(CO1)**
  2) Demonstrate a traffic light circuit using breadboard.**(CO3)**
  3) Build and demonstrate automatic Street Light using LDR. **(CO2)**
  4) Simulate the Arduino LED blinking activity in Tinkercad. **(CO1)**
  5) Build and demonstrate an Arduino LED blinking activity using Arduino IDE.(CO1)
  6) Interfacing IR Sensor and Servo Motor with Arduino.(CO3)
  7) Blink LED using ESP32. **(CO1)**
  8) LDR Interfacing with ESP32.**(CO2)**
  9) Control an LED using Mobile App. (CO3)
  10) Design and 3D print a Walking Robot **(CO4)**
  11) Design and 3D Print a Rocket. **(CO4)**
  12) Build a live soil moisture monitoring project, and monitor soil moisture levels of a remote plan in your computer dashboard. (CO5)
  13) Demonstrate all the steps in design thinking to redesign a motor bike. **(CO5)**
Students need to refer to the following links:

Course Outcomes: The students will be able to experiment, innovate, and solve real-world challenges.

1) https://aim.gov.in/pdf/equipment-manual-pdf.pdf
2) https://atl.aim.gov.in/ATL-Equipment-Manual/
3) https://aim.gov.in/pdf/Level-1.pdf
4) https://aim.gov.in/pdf/Level-2.pdf
5) https://aim.gov.in/pdf/Level-3.pdf

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation BTL (0-3)
1	**CO1: Develop**	L3	**PO1** **PO5**	**PO1: Apply(L3**) **PO5: Select(L1)**	3 3
2	**CO2: Analyze**	L4	**PO2** **PO3** **PO5**	**PO2: Review (L3**) **PO3: Develop(L3)** **PO5: Create (L6)**	3 3 1
3	**CO3: Analyze**	L4	**PO3** **PO5** **PO9** **PO10**	**PO3: Design (L6)** **PO5: Create(L6)** **PO9: Thumb rule** **PO10: Thumb rule**	1 1 3 3
4	**CO4: Design**	L6	**PO3** **PO4** **PO5**	**PO3: Analyze(L4)** **PO4: Design(L6)** **PO5: Create(L6)**	3 3 3
5	**CO5: Create**	L6	**PO2** **PO3** **PO5** **PO6** **PO9** **PO10** **PO11**	**PO2: Review(L2)** **PO3: Analyze(L4)** **PO5:Create(L6)** **PO6:Thumb rule** **PO9:Thumb rule** **PO10:Thumb rule** **PO11: Thumb rule**	3 3 3 3 3 3 3

Justification Statements:

CO1: Develop Arduino/ESP32 programming for basic circuits using breadboard/Tinkercad
Action Verb: **Develop (L3)**
PO1 Verb: Apply (L3)
CO1 Action verb is equal as PO1 verb. Therefore, the correlation is high (3)
PO5 Verb: Select (L1)
CO1 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)

CO2: Analyze the LDR interfacing circuits with Arduino / ESP32 controllers.

Action Verb: Analyze (L4)
PO2 Verb: Review (L3)
CO2 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Develop (L3)

CO2 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: Create (L6)
CO2 Action verb is lesser than as PO5 verb by two levels Therefore, the correlation is low (1)

CO3: Analyze the control of traffic light circuit, sensor-based servomotor and mobile app-based LED.
Action Verb: Analyze (L4)
PO3 Verb: Design (L6)
CO3 Action verb is lesser than PO3 verb by two levels. Therefore, the correlation is low (1)
PO5 Verb: Create (L6)
CO3 Action verb is lesser than PO5 verb by two levels Therefore, the correlation is low (1)
PO9: Thumb rule
CO3 using Thumb rule, correlates with PO9 as high (3)
PO10: Thumb rule
CO3 using Thumb rule, correlates with PO10 as high (3)

CO4: Design a walking robot and rocket using 3-Dimensional (3D) printing Technology.

Action Verb: Design (L6)
PO3 Verb: Analyze (L4)
CO4 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO4 Verb: Design (L6)
CO4 Action verb is equal to PO4 verb. Therefore, the correlation is high (3)
PO5 Verb: Create (L6)
CO4 Action verb is equal to as PO5 verb. Therefore, the correlation is high (3)

CO5: Create a prototype for soil moisture monitor and redesign a motor bike using Design Thinking steps
Action Verb: Create (L6)

PO2 Verb: Review (L2)
CO5 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Analyze (L4)
CO5 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: Create (L6)
CO5 Action verb is equal to PO5 verb. Therefore, the correlation is high (3)
PO6 Verb: Thumb rule
CO5 using Thumb rule, correlates with PO6 as high (3)
PO9: Thumb rule
CO5 using Thumb rule, correlates with PO9 as high (3)
PO10: Thumb rule
CO5 using Thumb rule, correlates with PO10 as high (3)
PO11: Thumb rule
CO5 using Thumb rule, correlates with PO11 as high (3)

B. Tech - ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
(Effective for the batches admitted from 2023-24)
B.Tech III Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P	C			
1	PC	23APC3308	Advanced Machine Learning	2	1	0	3	30	70	100
2	PC	23APC3309	Explainable AI & Model Interpretability	2	1	0	3	30	70	100
3	PC	23APC3311	AI for Edge Computing	2	1	0	3	30	70	100
4	PE-II	23APE3305 23APE3306 23APE3307 23APE3308	1.Graph Neural Networks 2.Recommender Systems 3.Predictive Analytics 4.Big Data	2	1	0	3	30	70	100
5	PE-III	23APE3309 23APE3310 23APE3311 23APE3312	5.Quantum Computing 6.Computer Vision 7.Social Network Analysis 8.Applied Machine Learning	2	1	0	3	30	70	100
6	OE-II		OPEN ELECTIVE-II	2	1	0	3	30	70	100
7	PC	23APC3310	ML Model Optimization Lab	0	0	3	1.5	30	70	100
8	PC	23APC3312	Edge Computing Lab	0	0	3	1.5	30	70	100
9	SC	23ASC3301	Full Stack Development-II	1	0	2	2	30	70	100
10	MC	23AMC9902	Technical Paper Writing & IPR	0	0	0	-	30	-	30
11	SC	23ASC3302	**Workshop**	-	-	-	-	-	-	-
			Total	15	6	8	23	300	630	930

Open Elective – II

S NO	Course Code	Course Name	Offered by the Dept.
1	23AOE0103	Disaster Management	CIVIL
2	23AOE0104	Sustainability In Engineering Practices	
3	23AOE0202	Renewable Energy Sources	EEE
4	23AOE0302	Automation and Robotics	ME
5	23AOE0402	Digital Electronics	ECE
6	23AOE9902	Advanced Operations Research	Mathematics
7	23AOE9907	Physics Of Electronic Materials And Devices	Physics
8	23AOE9912	Chemistry Of Polymers And Applications	Chemistry
9	23AOE9916	Academic Writing and Public Speaking	Humanities
10	23AOE9903	Mathematical Foundation of Quantum Technologies	Mathematics

Course Code	Year & Sem	ADVANCED MACHINE LEARNING	L	T	P	C
23APC3308	III-II	(Professional Core)	2	1	0	3

Course Outcomes

After studying the course, student will be able to

CO1: Understand ensemble methods like bagging, boosting, stacking, regularization for ML model improvement.

CO2: Analyze SVMs for classification, regression, and dimensionality reduction using custom and standard kernel.

CO3: Apply Expectation Maximization and variational inference for learning Bayesian tasks.

CO4: Analyze HMMs, CRFs, clustering, and autoencoders for structured and unsupervised learning tasks.

CO5: Apply optimization and deep generative models like VAEs, GANs, and reinforcement learning in advanced AI applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	ensemble learning methods like bagging, boosting, stacking, and regularization		for ML model improvement	L2
CO2	**Analyze**	SVMs for classification, regression, and dimensionality reduction using custom and standard kernel.			L4
CO3	**Apply**	EM and variational inference		for learning Bayesian tasks	L3
CO4	**Analyze**	HMMs, CRFs, clustering, and autoencoders		for structured and unsupervised learning tasks	L4
CO5	**Apply**	optimization techniques and deep generative models like VAEs, GANs, and reinforcement learning in advanced AI applications			L3

UNIT – I	Ensemble Learning and Model Generalization	

Bias-Variance Trade-off Revisited, Bagging and Bootstrap Aggregating, Random Forests – Theory and Implementation, Boosting Techniques – AdaBoost, Gradient Boosting, XGBoost and LightGBM, Stacking and Blending of Models, Regularization Methods – L1, L2, Dropout, Early Stopping and Cross-Validation Strategies.

UNIT – II	Kernel Methods and Support Vector Machines	

Linear and Non-linear Classification, Kernel Trick – Polynomial, RBF, and Custom Kernels, Soft Margin SVMs, Dual Form and Optimization of SVM, Support Vector Regression, Kernel PCA for Non-linear Dimensionality Reduction, Practical Issues with Kernel Methods, Applications in Text and Image Classification

UNIT – III	Probabilistic Graphical Models and Bayesian Learning	

Introduction to Probabilistic Graphical Models, Bayesian Networks – Construction and Inference, Markov Random Fields (MRFs), Conditional Random Fields (CRFs), Expectation-Maximization (EM) Algorithm, Variational Inference, Bayesian Linear Regression, Gaussian Processes for Regression and Classification

UNIT – IV	Structured Prediction and Unsupervised Learning	

Hidden Markov Models (HMMs) and Sequence Modeling, Structured SVMs and CRFs, Clustering Revisited – Hierarchical and Spectral Methods, Dimensionality Reduction – ICA, t-SNE, UMAP,
Matrix Factorization and Collaborative Filtering, Autoencoders and Variational Autoencoders (VAEs), Clustering

Evaluation Metrics, Advanced Use Cases in NLP and Computer Vision.

UNIT – V	Optimization and Deep Generative Models	

Convex vs. Non-convex Optimization, Gradient Descent Variants – SGD, Adam, RMSProp, Deep Generative Models – VAEs and GANs, Conditional GANs and StyleGANs, Reinforcement Learning Introduction, Policy Gradient Methods, Generative Pre-trained Transformers (GPT) Overview, Advanced Topics – Meta Learning, Few-shot Learning.

Textbooks:
1. ―Pattern Recognition and Machine Learning‖ by Christopher M. Bishop
2. ―Machine Learning: A Probabilistic Perspective‖ by Kevin P. Murphy
3. ―Deep Learning‖ by Ian Goodfellow, Yoshua Bengio, and Aaron Courville

Reference Books:
1. ―Understanding Machine Learning: From Theory to Algorithms‖ by Shai Shalev-Shwartz and Shai Ben-David
2. ―The Elements of Statistical Learning‖ by Trevor Hastie, Robert Tibshirani, and Jerome Friedman
3. ―Bayesian Reasoning and Machine Learning‖ by David Barber
   4. Recent IEEE Transactions and ACM journals on ML

Mapping of course outcomes with program outcomes

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

Correlation Matrix:

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				Understand	L2	PO1 PO2 PO4 PO11	PO1: Apply(L3) PO2: Identify(L3) PO4: Analyze(L4) PO11:Thumb rule	2 2 1 2
2				Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO6	PO1: Apply(L3) PO2: Identify(L3) PO3: Apply (L3) PO4: Analyze (L4) PO5: Apply (L3) PO6: Thumb rule	3 3 3 3 3 3
3				Apply	L3	PO1 PO2 PO3 PO5 PO6 PO10 PO11	PO1: Apply(L3) PO2: Identify (L3) PO3: Design(L6) PO5: Create(L6) PO6: Thumb rule PO10:Thumb rule PO11:Thumb rule	3 3 1 1 2 2 2

4				**Analyze**	**L4**	**PO1** **PO2** **PO3** **PO4** **PO6** **PO11**	**PO1: Apply(L3)** PO2: Formulate (L6) **PO3: Develop (L6)** **PO4: Analyze(L4)** **PO6: Thumb rule** **PO11: Thumb rule**	**3** **1** **1** **3** **3** **3**
5				**Apply**	**L3**	**PO1** **PO2** **PO4** **PO5** **PO6** **PO11**	**PO1: Apply(L3)** PO2: Formulate (L6) **PO4: Analyze(L4)** **PO5: Apply(L3)** **PO6: Thumb rule** **PO11: Thumb rule**	**3** **3** **2** **3** **2** **2**

Justification Statements:

CO1: Understand ensemble methods like bagging, boosting, stacking,regularization for ML model improvement.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO2 Verb: Identify (L3)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)
PO4 verb: Analyze(L4)
CO1 Action verb is less than PO4 verb by two level. Therefore the correlation is moderate (2)
PO11 verb:Thumb rule
Applies model tuning and selection strategies in real-world business scenarios.

CO2: Analyze SVMs for classification, regression, and dimensionality reduction using custom and standard kernel.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO2 Action verb is more than PO1 verb. Therefore the correlation is high (3)
PO2: Identify (L3)
CO2 Action verb is more than PO2 verb. Therefore the correlation is high (3)
PO3: Apply (L3)
CO2 Action verb is more than PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is same as PO4 verb. Therefore the correlation is high(3)
PO5: Apply (L3)
CO2 Action verb is same as PO5 verb. Therefore the correlation is high (3)
PO6: Thumb rule
Recognizes the impact of SVM-based decisions in real-world domains like medical diagnostics or fraud detection.

CO3: : Apply Expectation Maximization and variational inference for learning Bayesian tasks
Action Verb: Apply (L3)
PO1: Apply (L3)
Action verb is same as PO1 verb. Therefore the correlation is high (3)
PO2: Identify (L3)
Action verb is same as PO2 verb. Therefore the correlation is high (3).
PO3: Design (L6)
CO3 Action verb is PO3 verb by three levels. Therefore the correlation is low(1)
PO5: Create (L6)
CO3 Action verb is PO5 verb by three levels. Therefore the correlation is low(1).
PO6: Thumb rule
Awareness of how Bayesian modeling impacts decision-making in real-world systems (e.g., healthcare, finance).
PO10: Thumb rule

Documents and presents probabilistic model design, assumptions, and results effectively.
PO11: Thumb rule
Applies Bayesian decision-making in business or project contexts.

CO4: Analyze HMMs, CRFs, clustering, and autoencoders for structured and unsupervised learning tasks.
Action Verb: Analyze (L4)
PO1:Apply(L3)
CO4 Action verb is more than PO1 verb. Therefore the correlation is high (3)
PO2: Formulate (L6)
CO4 Action verb is less than PO2 verb by two level. Therefore the correlation is moderate (1)
PO3: Develop (L6)
CO4 Action verb is less than PO3 verb by two level. Therefore the correlation is moderate (1)
PO4: Analyze(L4)
CO4 Action verb is same as PO4 verb . Therefore the correlation is high (3)
PO6: Thumb rule
The models studied in this CO have applications in domains like healthcare diagnostics, fraud detection, and language understanding, indirectly impacting societal welfare.
PO11: Thumb rule
The application of clustering and dimensionality reduction helps optimize resources and processes, which supports effective decision-making in projects and business contexts.
CO5: Apply optimization and deep generative models like VAEs, GANs, and reinforcement learning in advanced AI applications.
Action Verb: Apply(L3)
PO1 Verb: Apply (L3)
CO5 Action verb is same as PO1 verb . Therefore the correlation is high (3)
PO2 Verb: Identify (L3)
CO5 Action verb is same as PO2 verb. Therefore the correlation is moderate (3)
PO4: Analyze(L4)
CO5 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate(2)
PO5: Apply(L3)
CO5 Action verb is same as PO1 verb . Therefore the correlation is high (3)
PO6: Thumb rule
Deep generative models and reinforcement learning are used in healthcare (e.g., drug discovery), autonomous systems, and personalized content, impacting societal development.
PO11: Thumb rule Applying optimization and generative AI enables cost-effective automation and innovation in industries such as finance, retail, and creative sectors, linking to resource and project management.

Course Code	Year & Sem	EXPLAINABLE AI & MODEL INTERPRETABILITY	L	T	P	C
23APC3309	III-II		2	1	0	3

Course Outcomes

After studying the course, student will be able to

CO1: Understand the foundations and ethical considerations of Explainable AI.

CO2: Apply the model-specific explainability techniques for interpretable machine learning.

CO3: Analyze model-agnostic explainability methods and evaluate their effectiveness.

CO4: Analyze deep learning interpretability techniques and deep model explanations.

CO5: Evaluate mitigate bias using fairness metrics and XAI tools.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the foundations and ethical considerations of Explainable AI			L2
CO2	Apply	the model-specific explainability techniques		for interpretable machine learning	L3
CO3	Analyze	model-agnostic explainability methods and evaluate their effectiveness			L4
CO4	Analyze	deep learning interpretability techniques and deep model explanations			L4
CO5	Evaluate	mitigate bias	using fairness metrics and XAI tools		L5

UNIT - I	Foundations of Explainable AI	

Introduction to Explainability and Interpretability, Importance of XAI in Healthcare, Finance, and Law , White-box vs Black-box Models, Desiderata: Fairness, Accountability, Transparency, HumanCentered AI and Trust ,Taxonomy of XAI Techniques (Global vs Local, Post-hoc vs Intrinsic), Regulatory and Ethical Implications (GDPR, AI Bill of Rights), Model Simplicity vs Predictive Power

UNIT - II	Model-Specific Explainability Techniques	

Decision Trees and Rule-based Models, Linear Models and Feature Importance, Generalized Additive Models (GAMs), Visualization of Weights and Coefficients, Logistic Regression Coefficient Interpretation, Case Study: Credit Scoring using Transparent Models,Comparison of Interpretable ML Models, Use Cases and Trade-offs.

UNIT - III	Model-Agnostic Explainability Techniques	

Local Interpretable Model-agnostic Explanations (LIME), SHAP Values (SHapley Additive exPlanations), Partial Dependence Plots (PDPs), Individual Conditional Expectation (ICE) Plots,Anchors and Counterfactual Explanations, Feature Interaction and Permutation Importance, Comparative Analysis of SHAP, LIME, PDP, Model Debugging with XAI.

UNIT - IV	Deep Learning Explainability	

Visualizing CNNs: Filters, Feature Maps, Saliency Maps and Grad-CAM, Integrated Gradients, Explaining RNNs and LSTM Outputs, Concept Activation Vectors (TCAV), Attention-based Interpretability in Transformers, Explaining Language Models (BERT, GPT) Evaluation of Deep Model Explanations

UNIT - V	Fairness, Bias & Tools for XAI	

Fairness Metrics: Demographic Parity, Equal Opportunity, Sources of Bias in Data and Models, Discrimination Detection and Mitigation Strategies, Introduction to AIF360, What-If Tool, Fairlearn, Case Study: Bias in Hiring Algorithms, Explainability in ML Pipelines (MLFlow, Skater), XAI in Federated and Privacy-Preserving AI, Designing Interpretable AI Systems from Scratch

Mapping of course outcomes with program outcomes

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

Correlation Matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correl ation	Co's Action verb	BTL			
1				Understand	L2	PO1 PO2 PO3 PO4 PO6 PO7	PO1: Apply(L3) PO2: Identify(L3) PO3: Design(L6) PO4:Analyze(L4) PO6: Thumb rule PO7:Thumb rule	2 2 1 1 2 2
2				Apply	L3	PO1 PO2 PO3 PO4 PO6	PO1: Apply(L3) PO2: Formulate (L6) PO3: Analyze (L4) PO4: Analyze (L4) PO6:Thumb rule	3 1 2 2 2
3				Analyze	L4	PO1 PO2 PO4 PO6	PO1: Apply(L3) PO2: Analyze(L4) PO4:Analyze(L4) PO6: Thumb rule	3 3 3 3
4				Analyze	L4	PO1 PO2 PO3 PO4 PO11	PO1: Apply (L3) PO2: Formulate(L6) PO3: Analyze(L4) PO4: Model(L3) PO11: Thumb rule	3 1 3 3 3
5				Evaluate	L5	PO1 PO2 PO3 PO4 PO5 PO6 **PO11**	PO1: Apply(L3) PO2:Analyze(L4) PO3: Identify(L3) PO4:Model(L3) PO5:Create(L6) PO6:Thumb rule PO11: Thumb rule	3 3 3 3 2 3 3

Justification Statements:
CO1: Understand the foundations and ethical considerations of Explainable AI.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate(2).
PO2 Verb: Identify(L3)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate(2)
PO3:Design(L6)
CO1 Action verb is less than PO3 verb. Therefore the correlation is low(1)

PO4:Analyze(L4)
CO1 Action verb is less than PO2 verb by two levels. Therefore the correlation is low(1).
PO6:Thumb rule
Promote explainable AI that supports informed decision-making, protects user rights, and addresses societal needs with transparency and accountability.
PO7:Thumb rule
Develop explainable AI systems that support sustainable practices and minimize unintended societal and environmental impacts.

CO2: Apply the model-specific explainability techniques for interpretable machine learning
Action Verb: Apply (L3)

PO1: Apply (L3)
CO2 Action verb is same as PO1 verb. Therefore the correlation is high (3)
PO2: Formulate (L6)
CO2 Action verb is less than PO2 verb. Therefore the correlation is low(1)
PO3: Analyze (L4)
CO2 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate(2).
PO4: Analyze(L4)
CO2 Action verb is less than PO4 verb by one levels. Therefore the correlation is moderate(2).
PO6:Thumb rule
Use interpretable models to ensure decisions are understandable, fair, and accountable, especially in socially impactful domains.

CO3: Analyze model-agnostic explainability methods and evaluate their effectiveness
Action Verb: Analyze(L4)
PO1: Apply (L3)
CO3 Action verb is greater than PO1 verb. Therefore the correlation is high(3)
PO2: Analyze (L4)
Action verb is same as PO2 verb. Therefore the correlation is high(3)
PO4: Analyze (L4)
Action verb is same as PO4 verb. Therefore the correlation is high(3).
PO6: Thumb rule
Choose explainability methods that make black-box models transparent and accountable to ensure ethical use in societal applications.

CO4: Analyze deep learning interpretability techniques and deep model explanations.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO4 Action verb is greater than PO1 verb . Therefore the correlation is high (3)
PO2: Formulate (L6)
CO4 Action verb is less than PO2 verb by two levels . Therefore the correlation is low(1).
PO3: Analyze (L4)
CO4 Action verb is same as PO3 verb . Therefore the correlation is high (3
PO4: Model(L3)
CO4 Action verb is greater than PO4 verb . Therefore the correlation is high (3)
PO11: Thumb rule
Select the most interpretable deep learning technique that aligns with project goals, stakeholder requirements, balancing model performance with transparency and compliance needs.

CO5: Evaluate mitigate bias using fairness metrics and XAI tools.
Action Verb: Evaluate(L5)
PO1 Verb: Apply (L3)
CO5 Action verb is greater than PO1 verb . Therefore the correlation is high (3)
PO2 Verb: Analyze(L4)
CO5 Action verb is greater than PO2 verb . Therefore the correlation is high (3)
PO3: Identify(L3)
CO5 Action verb is greater than PO3 verb . Therefore the correlation is high (3)
PO4 Verb: Model (L3)

CO5 Action verb is greater than PO4 verb . Therefore the correlation is high (3)

PO5: create(L6)

CO5 Action verb is one less than PO5 verb . Therefore the correlation is moderate (2)

PO6: Thumb rule

Use fairness metrics and XAI tools to detect and reduce bias, ensuring AI systems serve society equitably and responsibly.

PO11: Thumb rule

Integrate fairness evaluation into project workflows to build responsible AI systems that meet compliance, budget, and stakeholder expectations.

ANNAMACHARYA INSTITUTE OF TECHNOLOGY ANDSCIENCES:TIRUPATI
(AUTONOMOUS)
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	AI FOR EDGE COMPUTING	L	T	P	C
23APC3311	III-II	(Professional Core)	2	1	0	3

Course Outcomes

After studying the course, student will be able to

CO1: **Understand** the fundamentals of Edge Computing and its relationship with Artificial Intelligence.

CO2: **Analyze** the edge-centric architectures and frameworks suitable for AI workloads.

CO3: **Apply** the optimized AI models on edge devices considering resource constraints.

CO4: **Apply** the real-time data analytics and AI inference on edge nodes with minimal latency.

CO5: **Analyze** the future directions and open research areas in edge-based AI systems and applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the fundamentals of Edge Computing and its relationship with Artificial Intelligence.			L2
CO2	Analyze	the edge-centric architectures and frameworks suitable		for AI workloads.	L4
CO3	Apply	the optimized AI models		on edge devices considering resource constraints.	L3
CO4	Apply	the real-time data analytics and AI inference		on edge nodes with minimal latency.	L3
CO5	Analyze	the future directions and open research areas in edge-based AI systems and applications.			L4

UNIT I – Introduction to Edge Computing and AI
Evolution of Computing Paradigms: Cloud, Fog, and Edge, Introduction to Edge AI – Concepts and Motivation, Architecture of Edge Computing Systems, Differences between Edge AI and Cloud AI, Use Cases of Edge AI – Smart Cities, Healthcare, IoT, and Industry 4.0, Hardware for Edge AI – Edge GPUs, TPUs, FPGAs, Types of Edge Devices – Raspberry Pi, Jetson Nano, Coral, Challenges in Deploying AI on Edge
UNIT II – AI Models and Edge Inference
Types of AI Models Suitable for Edge Deployment, Model Optimization Techniques: Quantization, Pruning, Distillation, Transfer Learning for Edge AI, Inference Acceleration using Edge Hardware, Lightweight Models: MobileNet, SqueezeNet, TinyML, Frameworks for Edge Deployment: TensorFlow Lite, ONNX, OpenVINO, Compilation Tools: TVM, Glow, Energy and Latency-aware Inference.
UNIT III – Edge-Centric Architectures and Data Management
Distributed AI Architectures: Edge, Fog, and Cloud, Collaborative Intelligence – Edge-Cloud Offloading Strategies, Data Lifecycle in Edge AI Systems, Real-time Stream Processing at the Edge, Data Compression and Fusion Techniques, Caching and Scheduling Mechanisms, Privacy-Preserving Edge AI (Federated Learning, Differential Privacy), Case Study: Real-time Video Analytics using Edge Devices,
UNIT IV – Security, Privacy, and Ethical Aspects of AI at the Edge
Security Threats in Edge Environments, Privacy Concerns with AI Inference on Personal Devices, Federated Learning: Concepts and Frameworks (e.g., Flower, TensorFlow Federated), Data Anonymization and Encryption Techniques, Blockchain for Secure Edge AI, Explainable AI for Edge Decisions, Regulations and Ethical Challenges in Edge AI, Case Studies on Privacy-Aware AI Systems.

UNIT V – Applications and Future Trends in Edge AI
Edge AI in Autonomous Vehicles, Industrial Automation and Predictive Maintenance, AI-Driven Surveillance and Smart Homes, Edge AI in Healthcare Monitoring Systems, 5G and Edge AI Integration, Emerging Trends: TinyML, Neuro-morphic Computing, Benchmarking Tools for Edge AI Performance, Future Research Directions and Innovation Opportunities.

Textbooks

1. "Artificial Intelligence at the Edge" by Daniel Situnayake & Pete Warden
2. "Edge Computing: A Primer" by Jie Cao, Weisong Shi, and Qun Li
3. "TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers" by Pete Warden and Daniel Situnayake

Reference Books

1. "Designing Distributed Systems" by Brendan Burns (O'Reilly)
2. "Hands-On Edge Analytics with Azure IoT" by Abhishek Kumar
3. Recent IEEE and ACM journal publications on Edge AI and Federated Learning

Online Courses

1. TinyML Specialization – Harvard & Google (edX)
2. AI for Edge Computing – NPTEL
3. Federated Learning – Coursera (Intel & University of Illinois)

Mapping of course outcomes with program outcomes

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

Correlation matrix:

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				Understand	L2	PO1 PO3 PO5	PO1:Apply(L3) PO3: Identify (L3) PO5: Apply(L3)	2 2 2
2				Analyze	L4	PO1 PO3 PO5 PO6	PO1: Apply(L3) PO3:Design(L6) PO5: Apply(L3) PO6:Thumb Rule	2 1 1 2
3				Apply	L3	PO1 PO3 PO6	PO1: Apply(L3) PO3: Apply(L3) PO6:Thumb Rule	3 3 2
4				Apply	L3	PO1 PO3 PO5 PO6 PO7 PO11	PO1: Apply(L3) PO3: Identify (L3) PO5: Apply(L3) PO6:Thumb Rule PO7:Thumb Rule PO11:Thumb Rule	3 3 3 2 3 2
5				Analyze	L4	PO1 PO3 PO5 PO6 PO7 PO11	PO1: Apply(L3) PO3: Identify (L3) PO5: Apply(L3) PO6:Thumb Rule PO7:Thumb Rule PO11:Thumb Rule	2 2 2 2 2 2

Justification Statements:
CO1: **Understand** the fundamentals of Edge Computing and its relationship with Artificial Intelligence.
Action Verb: Understand (L2)
PO1: Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO3: Identify (L3)
CO1 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate (2)
PO5: Apply(L3)
CO1 Action verb is less than PO5 verb by one level. Therefore the correlation is moderate (2)

CO2: **Analyze** the edge-centric architectures and frameworks suitable for AI workloads.
Action Verb: Analyze (L4)
PO1: Apply(L3)
CO2 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO3:Design(L6)
CO2 Action verb is less than PO3 verb by two level. Therefore the correlation is low (1)
PO5: Apply(L3)
CO2 Action verb is less than PO5 verb by one level. Therefore the correlation is moderate (2)
PO6:Thumb Rule
We use the different AI models for most of the disciplines in the society. Therefore the correlation is moderate (2).

CO3: **Apply** the optimized AI models on edge devices considering resource constraints.
Action Verb: Apply (L3)
PO1: Apply(L3)
CO3 Action verb is same as PO1 verb. Therefore the correlation is high (3)
PO3: Apply(L3)
CO3 Action verb is same as PO3 verb. Therefore the correlation is high (3)
PO6:Thumb Rule
We are using the Real-time Stream Processing at the AI Edge for most of the disciplines in the society. Therefore the correlation is moderate (2).

CO4: **Apply** the real-time data analytics and AI inference on edge nodes with minimal latency.
Action Verb: Apply (L3)
PO1: Apply(L3)
CO4 Action verb same as PO1 verb. Therefore the correlation is high (3)
PO3: Identify (L3)
CO4 Action verb same as PO3 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO4 Action verb same as PO5 verb. Therefore the correlation is high (3)
PO6: Thumb Rule
We are using the Security, Privacy, and Ethical Aspects of AI at the Edge for most of the disciplines in the society. Therefore the correlation is moderate (2).
PO7: Thumb Rule
By using the Security and Privacy must follow the ethics for the creating applications. Therefore the correlation is High (3).
PO11: Thumb Rule
We are using the Security and Privacy concepts learn lifelong. Therefore the correlation is Moderate (2).
CO5: **Analyze** the future directions and open research areas in edge-based AI systems and applications.
Action Verb: Analyze (L4)

PO1: Apply (L3)
CO5 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO3: Identify (L3)
CO5 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate (2)
PO5: Apply (L3)
CO5 Action verb is less than PO5 verb by one level. Therefore the correlation is moderate (2)
PO6: Thumb Rule

We use the different AI models for most of the disciplines in the society. Therefore the correlation is moderate (2).

PO7: Thumb Rule

By using the Security concepts must follow the ethics for the creating applications. Therefore the correlation is Moderate (2).

PO11: Thumb Rule

We are using the maintain the Security and Privacy concepts learn lifelong. Therefore the correlation is Moderate (2).

Course Code	Year & Sem	GRAPH NEURAL NETWORKS	L	T	P	C
23APE3305	**III-II**		2	1	**0**	**3**

Course Outcomes

After studying the course, student will be able to

CO1: Understand graph theory basics, graph types, and ML to structured the graph data.

CO2: Analyze spectral and spatial graph convolutions and their computational implications.

CO3: Apply GNN models like GCN, GAT, GraphSAGE, GIN, MPNN to perform learning task on graph data.

CO4: Evaluate GNN performance in node classification, link prediction,Social network modelling.

CO5: Design GNN models using PyTorch Geometric with preprocessing, training, evaluation to exploring advanced architectures.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	graph theory basics, graph types, and ML		to graph-structured data	L2
CO2	**Analyze**	spectral and spatial graph convolutions and their computational implications.			L4
CO3	**Apply**	GNN models like GCN, GAT, GraphSAGE, GIN, MPNN		to perform learning tasks on graph data.	L3
CO4	**Evaluate**	GNN performance in node classification, link prediction,Social network modelling			L5
CO5	**Design**	Design GNN models using PyTorch Geometric with preprocessing, training, evaluation		to exploring advanced architectures.	L6

UNIT I: Fundamentals of Graph Theory and Machine Learning on Graphs

Introduction to Graphs: Nodes, Edges, Adjacency Matrix, Types of Graphs: Directed, Undirected, Weighted, Bipartite, Graph Traversal Algorithms (BFS, DFS), Graph Representations for ML (Adjacency List, Matrix, Laplacian), Node, Edge, and Graph-level Prediction Problems, Motivation and Challenges for Learning on Graphs.

UNIT II: Spectral and Spatial Methods for Graph Learning

Spectral Graph Theory Basics, Graph Convolution via Spectral Methods, Chebyshev and First-order Approximations, Spatial Graph Convolutions, Comparison of Spectral vs Spatial GNNs, Graph Laplacian and Eigenvalue Properties.

UNIT III: Graph Neural Network Architectures

Graph Convolutional Networks (GCNs), Graph Attention Networks (GATs), GraphSAGE: Sampling and Aggregation, Graph Isomorphism Networks (GIN), Message Passing Neural Networks (MPNNs), Inductive vs Transductive GNN Learning.

UNIT IV: Applications of GNNs

Node Classification (e.g., Cora, Citeseer), Link Prediction (e.g., Recommender Systems), Graph Classification (e.g., Molecule Property Prediction), Traffic Forecasting and Social Network Modeling,

GNNs in Healthcare and Bioinformatics, Explainability and Interpretability in GNNs.

UNIT V: Implementation, Optimization, and Recent Advances
Overview of PyTorch Geometric and DGL, Data Loading and Preprocessing for Graph Datasets, Model Training, Loss Functions, and Evaluation Metrics, Hyperparameter Tuning in GNNs, Recent Research Trends and Architectures (e.g., Heterogeneous GNNs, Graph Transformers), Challenges and Future Directions in GNNs.

Test Books:

1. Zonghan Wu, Shirui Pan, Fengwen Chen, Guodong Long, Chengqi Zhang, Philip S. Yu, A Comprehensive Survey on Graph Neural Networks, IEEE Transactions on Neural Networks and Learning Systems, 2021.

2. Yao Ma, Jiliang Tang,Deep Learning on Graphs, Cambridge University Press, 2021.

3. William L. Hamilton, Graph Representation Learning, Morgan & Claypool Publishers, 2020.

Reference Books:

1. Barrett, Jure Leskovec, Mining of Massive Datasets, Cambridge University Press.

2. Thomas Kipf,GCN and related papers and tutorials (arXiv).

3. Petar Veličković, Graph Attention Networks (original paper and slides).

4. Michael Bronstein et al.,Geometric Deep Learning: Grids, Groups, Graphs, Geodesics, and Gauges (arXiv preprint).

Online Learning Resources:

1. https://pytorch-geometric.readthedocs.io/– PyTorch Geometric Docs

2. https://cs.stanford.edu/people/jure/ – Stanford GNN Projects

3. https://www.coursera.org/learn/graph-neural-networks – Coursera GNN Course by Stanford

Mapping of course outcomes with program outcomes

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

Correlation Matrix:

Unit No.	CO Lesson plan(Hrs)	%	Corr elati on	Co's Action verb	BTL	Program Outcom e (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlatio n (0-3)
1				Understand	L2	PO1 PO2 PO5	**PO1: Apply(L3)** **PO2: Analyze(L4)** **PO5:Apply(L3)**	2 1 2
2				Analyze	L4	PO1 PO2 PO4 PO5 PO6	**PO1: Apply(L3)** **PO2: Formulate (L6)** **PO4: Analyze (L4)** **PO5: Design (L6)** **PO6:Thumb rule**	3 1 3 1 3
3				Apply	L3	**PO1** **PO3** **PO4** **PO5**	**PO1: Apply(L3)** **PO3: Design(L6)** **PO4:Analyze(L4)** **PO5: Create(L6)**	3 1 2 1

4				Evaluate	L5	PO2 PO4 PO6 PO11	PO2: Formulate (L6) PO4: Analyze(L4) PO6: Thumb rule PO11: Thumb rule	2 3 3 3
5				Design	L6	PO1 PO3 PO5 PO6 PO7 PO11	PO1: Apply(L3) PO3: Identify(L3) PO5:Create(L6) PO6:Thumb rule PO7: Thumb rule PO11: Thumb rule	3 3 3 3 3 3

Justification Statements:

CO1: Understand graph theory basics, graph types, and ML to graph-structured data.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action verb is same as PO1 verb. Therefore the correlation is high(3)
PO2 Verb: Analyze(L4)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate(2)
PO5:Apply(L3)
CO1 Action verb is same as PO5 verb. Therefore the correlation is high(3)

CO2: Analyze spectral and spatial graph convolutions and their computational implications.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO2 Action verb is more than PO1 verb. Therefore the correlation is high (3)
PO2: Formulate (L6)
CO2 Action verb is less than PO2 verb by two levels. Therefore the correlation is low(1)
PO4: Analyze (L4)
CO2 Action verb is same as PO4 verb. Therefore the correlation is high(3)
PO5: Design(L6)
CO2 Action verb is less than PO5 verb by two levels. Therefore the correlation is low(1).
PO6:Thumb rule
Choose spectral methods for theoretical clarity and spatial methods for scalability in practical GNN applications.

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CO3: Apply GNN models like GCN, GAT, GraphSAGE, GIN, MPNN to perform learning task on graph data.
Action Verb: Apply(L3)
PO1: Apply (L3)
CO3 Action verb is same as PO1 verb. Therefore the correlation is high(3)
PO3: Design (L6)
Action verb is less than PO3 verb. Therefore the correlation is low(1).
PO4: Analyze (L4)
Action verb is less than PO4 verb by one level. Therefore the correlation is moderate(2)
PO5: Create (L6)
CO3 Action verb is less than PO5 verb. Therefore the correlation is low(1)

CO4: Evaluate GNN performance in node classification, link prediction,Social network modelling.
Action Verb: Evaluate (L5)
PO2: Formulate (L6)
CO4 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)
PO4: Analyze(L4)
CO4 Action verb is greater than PO4 verb . Therefore the correlation is high (3)
PO6: Thumb rule
Ensure GNN evaluations consider fairness, privacy, and societal impact, especially when applied to social networks and human-centered data
PO11: Thumb rule

Assess GNN models for accuracy, scalability, and resource efficiency to ensure they meet project goals within time and budget constraints.

CO5: Design GNN models using PyTorch Geometric with preprocessing, training, evaluation to exploring advanced architectures.

Action Verb: Design(L6)

PO1 Verb: Apply (L3)

CO5 Action verb is greater than PO1 verb . Therefore the correlation is high (3)

PO3: Identify(L3)

CO5 Action verb is greater than PO3 verb . Therefore the correlation is high (3)

PO5: create(L6)

CO5 Action verb is same as PO5 verb . Therefore the correlation is high (3)

PO6: Thumb rule

Design GNN solutions that are socially responsible, ensuring fairness, transparency, and ethical use in sensitive real-world applications.

PO7: Thumb rule

Design GNN models that optimize computational resources and support sustainable AI practices in environmentally sensitive applications

PO11: Thumb rule

Plan, build, and evaluate GNN models efficiently, balancing performance goals with time, cost, and resource constraints in project settings

Course Code	Year & Sem	Recommender Systems (Professional Elective II)	L	T	P	C
23APE3306	III-II		2	1	0	3

Course Outcomes

After studying the course, student will be able to

CO1: Understand the core concepts and types of recommender systems.
CO2: Analyze the basic collaborative and content-based filtering techniques.
CO3: Apply the matrix factorization and deep learning models to recommendation problems.
CO4: Evaluate the recommender system performance using appropriate metrics.
CO5: **Create** scalable and context-aware recommender systems for diverse applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the core concepts and types of recommender systems.			L2
CO2	Analyze	the basic collaborative and content-based filtering techniques.			L3
CO3	Apply	matrix factorization and deep learning models.		to recommendation problems.	L3
CO4	Evaluate	the recommender systems performance	Using appropriate metrics.		L5
CO5	Create	scalable and context-aware recommender systems		for diverse applications.	L6

UNIT I: Introduction to Recommender Systems

> Introduction to Information Filtering Systems, Types of Recommender Systems: Content-based, Collaborative, Hybrid, Data Sources: Explicit vs Implicit Feedback, Applications and Challenges in Recommendation, User and Item Profiling, Popularity, Personalization, and Serendipity Trade-offs.

UNIT II: Collaborative Filtering Techniques

> User-based Collaborative Filtering, Item-based Collaborative Filtering, Similarity Measures: Cosine, Pearson, Jaccard, Neighborhood Selection and k-NN, Cold-start and Data Sparsity Issues, Memory- based vs Model-based Collaborative Filtering.

UNIT III: Content-based and Hybrid Systems

> Item Feature Extraction and Vector Representation, TF-IDF and Cosine Similarity in Recommendations, User Profile Learning, Limitations of Content-based Filtering, Hybrid Recommender Architectures, Case Study: Netflix, Amazon Hybrid Systems.

UNIT IV: Matrix Factorization and Deep Learning Approaches

> Latent Factor Models and SVD, ALS and SGD for Matrix Factorization, Non-negative Matrix Factorization (NMF), Neural Collaborative Filtering (NCF), Deep Learning Models: Autoencoders, CNNs, RNNs for Recommendations, Graph-based and Knowledge Graph Recommenders.

UNIT V: Evaluation, Ethics, and Industrial Applications

> Evaluation Metrics: Precision, Recall, F1, NDCG, MAP, A/B Testing in Recommender Systems, Explainability in Recommendations, Fairness, Bias, and Privacy in Recommenders, Scalability and Real-time Recommendations, Deploying Recommender Systems at Scale (e.g., Spotify, YouTube).

Mapping of course outcomes with program outcomes

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

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Identify(L3)	2 2
2				Analyze	L3	PO1 PO2 PO4 PO3 PO5	PO1: Apply(L3) PO2: Identify(L3) PO3: Apply (L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 2 3
3				Apply	L3	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3: Design(L6) PO4: Analyze (L4) PO5: Create(L6)	3 3 1 2 1
4				Evaluate	L5	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Formulate (L6) PO3: Develop (L6) PO4: Analyze(L4) PO5: Apply(L3)	3 2 2 3 3
5				Create	L6	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify(L3) PO3: Design(L6) PO4: Analyze(L4) PO5: Apply(L3)	3 3 3 3 3

Justification Statements:

CO1: Understand the core concepts and types of recommender systems.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO2 Verb: Identify (L3)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)
CO2: Analyze the basic collaborative and content-based filtering techniques.
Action Verb: Analyze (L3)
PO1: Apply (L3)
CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Identify (L3)
CO2 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
PO3: Apply (L3)
CO2 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is less than PO4 verb by one level. Therefore the correlation is Moderate (2)
PO5: Apply (L3)

CO2 Action verb is same as PO5 verb. Therefore the correlation is high (3)

CO3: Apply the matrix factorization and deep learning models to recommendation problems.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO3 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Identify (L3)
CO3 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
PO3: Design (L6)
CO3 Action verb less than PO2 verb by two levels. Therefore the correlation is low (1)
PO4: Analyze (L4)
CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is moderate (2)
PO5: Create (L6)
CO3 Action verb less than PO5 verb by two levels. Therefore the correlation is low (1)

CO4: Evaluate the recommender system performance using appropriate metrics.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO4 Action verb is greater than PO1 verb. Therefore the correlation is high (3)
PO2: Formulate (L6)
CO4 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate(2)
PO3: Develop (L6)
CO4 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate (2)
PO4: Analyze (L4)
CO4 Action verb is greater than PO4 verb. Therefore the correlation is high (3)
PO5: Apply (L3)
CO4 Action verb is greater than PO5 verb. Therefore the correlation is high (3)

CO5: Create scalable and context-aware recommender systems for diverse applications.
Action Verb: Create (L6)
PO1 Verb: Apply (L3)
CO5 Action verb is greater than PO1 verb. Therefore the correlation is high (3)
PO2 Verb: Identify (L3)
CO5 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO3: Design (L6)
CO4 Action verb is same as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO4 Action verb is greater than PO4 verb. Therefore the correlation is high (3)
PO5: Apply (L3)
CO4 Action verb is greater than PO5 verb. Therefore the correlation is high (3)

Course Code	Year & Sem	PREDICTIVE ANALYTICS (Professional Elective-II)	L	T	P	C
23APE3307	III-II		2	1	0	3

Course Outcomes

After studying the course, student will be able to

CO1: Understand the principles and importance of predictive analytics.

CO2: Apply Data Cleaning, Dimensionality Reduction, and Feature Scaling for datasets.

CO3: Understand regression and classification models for predictive tasks.

CO4: Evaluate and validate models using standard metrics.

CO5: Create predictive solutions to solve domain-specific challenges.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the principles and importance of predictive analytics.			L2
CO2	Apply	Data Cleaning, Dimensionality Reduction, and Feature Scaling for datasets.		PCA, LDA	L3
CO3	Understand	regression and classification models for predictive tasks.			L2
CO4	Evaluate	models using standard metrics		Confusion Matrix	L5
CO5	Create	predictive solutions to solve domain-specific challenges		AdaBoost, XGBoost, ANN,and LSTM	L6

UNIT – I	Introduction to Predictive Analytics	
	Introduction to Predictive Analytics and Business Intelligence, Types of Predictive Models: Classification, Regression, Time Series, Supervised vs Unsupervised Learning, Predictive Modeling Workflow, Applications in Marketing, Finance, Healthcare, Challenges in Predictive Analytics.	
UNIT – II	**Data Preparation and Feature Engineering**	
Data Cleaning: Handling Missing, Noisy, and Inconsistent Data, Feature Selection and Dimensionality Reduction (PCA, LDA), Feature Scaling: Normalization, Standardization, Encoding Categorical Variables, Feature Extraction and Construction, Dealing with Imbalanced Datasets.		
UNIT – III	**Predictive Modeling with Regression and Classification**	
	Linear Regression and Polynomial Regression, Logistic Regression for Binary Classification, Decision Trees and Random Forest, k-Nearest Neighbors (k-NN) and Naïve Bayes, Support Vector Machines (SVM), Model Selection and Comparison.	
UNIT – IV	**Model Evaluation and Validation**	
Training, Testing, and Validation Sets, Cross-Validation Techniques (k-Fold, Stratified, LOOCV), Evaluation Metrics: Accuracy, Precision, Recall, F1 Score, ROC-AUC, Confusion Matrix and Classification Report, Bias-Variance Trade-off and Overfitting, Hyperparameter Tuning: Grid Search, Random Search.		
UNIT – V	**Advanced Topics and Applications**	
Ensemble Learning: Bagging, Boosting (AdaBoost, XGBoost), Predictive Analytics with Time Series (ARIMA, Prophet), Deep Learning for Predictive Modeling (ANNs, LSTM), Use of Predictive Analytics in IoT, Retail, and Healthcare, Ethics and Privacy in Predictive Analytics, Building and Deploying End-to-		

End Predictive Systems.	

Textbooks:

1. Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Wiley, 2014.
2. John D. Kelleher, Brendan Tierney, Data Science: Predictive Analytics and Data Mining, MIT Press, 2018.

Reference Books:

1. Galit Shmueli et al.,Data Mining for Business Analytics: Concepts, Techniques, and Applications in R, Wiley, 2017.
2. Eric Siegel, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Wiley, 2016.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer, 2009.

Mapping of course outcomes with program outcomes

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

Correlation matrix

Unit No.	CO						Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb		BTL			
1				Understand		L2	PO1	PO1: Apply(L3)	1
							PO2	PO2: Identify(L3)	1
							PO3	PO3: Apply (L3)	1
							PO4	PO4: Analyze (L4)	1
							PO5	PO5: Apply(L3	1
							PO6	PO6: Thumb rule	2
2				Apply		L3	PO1	PO1: Apply(L3)	3
							PO2	PO2: Identify(L3)	3
							PO3	PO3: Apply (L3)	3
							PO4	PO4: Analyze (L4)	2
							PO5	PO5: Apply(L3	3
							PO6	PO6: Thumb rule	2
3				Understand		L2	PO1	PO1: Apply(L3)	1
							PO2	PO2: Identify(L3)	1
							PO3	PO3: Apply (L3)	1
							PO4	PO4: Analyze (L4)	1
							PO5	PO5: Apply(L3	1
							PO6	PO6: Thumb rule	2
4				Evaluate		L5	PO1	PO1: Apply(L3)	1
							PO2	PO2: Identify(L3)	1
							PO3	PO3: Apply (L3)	1
							PO4	PO4: Analyze (L4)	2
							PO5	PO5: Apply(L3)	1

							PO6	PO6: Thumb rule	3
5					Create	L6	PO1 PO2 PO3 PO4 PO5 PO6	PO1: Apply(L3) PO2: Identify(L3) PO3: Apply (L3) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule	1 1 1 2 1 3

Justification Statements:

CO1: Understand the principles and importance of predictive analytics.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO2 Verb: Identify (L3)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)
PO3: Apply (L3)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)
PO4: Analyze (L4)
CO1 Action verb is less than PO4 verb by Two levels. Therefore the correlation is Moderate (1)
the correlation is low (1).
PO5: Create (L6)
CO1 Action verb less than PO5 verb by four levels. Therefore the correlation is low (1)
PO6: Thumb rule
Since we are developing scenes and 3d objects for engineering and societal departments. Therefore the correlation is moderate (2)

CO2: Apply Apply Data Cleaning, Dimensionality Reduction, and Feature Scaling for datasets.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO2 Verb: Identify (L3)
CO1 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO3: Apply (L3)
CO1 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO1 Action verb is less than PO4 verb by one level. Therefore the correlation is Moderate (2)
the correlation is moderate (2).
PO5: Create (L6)
CO1 Action verb less than PO5 verb by two levels. Therefore the correlation is low (1)
PO6: Thumb rule
Since we are developing scenes and 3d objects for engineering and societal departments. Therefore the correlation is high (3)

CO3: Understand regression and classification models for predictive tasks.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO2 Verb: Identify (L3)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)
PO3: Apply (L3)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)
PO4: Analyze (L4)
CO1 Action verb less than PO5 verb by two levels. Therefore the correlation is low (1)
PO5: Create (L6)
CO1 Action verb less than PO5 verb by four levels. Therefore the correlation is low (1)
PO6: Thumb rule
Since we are developing scenes and 3d objects for engineering and societal departments. Therefore the correlation is moderate (2)

CO4: Evaluate and validate models using standard metrics.
Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3)
CO1 Action verb is grater than PO1 verb by two levels. Therefore the correlation is low (1)
PO2 Verb: Identify (L3)
CO1 Action verb is grater than PO1 verb by two levels. Therefore the correlation is low (1)
PO3: Apply (L3)
CO1 Action verb is grater than PO1 verb by two levels. Therefore the correlation is low (1)
PO4: Analyze (L4)
CO1 Action verb is greater than PO4 verb by one level. Therefore the correlation is Moderate (2)
the correlation is moderate (2).
PO5: Create (L6)
CO1 Action verb less than PO5 verb by two levels. Therefore the correlation is low (1)
PO6: Thumb rule
Since we are developing scenes and 3d objects for engineering and societal departments. Therefore the correlation is high (3)

CO5: Create predictive solutions to solve domain-specific challenges.
Action Verb: Evaluate (L6)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by three levels. Therefore the correlation is low (1)
PO2 Verb: Identify (L3)
CO1 Action verb is less than PO1 verb by three levels. Therefore the correlation is low (1)
PO3: Apply (L3)
CO1 Action verb is less than PO1 verb by three levels. Therefore the correlation is low (1)
PO4: Analyze (L4)
CO1 Action verb is greater than PO4 verb by one level. Therefore the correlation is Moderate (2)
the correlation is moderate (2).
PO5: Create (L6)
CO1 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO6: Thumb rule
Since we are developing scenes and 3d objects for engineering and societal departments. Therefore the correlation is high (3)

Course Code	Year & Sem	BIG DATA	L	T	P	C
23APE3308	III - II	**(Professional Elective - II)**	2	1	0	3

Course Outcomes

After studying the course, student will be able to

CO1: **Understand** the characteristics of Big Data and explain the architecture and   Components of the Hadoop ecosystem including HDFS, YARN, and related tools.

CO2: **Apply** the execute basic MapReduce programs and apply Hive and Pig for efficient   data processing in Hadoop.

CO3: **Analyze** the NoSQL database models with RDBMS and perform basic HBase   operations integrated with Hadoop.

CO4: **Analyze** the Big Data analytics using Apache Spark components such as Spark SQL, Streaming Curd operations, and MLlib.

   CO5: **Evaluate** the real-world Big Data applications across sectors and develop a mini-project   integrating cloud platforms and Big Data tools.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The characteristics of big data and architecture and Components Hadoop ecosystem	including HDFS, YARN, and related tools		L2
CO2	Apply	Execute basic Map Reduce programs Hive and Pig		for efficient data processing in hadoop	L3
CO3	Analyze	The NoSQL database models with RDBMS and performs basic HBase operations integrated with hadoop			L4
CO4	Analyze	The Big Data analytics	using Apache Spark components such as Spark SQL, Streaming, Curd operations and MLlib.		L4
CO5	Evaluate	Real-world Big Data applications across sectors and develop a mini-project integrating cloud platforms and Big Data tools.			L5

UNIT I: Introduction to Big Data and Hadoop Ecosystem
Definition, Characteristics of Big Data (Volume, Variety, Velocity, Veracity, Value), Types of Data: Structured, Semi-Structured, and Unstructured, Traditional vs Big Data Systems, Big Data Challenges and Benefits, Introduction to Hadoop: Architecture and Components, Hadoop Distributed File System (HDFS): Features, Design, Blocks, YARN and MapReduce Overview, Hadoop Ecosystem Components: Pig, Hive, HBase, Sqoop, Flume.
UNIT II: MapReduce Programming and Hadoop Tools
MapReduce Programming Model: Mapper, Reducer, Partitioner, InputSplit and RecordReader, Combiner, Writing MapReduce Programs in Java, Advanced MapReduce Concepts: Counters, Joins, Secondary Sort, Hive: Data Warehousing Concepts, HiveQL, Partitions, Buckets, Pig: Data Flow, Pig Latin Scripts, Data Import & Export with Sqoop, Real-Time Data Collection using Flume.
UNIT III: NoSQL Databases and HBase

Introduction to NoSQL Databases, Types of NoSQL: Key-Value, Document, Column, Graph, Differences between RDBMS and NoSQL, HBase Data Model: Column Families, Regions, Tables, HBase Architecture and Internals, HBase CRUD Operations using Java, Integration of HBase with Hadoop, Case Study: Big Data Storage in Social Media.

UNIT IV: Apache Spark and Big Data Analytics

Apache Spark: RDDs and DAG Execution Model, Spark Core and Spark SQL, DataFrames and Datasets in Spark, Spark Streaming: Architecture and DStreams, Spark MLlib: Machine Learning on Big Data, GraphX: Graph Processing in Spark, Performance Tuning and Optimization in Spark, Case Study: Building a Spark Application for Real-Time Analytics.

UNIT V: Applications and Case Studies in Big Data

Big Data in Healthcare: Predictive Analysis, Genomics, Big Data in Finance: Fraud Detection, Risk Analytics, Big Data in E-Commerce: Customer Behavior, Personalization, Sentiment Analysis using Big Data, Big Data for Smart Cities and IoT, Big Data and Cloud Computing Integration (AWS, GCP, Azure), Data Privacy, Security, and Ethical Issues – (E), Mini-Project: Design and Development of a Big Data Solution.

Textbooks:
1. Tom White, Hadoop: The Definitive Guide, O'Reilly Media.
2. V. Srinivasa Subramanian, Big Data Analytics, Wiley India.
3. Anand Rajaraman and Jeffrey D. Ullman, Mining of Massive Datasets, Cambridge University Press.

Reference Books:
1. Chuck Lam, Hadoop in Action**,** Manning Publications.
2. Bill Franks, Taming the Big Data Tidal Wave, Wiley.
3. Alex Holmes, Hadoop in Practice, Manning Publications.
4. Michael Minelli, Big Data, Big Analytics: Emerging Business Intelligence, Wiley.

Online Learning Resources:
• Coursera – Big Data Specialization by UC San Diego
• edX – Big Data Analysis with Apache Spark (UC Berkeley)
• Udacity – Data Engineering Nanodegree

Mapping of course outcomes with program outcomes

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

Correlation Matrix

Unit No.	CO Lesson plan (Hrs)	%	Correlation	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO12)	Level of Correlation (0-3)
1				CO1: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Identify(L3)	2 2
2				CO2: Apply	L3	PO1 PO2 PO4 PO5 PO11	PO1: Apply(L3) PO2: Identify (L3) PO4: Analyze (L4) PO5: Select(L3) PO12: Thumb rule	3 3 3 3 1
3				CO3: Analyze	L4	PO1 PO2 PO4 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO4: Analysis (L4) PO12: Thumb rule	2 3 3 1
4				CO4: Analyze	L4	PO1 PO2 PO4 PO11	PO1: Apply(L3) PO2: Identify (L3) PO4: Analysis(L4) PO12: Thumb rule	1 1 3 2
5				CO5: Evaluate	L6	PO1 PO2 PO4 PO11	PO1: Apply(L3) PO2: Identify(L3) PO4: Analysis(L4) PO12: Thumb rule	1 1 1 1

Justification Statements:

CO1: Understand the characteristics of Big Data and explain the architecture and Components of the Hadoop ecosystem including HDFS, YARN, and related tools

Action Verb: Understand (L2)

PO1 Verb: Apply (L3)

CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)

PO2 Verb: Identify (L3)

CO1 Action verb is less than PO2 verb by one level. Therefore, the correlation is medium (2)

CO2: Apply execute basic MapReduce programs and apply Hive and Pig for efficient data processing in Hadoop

Action Verb: Apply (L3)

PO1: Apply (L3)

CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2: Identify (L3)

CO2 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO4: Analyze (L4)

CO2 Action verb is less than PO4 verb by one level. Therefore, the correlation is high (3)

PO5: Select (L3)

CO2 Action verb is same level as PO5 verb. Therefore, the correlation is high (3)

PO11: Thumb rule

For use some different technologies to handling big data. Therefore, the correlation is low (1)

CO3: Analyze the NoSQL database models with RDBMS and perform basic HBase operations integrated with Hadoop.

Action Verb: Analyze (L4)

PO1: Apply (L3)

CO3 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)

PO2: Analyze (L4)

CO3 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO4: Analysis (L4)

CO3 Action verb is same level as PO4 verb. Therefore, the correlation is high (3)

PO11: Thumb rule

For use map reduce and H base technologies to handling big data. Therefore, the correlation is   low (1

CO4: Analyze the Big Data analytics using Apache Spark components such as Spark SQL Streaming Curd operations, and MLlib.

Action Verb: Evaluate (L5)

PO1: Apply(L3)

CO4 Action verb is less than PO1 verb by two levels. Therefore, the correlation is low (1)

PO2: Identify (L3)

CO4 Action verb is less than PO2 verb by two levels. Therefore, the correlation is low (1)

PO3: Design (L6)

CO4 Action verb is less than PO3 verb by one level. Therefore, the correlation is medium (2)

PO4: Analysis (L4)

CO4 Action verb is less than PO4 verb by one level. Therefore, the correlation is medium (2)

PO11: Thumb rule

For use map reduce applications to test and debug big data. Therefore, the correlation is medium (2)

CO5: Evaluate real-world Big Data applications across sectors and develop a mini-project   integrating cloud platforms and Big Data tools

Action Verb: Create (L6)

PO1: Apply(L3)

CO5 Action verb is less than PO1 verb by two levels. Therefore, the correlation is low (1)

PO2: Identity (L3)

CO5 Action verb is less than PO2 verb by two levels. Therefore, the correlation is low (1)

PO4: Analysis (L4)

CO5 Action verb is less than PO4 verb by two levels. Therefore, the correlation is low (1)

PO12: Thumb rule

For use to create data base application using Hive and NoSQL technologies to handling big data. Therefore, the correlation is high (3)

Course Code	Year & Sem	QUANTUM COMPUTING		L	T	P	C
23APE3309	III-II	(Professional Elective – III)		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the fundamental concepts of quantum mechanics used in computing.

CO2: Analyze quantum circuits using standard gates.

CO3: Apply quantum algorithms like Deutsch-Jozsa, Grover's, and Shor's.

CO4: Understand simple quantum programs using Qiskit or similar platforms.

CO5: Analyze applications and challenges of quantum computing in real-world domains.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Understand	the fundamental concepts of quantum mechanics used in computing.			L2
CO2	Analyze	quantum circuits	using standard gates.		L4
CO3	Apply	quantum algorithms like Deutsch-Jozsa, Grover's, and Shor's.			L3
CO4	Understand	simple quantum programs	using Qiskit or similar platforms		L2
CO5	Analyze	applications and challenges of quantum computing in real-world domains.		-	L4

UNIT – I	**Fundamentals of Quantum Mechanics and Linear Algebra**	

Classical vs Quantum Computation, Complex Numbers, Vectors, and Matrices, Hilbert Spaces and Dirac Notation, Quantum States and Qubits, Superposition and Measurement, Tensor Products and Multi-Qubit Systems

UNIT – II	**Quantum Gates and Circuits**	

quantum Logic Gates:Pauli, Hadamard, Phase, Controlled Gates and CNOT, Unitary Operations and Reversibility, Quantum Circuit Representation, Quantum Teleportation, Simulation of Quantum Circuits

UNIT – III	**Quantum Algorithms and Complexity**	

Quantum Parallelism and Interference, Deutsch and Deutsch-Jozsa Algorithms, Grover's Search Algorithm, Shor's Factoring Algorithm, Quantum Fourier Transform, Complexity Classes: BQP, P, NP, and QMA

UNIT – IV	**Quantum Programming and Simulation Platforms**	

Introduction to Qiskit and IBM Quantum Experience, Writing Quantum Circuits in Qiskit, Measuring Qubits and Results, Classical-Quantum Hybrid Programs, Noisy Intermediate-Scale Quantum (NISQ) Systems, Limitations and Current State of Quantum Hardware

UNIT – V	**Applications and Future of Quantum Computing**	

Quantum Machine Learning: Basics and Models, Quantum Cryptography and Quantum Key Distribution, Quantum Algorithms in AI and Optimization, Quantum Advantage and Supremacy, Ethical and Societal Impact of Quantum Technologies, Future Trends and Research Directions

Textbooks:

1. Michael A. Nielsen, Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press, 10th Anniversary Edition, 2010.

2. Eleanor Rieffel and Wolfgang Polak, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.

3. Chris Bernhardt, *Quantum Computing for Everyone*, MIT Press, 2019

Reference Books:
1. David McMahon, *Quantum Computing Explained*, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, *An Introduction to Quantum Computing*, Oxford University Press, 2007.
3. Scott Aaronson, *Quantum Computing Since Democritus*, Cambridge University Press, 2013

Online Learning Resources:
1. IBM Quantum Experience and Qiskit Tutorials
2. Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
3. edX – The Quantum Internet and Quantum Computers
4. YouTube – Quantum Computing for the Determined by Michael Nielsen
5. Qiskit Textbook – IBM Quantum

Mapping of course outcomes with program outcomes

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

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0–3)
	Lesson Plan(Hrs)	%	Corre Lation	CO's Action Verb	BTL			
1				Understand	L2	PO1 PO2	PO1: Apply (L3) PO2: Identify (L3)	2 2
2				Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO6 PO9	PO1: Apply (L3) PO2: Identify (L3) PO3: Apply (L3) PO4: Analyze (L4) PO5: Apply (L3) PO6: Thumb rule PO9: Thumb rule	3 3 3 3 3 2 2
3				Apply	L3	PO1 PO2 PO3 PO4	PO1: Apply (L3) PO2: Identify (L3) PO3: Design (L6) PO4: Analyze (L4)	3 3 1 2
4				Understand	L5	PO1 PO2 PO3 PO4 PO5	PO1: Apply (L3) PO2: Analyze (L4) PO3: Develop (L6) PO4: Analyze (L4) PO5: Apply (L3)	3 3 2 3 3
5				Analyze	L6	PO1 PO2 PO3 PO4 PO5 PO6 PO9	PO1: Apply (L3) PO2: Identify (L3) PO3: Design (L6) PO4: Analyze (L4) PO5: Apply (L3) PO6: Thumb rule PO9: Thumb rule	3 3 3 3 3 2 3
	Total							

Justification Statements:

CO1: Understand the fundamental concepts of quantum mechanics used in computing.
Action Verb: Understand (L2)
PO1 Verb: **Apply (L3)**
CO1 action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2).
PO2 Verb: **Identify (L3)**
CO1 action verb is less than PO2 verb by one level. Therefore, the correlation is moderate (2).

CO2: Analyze quantum circuits using standard gates.
Action Verb: **Analyze (L4)**
PO1 Verb: Apply (L3)
CO2 action verb is greater than PO1 verb by one level. Therefore, the correlation is high (3).
PO2 Verb: **Identify (L3)**
CO2 action verb is greater than PO2 verb by one level. Therefore, the correlation is high (3).
PO3 Verb: **Apply (L3)**
CO2 action verb is greater than PO3 verb by one level. Therefore, the correlation is high (3).
PO4 Verb: **Analyze (L4)**
CO2 action verb is same as PO4 verb. Therefore, the correlation is high (3).
PO5 Verb: **Apply (L3)**
CO2 action verb is greater than PO5 verb by one level. Therefore, the correlation is high (3).
PO6: **Thumb rule**
Computer vision techniques are applied in multiple domains like medical imaging, remote sensing, and robotics. Therefore, the correlation is moderate (2).
PO9: **Thumb rule**
Feature extraction and analysis require collaboration between engineers, analysts, and domain experts. Therefore, the correlation is moderate (2).

CO3: Apply quantum algorithms like Deutsch-Jozsa, Grover's, and Shor's.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO3 action verb is same as PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: Identify (L3)
CO3 action verb is same as PO2 verb. Therefore, the correlation is high (3).
PO3 Verb: Design (L6)
CO3 action verb is less than PO3 verb by three levels. Therefore, the correlation is low (1).
PO4 Verb: Analyze (L4)
CO3 action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2).

CO4: Understand simple quantum programs using Qiskit or similar platforms.
Action Verb:Understand (L2)
PO1 Verb: Apply (L3)
CO4 action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3).
PO2 Verb: **Analyze (L4)**
CO4 action verb is greater than PO2 verb by one level. Therefore, the correlation is high (3).
PO3 Verb: **Develop (L6)**
CO4 action verb is less than PO3 verb by one level. Therefore, the correlation is moderate (2).
PO4 Verb: **Analyze (L4)**
CO4 action verb is greater than PO4 verb by one level. Therefore, the correlation is high (3).
PO5 Verb: **Apply (L3)**
CO4 action verb is greater than PO5 verb by two levels. Therefore, the correlation is high (3).

CO5: Analyze applications and challenges of quantum computing in real-world domains.
Action Verb:Analyze(L4)
PO1 Verb: Apply (L3)
CO5 action verb is greater than PO1 verb by three levels. Therefore, the correlation is high (3).
PO2 Verb: Identify (L3)
CO5 action verb is greater than PO2 verb by three levels. Therefore, the correlation is high (3).
PO3 Verb: Design (L6)
CO5 action verb is same as PO3 verb. Therefore, the correlation is high (3).
PO4 Verb: Analyze (L4)
CO5 action verb is greater than PO4 verb by two levels. Therefore, the correlation is high (3).
PO5 Verb: Apply (L3)
CO5 action verb is greater than PO5 verb by three levels. Therefore, the correlation is high (3).
PO6: Thumb rule
The use of ethical AI practices and modern 3D vision models ensures safety, societal impact, and sustainability. Therefore, the correlation is moderate (2).
PO9: Thumb rule
Creation of practical Computer Vision applications requires collaboration with multi-disciplinary teams and stakeholders. Therefore, the correlation is high (3).

Course Code	Year & Sem	Computer Vision (Professional Elective – III)	L	T	P	C
23APE3310	III - II		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the fundamental concepts of image formation, color models, image enhancement and filtering techniques.

CO2: Analyze visual features using edge detection, corner detection and blob detection techniques across various image types.

CO3: Apply segmentation methods, contour analysis and object recognition algorithms to vision-based tasks.

CO4: Evaluate convolutional neural network architectures for solving classification and object detection problems.

CO5: Create computer vision applications using 3D vision approaches, scene understanding models and ethical AI practices.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Understand	the fundamental concepts of image formation, color models, image enhancement and filtering techniques			L2
CO2	Analyze	visual features using edge detection, corner detection and blob detection techniques	across various image types		L4
CO3	Apply	segmentation methods, contour analysis and object recognition algorithms		to vision-based tasks	L3
CO4	Evaluate	convolutional neural network architectures		for classification and object detection problems	L5
CO5	Create	computer vision applications	using 3D vision approaches, scene understanding models and ethical AI practices	-	L6

UNIT – I	Introduction to Image Processing and Computer Vision	
Introduction to Computer Vision and its Applications, Image Formation, Image Sensing and Acquisition, Color Models: RGB, HSV, YCbCr, Image Enhancement Techniques, Geometric Transformations and Image Resizing, Noise Removal and Filtering Techniques.		
UNIT – II	**Feature Detection and Description**	
Edge Detection: Canny, Sobel, and Laplacian, Corner Detection: Harris and FAST, Blob Detection: LoG, DoG, SIFT, SURF, and ORB Descriptors, Image Matching and Feature Correspondence, Homography and Perspective Transformation.		
UNIT – III	**Image Segmentation and Object Recognition**	
Thresholding and Region-Based Segmentation, Clustering Methods: K-means, Mean Shift, Graph-Based and Watershed Algorithms, Contour Detection and Shape Analysis, Template Matching and Object Detection, Introduction to Object Tracking Algorithms.		
UNIT – IV	**Deep Learning for Computer Vision**	
Introduction to Convolutional Neural Networks (CNNs), CNN Architecture: Layers, Activation, Pooling, Pretrained Models: VGG, ResNet, MobileNet, Image Classification using CNNs, Object Detection: R-CNN, Fast R-CNN, YOLO, SSD, Transfer Learning and Fine-Tuning.		
UNIT – V	**Advanced Topics and Applications**	
3D Vision and Depth Estimation, Structure from Motion (SfM) and SLAM, Facial Recognition Systems, Scene Understanding and Semantic Segmentation, Vision Applications in Healthcare, AR/VR, Robotics,		

Ethics, Bias, and Fairness in Vision Systems.

Textbooks:
1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer, 2022.
2. Simon J. D. Prince, *Computer Vision: Models, Learning, and Inference*, Cambridge University Press, 2012.
3. Adrian Rosebrock, *Deep Learning for Computer Vision with Python*, PyImageSearch, 2019.

Reference Books:
1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Pearson, 4th Edition, 2018.
2. Jan Erik Solem, *Programming Computer Vision with Python*, O'Reilly Media, 2012.
3. Bernd Jähne, *Digital Image Processing*, Springer, 6th Edition, 2005.

Online Learning Resources:
1. Coursera – Computer Vision by University at Buffalo
2. Fast.ai – Practical Deep Learning for Coders
3. PyImageSearch Blog and Courses

Mapping of course outcomes with program outcomes

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

Correlation matrix

Unit No.	Lesson Plan(Hrs)	%	Corre Lation	CO's Action Verb	BTL	Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0–3)
1				Understand	L2	PO1 PO2	PO1: Apply (L3) PO2: Identify (L3)	2 2
2				Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO6 PO9	PO1: Apply (L3) PO2: Identify (L3) PO3: Apply (L3) PO4: Analyze (L4) PO5: Apply (L3) PO6: Thumb rule PO9: Thumb rule	3 3 3 3 3 2 2
3				Apply	L3	PO1 PO2 PO3 PO4	PO1: Apply (L3) PO2: Identify (L3) PO3: Design (L6) PO4: Analyze (L4)	3 3 1 2
4				Evaluate	L5	PO1 PO2 PO3 PO4 PO5	PO1: Apply (L3) PO2: Analyze (L4) PO3: Develop (L6) PO4: Analyze (L4) PO5: Apply (L3)	3 3 2 3 3
5				Create	L6	PO1 PO2 PO3 PO4 PO5 PO6 PO9	PO1: Apply (L3) PO2: Identify (L3) PO3: Design (L6) PO4: Analyze (L4) PO5: Apply (L3) PO6: Thumb rule PO9: Thumb rule	3 3 3 3 3 2 3

Justification Statements:

CO1: Understand the fundamental concepts of image formation, color models, image enhancement, and filtering techniques.
Action Verb: Understand (L2)
PO1 Verb: **Apply (L3)**
CO1 action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2).
PO2 Verb: **Identify (L3)**
CO1 action verb is less than PO2 verb by one level. Therefore, the correlation is moderate (2).

CO2: Analyze visual features using edge detection, corner detection, and blob detection techniques across various image types.
Action Verb: **Analyze (L4)**
PO1 Verb: Apply (L3)
CO2 action verb is greater than PO1 verb by one level. Therefore, the correlation is high (3).
PO2 Verb: **Identify (L3)**
CO2 action verb is greater than PO2 verb by one level. Therefore, the correlation is high (3).
PO3 Verb: **Apply (L3)**
CO2 action verb is greater than PO3 verb by one level. Therefore, the correlation is high (3).
PO4 Verb: **Analyze (L4)**
CO2 action verb is same as PO4 verb. Therefore, the correlation is high (3).
PO5 Verb: **Apply (L3)**
CO2 action verb is greater than PO5 verb by one level. Therefore, the correlation is high (3).
PO6: **Thumb rule**
Computer vision techniques are applied in multiple domains like medical imaging, remote sensing, and robotics. Therefore, the correlation is moderate (2).
PO9: **Thumb rule**
Feature extraction and analysis require collaboration between engineers, analysts, and domain experts. Therefore, the correlation is moderate (2).

CO3: Apply segmentation methods, contour analysis and object recognition algorithms to vision-based tasks.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO3 action verb is same as PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: Identify (L3)
CO3 action verb is same as PO2 verb. Therefore, the correlation is high (3).
PO3 Verb: Design (L6)
CO3 action verb is less than PO3 verb by three levels. Therefore, the correlation is low (1).
PO4 Verb: Analyze (L4)
CO3 action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2).

CO4: Evaluate convolutional neural network architectures for solving classification and object detection problems.
Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3)
CO4 action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3).
PO2 Verb: **Analyze (L4)**
CO4 action verb is greater than PO2 verb by one level. Therefore, the correlation is high (3).
PO3 Verb: **Develop (L6)**
CO4 action verb is less than PO3 verb by one level. Therefore, the correlation is moderate (2).
PO4 Verb: **Analyze (L4)**
CO4 action verb is greater than PO4 verb by one level. Therefore, the correlation is high (3).
PO5 Verb: **Apply (L3)**
CO4 action verb is greater than PO5 verb by two levels. Therefore, the correlation is high (3).

CO5: Create computer vision applications using 3D vision approaches, scene understanding models and ethical AI practices.
Action Verb: **Create (L6)**
PO1 Verb: Apply (L3)

CO5 action verb is greater than PO1 verb by three levels. Therefore, the correlation is high (3).

PO2 Verb: Identify (L3)

CO5 action verb is greater than PO2 verb by three levels. Therefore, the correlation is high (3).

PO3 Verb: Design (L6)

CO5 action verb is same as PO3 verb. Therefore, the correlation is high (3).

PO4 Verb: Analyze (L4)

CO5 action verb is greater than PO4 verb by two levels. Therefore, the correlation is high (3).

PO5 Verb: Apply (L3)

CO5 action verb is greater than PO5 verb by three levels. Therefore, the correlation is high (3).

PO6: Thumb rule

The use of ethical AI practices and modern 3D vision models ensures safety, societal impact, and sustainability. Therefore, the correlation is moderate (2).

PO9: Thumb rule

Creation of practical Computer Vision applications requires collaboration with multi-disciplinary teams and stakeholders. Therefore, the correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES:TIRUPATI
(AUTONOMOUS)
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	SOCIAL NETWORK ANALYSIS (Professional Core)	L	T	P	C
23APE3311	III - II		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand social network structures and basic network models.

CO2: Analyze the structure and properties of large-scale social networks**.**

CO3: Apply communSity detection algorithms and influence maximization.

CO4: Evaluate diffusion models for viral marketing and Networks influences.

CO5: Apply the tools such as Gephi, Pajek, SNAP, Applications and Ethics for real-world SNA.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	Social Network structures and basic network models.			L2
CO2	Analyze	Structure and properties of large-scale social networks.			L4
CO3	Apply	Community Detection algorithms and influence maximization.			L3
CO4	Evaluate	Diffusion models for viral marketing and Networks influence.	Independent Cascade (IC) Model, Linear Threshold (LT) Model.	Models rumor spread, disease-like propagation, Simpler analysis, time to saturation, or cost per influence	L5
CO5	Apply	Tools, Applications and Ethics for real-world SNA	Need for visualization, analysis, or algorithm integration	Map engagement, collaboration, knowledge diffusion, Track infection hubs, shortest paths	L3

UNIT I: Introduction to Social Networks and Graph Theory

Basic Concepts: Graphs, Nodes, Edges, Directed/Undirected Graphs, Real-world Examples: Facebook, Twitter, LinkedIn, Adjacency Matrix and Graph Representation, Types of Social Networks: Ego, Bipartite, Multilayer, Degree Distribution, Path Length, and Connectivity, Random Graph Models: Erdős–Rényi and Watts-Strogatz.

UNIT II: Structural Properties of Networks

Network Centrality Measures: Degree, Closeness, Betweenness, Eigenvector Centrality and PageRank, Network Clustering and Community Detection Basics, Triadic Closure and Clustering Coefficient, Small-world Phenomenon and Milgram's Experiment, Homophily, Influence, and Structural Balance.

UNIT III: Community Detection and Subgroup Analysis

Girvan–Newman Algorithm and Modularity, Label Propagation and Louvain Method, Clique Detection and k-Core Decomposition, Overlapping Communities and Fuzzy Clustering, Cohesive Subgroups and Structural Equivalence, Evaluation Metrics: NMI, Modularity Score.

UNIT IV: Information Diffusion and Influence in Networks

Models of Diffusion: Linear Threshold and Independent Cascade, Influence Maximization and Viral Marketing, Contagion Models and Epidemic Spreading, Rumor Propagation and Cascade Models, Information Bottlenecks and Bridges, Measuring Influence and Reach.

UNIT V: Tools, Applications, and Ethics in SNA

SNA Tools: Gephi, Pajek, NetworkX, SNAP, Case Study: Twitter and Hashtag Analysis, LinkedIn Network

Mining and Graph Features, Applications in Marketing, Security, and Epidemiology, Ethical Issues in Social Network Data Mining, Building and Visualizing Your Own Social Graph.

Textbooks:
1. Wasserman, S., & Faust, K., *Social Network Analysis: Methods and Applications*, Cambridge University Press, 1994.
2. Easley, D., & Kleinberg, J., *Networks, Crowds, and Markets: Reasoning About a Highly Connected World*, Cambridge University Press, 2010.
3. Newman, M., *Networks: An Introduction*, Oxford University Press, 2010.

Reference Books:
1. Borgatti, S. P., Everett, M. G., & Johnson, J. C., *Analyzing Social Networks*, SAGE Publications, 2018.
2. Barabási, A.-L., *Linked: How Everything Is Connected to Everything Else*, Basic Books, 2014.
3. Hansen, D., Shneiderman, B., & Smith, M. A., *Analyzing Social Media Networks with NodeXL*, Elsevier, 2020.

Online Learning Resources:
• Coursera – Social Network Analysis (University of Michigan)
• YouTube – NetworkX and Gephi Tutorials (freeCodeCamp, TheNetNinja)
• edX – Networks: Friends, Money, and Bytes (University of California, Berkeley)
• Khan Academy – Graph Theory

Mapping of course outcomes with program outcomes:

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

Correlation matrix

Unit No.	CO Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
1				Understand	L2	PO1 PO2 PO3 PO5 PO9	PO1: Apply(L3) PO2: Identify(L3) PO3: Apply (L3) PO5: Apply (L3) PO9: Thumb Rule	2 2 2 2 2
2				Analyze	L4	PO1 PO2 PO3 PO4	PO1: Apply(L3) PO2: Identify(L3) PO3: Apply (L3) PO4: Analyze (L4)	3 3 3 2
3				Apply	L3	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3: Design(L6) PO4: Analyze (L4) PO5: Apply(L3)	3 3 2 2 2

4				Evaluate	L5	PO1 PO2 PO3 PO4 PO5 PO7 PO8	PO1: Apply(L3) PO2: Formulate (L6) PO3: Develop (L6) PO4: Analyze(L4) PO5: Apply(L3) PO7: Thumb Rule PO8: Thumb Rule	3 2 2 3 3 2 2
5				Apply	L3	PO1 PO2 PO3 PO4 PO5 PO6 PO9	PO1: Apply(L3) PO2: Identify(L3) PO3: Design(L6) PO4: Analyze (L4) PO5: Apply(L3) PO6: Apply(L3) PO9: Analyze (L4)	2 2 3 3 2 2 2

Justification Statements:
CO1: Understand social network structures and basic network models
Action Verb: Understand (L2)
PO1: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 : Identify (L3)
CO1 Action verb is less than PO2 verb by one level. Therefore, the correlation is moderate (2)
PO3: Apply (L3)
CO2 Action verb is same level as PO3 verb. Therefore, the correlation is moderate (2)
PO5: Apply (L3)
CO2 Action verb is same as PO5 verb. Therefore, the correlation is moderate(2)
PO9: Thumb rule
Recognizing social networks through Graph Theory Therefore, the correlation is Moderate (2)
CO2: Analyze the structure and properties of large-scale social networks.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2: Identify (L3)
CO2 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3: Apply (L3)
CO2 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO3 Action verb is same level as PO4 verb. Therefore, the correlation is moderate (2)
CO3: : Apply community detection algorithms and influence maximization**.**
Action Verb: Apply (L3)
PO1: Apply (L3)
CO3 Action verb is more than PO1 verb. Therefore, the correlation is high (3)
PO2: Identify (L3)
CO3 Action verb more than PO2 verb. Therefore, the correlation is high (3)
PO3: Design (L6)
CO3 Action verb less than PO2 verb by two levels. Therefore, the correlation is moderate(2)
PO4: Analyze (L4)
CO3 Action verb is same level as PO4 verb. Therefore, the correlation is high (3)
PO5: Create (L6)
CO3 Action verb less than PO5 verb by two levels. Therefore, the correlation is moderate (2)
CO4: Evaluate diffusion models for viral marketing and Networks influences.
Action Verb: Evaluate (L5)

PO1: Apply (L3)
CO4 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Formulate (L6)
CO4 Action verb is PO2 verb by two levels. Therefore, the correlation is moderate (2)
PO3: Develop (L6)
CO4 Action verb is PO2 verb by two levels. Therefore, the correlation is moderate (2)
PO4: Analyze (L4)
CO4 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Apply (L3)
CO4 Action verb is more than PO5 verb. Therefore, the correlation is high (3)
PO7: Thumb rule
Sharing Responsibility in modelling and Conflict management with role clarity. Therefore, the correlation is moderate (2).
PO8: Thumb rule
Identifying Ethical risks and Collaborate Effectively in multi role teams. Therefore, the correlation is moderate (2).
CO5: Apply the tools such as Gephi, Pajek, SNAP, Applications and Ethics for real-world SNA.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO5 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Identify (L3)
CO5 Action verb is less than PO2 verb by one level. Therefore, the correlation is moderate (2)
PO3: Develop (L6)
CO4 Action verb is PO2 verb by two levels. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is less than PO4 verb by one level. Therefore, the correlation is high (3)
PO5: Apply (L3)
CO2 Action verb is same as PO5 verb. Therefore, the correlation is moderate (2)
PO6: Thumb rule
Ensuring, Applying and Mastering the Network Analysis. Therefore, the correlation is moderate (2).
PO9: Thumb rule
Recognizing the tools, Evaluating the applications and Grounding the Ethics. Therefore, the correlation is moderate (2).

Course Code	Year & Sem	Applied Machine Learning	L	T	P	C
23APE3312	**III-II**		2	1	**0**	**3**

Course Outcomes (CO): After studying the course, student will be able to

CO1: **Understand** the concepts and types of machine learning algorithms.
CO2: **Analyze** the suitable machine learning algorithms for classification, regression, and clustering.
CO3: **Evaluate** the model performance and perform model tuning.
CO4: **Apply** the ML algorithms in real-life domains such as NLP, finance, and healthcare.
CO5:**Analyze** the Utilize tools like Scikit-learn, TensorFlow, and PyTorch for practical ML solutions.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the concepts and types of machine learning algorithms.			L2
2	**Analyze**	the suitable machine learning algorithms		for classification, regression, and clustering.	L4
3	**Evaluate**	the model performance and perform model tuning.		for engineering applications.	L5
4	**Apply**	the ML algorithms in real-life domains	such as NLP, finance, and healthcare.	for engineering problems.	L3
5	**Analyze**	the Utilize tools like Scikit-learn, TensorFlow, and PyTorch		for practical ML solutions.	L4

UNIT I: Fundamentals of Machine Learning

Introduction to Machine Learning: Definitions, Scope, and Applications, Types of Machine Learning: Supervised, Unsupervised, Semi-Supervised, Reinforcement, Key Concepts: Features, Labels, Training vs Testing Data, Data Splitting, Data Preprocessing: Cleaning, Feature Engineering, Feature Scaling, Overfitting, Underfitting, and Bias-Variance Trade-off, ML Pipeline & Cross-validation Techniques.

UNIT II: Supervised Learning Algorithms

Linear Regression and Ridge/Lasso Regularization, Logistic Regression and its Application in Classification, Decision Trees and Random Forests, Support Vector Machines (SVMs), k-Nearest Neighbors (k-NN), Model Evaluation: Confusion Matrix, Precision, Recall, F1, AUC.

UNIT III: Unsupervised and Ensemble Methods

Clustering Algorithms: k-Means, DBSCAN, Agglomerative, Dimensionality Reduction: PCA, t-SNE, Association Rule Mining: Apriori and FP-Growth, Ensemble Techniques: Bagging, Boosting, and Stacking, Gradient Boosting, AdaBoost, and XGBoost, Evaluation of Unsupervised Models and Visualization.

UNIT IV: Advanced Learning Paradigms

Reinforcement Learning: Markov Decision Process, Q-Learning, Semi-Supervised Learning Techniques, Introduction to Deep Learning: Perceptrons, MLP, Feature Selection & Feature Importance Methods, Model Tuning: Hyperparameter Optimization using Grid Search/Random Search, Explainable AI (XAI) and Model

Interpretability Tools.
UNIT V: Applications of Machine Learning
Machine Learning in Healthcare and Diagnostics, Financial Modeling and Fraud Detection, NLP Applications: Text Classification and Sentiment Analysis, Recommender Systems: Collaborative & Content-Based Filtering, Image Classification using Pre-trained Models, Deployment of ML Models using Flask, Streamlit.
TEXTBOOKS:
1. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly.
2. Ethem Alpaydin, Introduction to Machine Learning, MIT Press.
3. Tom Mitchell, Machine Learning, McGraw-Hill Education.
REFERENCE BOOKS:
1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer.
3. Peter Flach, Machine Learning: The Art and Science of Algorithms, Cambridge University Press.
4. François Chollet, Deep Learning with Python, Manning Publications.

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	2	3	2						3	2
2	3	3	3	3	3			3			3	3	2
3	3	3	3	2	3							3	2
4	3	3	3	3	3			3			3	2	
5	2	3	2		2								

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1				CO1: Understand	L2	PO1 PO2 PO3 PO4 PO5 PO6	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule	3 3 3 3 3 2
2				CO2: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO8 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3) PO8: Thumb rule PO11: Thumb rule	2 1 2 3 2 3 3
3				CO3: Evaluate	L5	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Apply(L3) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3)	1 1 1 2 1
4				CO4: Apply	L3	PO1 PO2 PO3 PO4 PO5 PO8	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO8: Thumb rule	3 2 3 3 3 3

5				CO5: Analyze	L4	PO1	PO1: Apply(L3)	2
						PO2	PO2: Review(L2)	1
						PO3	PO3: Develop(L3)	2
						PO4	PO4: Analyze(L4)	3
						PO5	PO5: Apply(L3)	2

(preceding row) | | | | | | | PO11 | PO11: Thumb rule | 3 |

Justification Statements:

CO1: Understand the concepts and types of machine learning algorithms.

Action Verb : Understand (L2)

PO1 Verb : Apply(L3)

CO1 Action verb is greater level of PO1verb. Therefore, the correlation is High (3)

PO2 Verb : Review(L2)

CO1 Action verb is same as PO2 verb. Therefore the correlation is High(3)

PO3: Develop (L3)

CO1 Action verb is greater level of PO3 verb. Therefore, the correlation is High (3)

PO4: Analyze (L4)

CO1 Action verb is greater level of PO4 verb. Therefore, the correlation is High (3)

PO5 Verb : Apply(L3)

CO1 Action verb is greater level of PO5 verb. Therefore, the correlation is High (3)

PO6: Thumb rule

Some of the machine learning models will provide solutions to current societal problems. Therefore the correlation is medium (2)

CO2: Analyze the suitable machine learning algorithms for classification, regression, and clustering.

Action Verb : Analyze (L4)

PO1: Apply(L3)

CO4 Action verb is less than PO1 by one level. Therefore, the correlation is Moderate (2).

PO2 Verb : Review(L2)

CO4 Action verb is less than PO2 by two level. Therefore the correlation is low (1).

PO3: Develop (L3)

CO4 Action verb verb is less than PO3 by one level. Therefore, the correlation is Moderate (2).

PO4: Analyze (L4)

CO4 Action verb is greater than PO4 verb. Therefore the correlation is High(3)

PO5 Verb : Apply(L3)

CO4 Action verb is less than PO5 verb by one level. Therefore, the correlation is Moderate (2).

PO8 : Thumb rule

While creating hypothesis one need to follow the ethical principles. Therefore, the correlation is High (3)

PO11: Thumb rule

In current scenario all machine learning models are updating so one needs to follow the change. Therefore, the correlation is high (3)

CO3: Evaluate the model performance and perform model tuning.

Action Verb : Evaluate (L5)

PO1 Verb : Apply(L3)

CO3 Action verb is less than PO1 verb by two level. Therefore, the correlation is low (1).

PO2 Verb : Apply(L3)

CO3 Action verb is less than PO2 verb by two level. Therefore the correlation is low (1).

PO3: Develop (L3)

CO3 Action verb is less than PO3 verb by two level. Therefore, the correlation is low (1).

PO4: Analyze (L4)

CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is Moderate(2).

PO5 Verb : Apply(L3)

CO3 Action verb is less than PO5 verb by two level. Therefore, the correlation is low (1).

CO4: Apply the ML algorithms in real-life domains such as NLP, finance, and healthcare.

Action Verb : Apply(L3)

PO1: Apply(L3)
CO4 Action verb is same as the PO1 verb. Therefore, the correlation is High (3).
PO2 Verb : Review(L2)
CO4 Action verb is less than PO2 verb by one level . Therefore the correlation is Moderate(2).
PO3: Develop (L3)
CO4 Action verb is same as the PO3 verb. Therefore, the correlation is High (3).
PO4: Analyze (L4)
CO4 Action verb is greater than PO4 verb. Therefore the correlation is High(3)
PO5 Verb : Apply(L3)
CO4 Action verb is same as the PO1 verb. Therefore, the correlation is High (3).
PO8 : Thumb rule
some ethical principles will apply while training a model using discrimination mothods. Therefore, the correlation is High (3)
PO11: Thumb rule
In today's world training a machine is big challenge to the developers, it is a continuous learning process. Therefore, the correlation is high (3)

CO5: Analyze the Utilize tools like Scikit-learn, TensorFlow, and PyTorch for practical ML solutions.
Action Verb : Analyze (L4)
PO1: Apply(L3)
CO5 Action verb is less than one level of PO1 verb. Therefore, the correlation is Medium (2)
PO2 Verb : Review(L2)
CO5 Action verb is less than two level of PO2 verb. Therefore the correlation is Low(1)
PO3: Develop (L3)
CO5 Action verb is less than one level of PO3 verb. Therefore, the correlation is Medium (2)
PO5 Verb : Apply(L3)
CO5 Action verb is less than one level of PO3 verb. Therefore, the correlation is Medium (2)

Course Code	Year & Sem	DIGITAL ELECTRONICS	L	T	P	C
23AOE0402	III-II	(Open Elective-II)	2	1	0	3

Course Outcomes:

CO1: Understand the logic gates and minimization of Boolean functions using K-Maps.
CO2: Analyze the design procedure of Arithmetic circuits and code conversions using logic gates.
CO3: Analyze the design concepts of combinational logic circuits using logic gates.
CO4: Analyze the design aspects of sequential logic circuits using flip flops.
CO5: Understand various programmable logic devices and digital ICs.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the logic gates and minimization of Boolean functions using K-Maps.	using K-Maps		L2
CO2	Analyze	the design procedure of Arithmetic circuits and code conversions using gates.	using logic gates.		L4
CO3	Analyze	the design concepts of combinational logic circuits	using logic gates.		L4
CO4	Analyze	the design aspects of sequential logic circuits using flip flops.	using flip flops.		L4
CO5	Understand	various programmable logic devices and digital ICs.			L2

UNIT – I		21Hrs

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Introduction to Logic Gates, Ex-OR, Ex-NOR operations, Minimization of Switching Functions: Karnaugh map method, Logic function realization: AND-OR, OR-AND and NAND/NOR realizations.

UNIT – II		12Hrs

Introduction to Combinational Design 1: Binary Adders, Subtractors and BCD adder, Code converters - Binary to Gray, Gray to Binary, BCD to excess3, BCD to Seven Segment display

UNIT – III		19Hrs

Combinational Logic Design 2: Decoders, Encoders, Priority Encoder, Multiplexers, Demultiplexers, Comparators, Implementations of Logic Functions using Decoders and Multiplexers.

UNIT – IV		12Hrs

Sequential Logic Design: Latches, Flip-flops, S-R, D, T, JK and Master-Slave JK FF, Edge triggered FF, set up and hold times, Ripple counters, Shift registers

UNIT – V		11Hrs

Programmable Logic Devices: ROM, Programmable Logic Devices (PLA and PAL).
Digital IC's: Decoder (74x138), Priority Encoder (74x148), multiplexer (74x151) and de-multiplexer (74x155), comparator (74x85).

Textbooks:

1. Digital Design, M.Morris Mano & Michel D. Ciletti, 5th Edition, Pearson Education, 1999.
2. Switching theory and Finite Automata Theory, ZviKohavi and NirahK.Jha, 2nd Edition, Tata McGraw Hill, 2005.

Reference Books:
1. Fundamentals of Logic Design, Charles H Roth,Jr., 5th Edition, Brooks/cole Cengage Learning, 2004

Online Learning Resources:

Nptel videos

Mapping of Course Outcomes with Program Outcomes

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

Correlation matrix

Unit No.	CO Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
1	14	18%	2	Understand	L2	PO1 PO2 PO3 PO4	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop (L3) PO4: Analyze (L4)	2 2 2 1
2	18	23%	4	Analyze	L4	PO1 PO2 PO3 PO4	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop (L3) PO4: Analyze(L4)	3 3 3 3
3	14	18%	4	Analyze	L4	PO1 PO2 PO3 PO4	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop (L3) PO4: Analyze(L4)	3 3 3 3
4	16	21%	4	Analyze	L4	PO1 PO3 PO4	PO1: Apply (L3) PO3: Develop (L3) PO4: Analyze(L4)	3 3 3
5	16	20%	2	Understand	L2	PO1 PO2 PO3	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop (L3)	2 2 2
	76	100 %						

Justification Statements:
CO1: Understand the logic gates and minimization of Boolean functions using K-Maps.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3) CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2 Verbs: Identify (L3) CO1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3 Verbs: Develop (L3) CO1 Action Verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO4 Verbs: Analyze (L4) CO1 Action verb is less than PO4 verb by two levels. Therefore, the correlation is low (1)
CO2: Analyze the design procedure of Arithmetic circuits and code conversions using logic gates.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3) CO2 Action verb is more than PO1 verb by one level. Therefore, the correlation is high (3)
PO2 Verbs: Identify (L3) CO2 Action verb is more than PO2 verb by one level. Therefore, the correlation is high (3)
PO3 Verbs: Develop (L3) CO2 Action verb is more than PO3 verb by one level. Therefore, the correlation is high (3)
PO4 Verbs: Analyze (L4) CO2 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).
CO3: Analyze the design concepts of combinational logic circuits using logic gates.
Action Verb: Analyze (L4)
PO1 Verbs: CO3 Action verb is more than PO1 verb by one level. Therefore, the correlation is high (3).
PO2 Verbs: CO3 Action verb is more than PO2 verb by one level. Therefore, the correlation is high (3).
PO3 Verb: CO3 Action verb is more than PO3 verb by one level. Therefore, the correlation is high (3).
PO4 Verbs: CO3 Action Verb is equal to PO4 verb, therefore correlation is high (3).
CO4: Analyze the design aspects of sequential logic circuits using flip flops.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3) CO4 Action verb is more than PO1 verb by one level. Therefore, the correlation is high (3).
PO2 Verb: Identify (L3) CO4 Action verb is more than PO3 verb by one level. Therefore, the correlation is high (3).
PO4 Verb: Develop (L3) CO4 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).
CO5: Understand various programmable logic devices and digital ICs.
Action Verb: Understand (L2)
PO1 Verb: CO5 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2 verb: CO5 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO3 verb: CO5 Action Verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).

Course Code	Year & Sem	ML MODEL OPTIMIZATION LAB	L	T	P	C
23APC3310	III-II	(Open Elective-II)	0	0	3	1.5

Course Outcomes

After studying the course, student will be able to

CO1: Apply hyper-parameter tuning, cross-validation techniques to improve ML model performance.

CO2: Analyze the model optimization methods like Bayesian optimization, regularization, and early stopping.

CO3: Create efficient neural networks using pruning, quantization-aware training, and knowledge distillation.

CO4: Evaluate model performance using advanced metrics and inference optimization tools.

CO5: Design automated machine learning workflows, model deployment optimization using TFLite /ONNX in edge devices.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Apply**	hyperparameter tuning, cross-validation techniques		to improve ML model performance	L3
CO2	**Analyze**	the model optimization methods like Bayesian optimization, regularization, and early stopping.			L4
CO3	**Create**	efficient neural networks	using pruning, quantization-aware training, and knowledge distillation.		L6
CO4	**Evaluate**	model performance	using advanced metrics and inference optimization tools.		L5
CO5	**Design**	automated machine learning workflows, model deployment optimization	using TFLite /ONNX in edge devices.		L6

List of Lab Experiments:

1. Implementing Grid Search and Random Search
   o Hyperparameter tuning using Scikit-learn's GridSearchCV and
     RandomizedSearchCV
     (Cognitive Level: Apply & Analyze)
2. Bayesian Optimization using Hyperopt / Optuna
   o Optimize model hyperparameters using probabilistic approaches
     (Cognitive Level: Analyze & Evaluate)
3. Early Stopping in Training Deep Learning Models
   o Implement early stopping to avoid overfitting with TensorFlow/Keras
     (Cognitive Level: Apply & Evaluate)
4. Regularization Techniques (L1, L2, Dropout)
   O Apply different regularization methods to improve model generalization (Cognitive

Level: Analyze)
5. Cross-Validation Techniques
   o K-Fold, Stratified K-Fold, and Leave-One-Out Cross-Validation
        (Cognitive Level: Apply & Evaluate)
6. Model Performance Evaluation
   o Use confusion matrix, precision, recall, F1-score, AUC-ROC for performance
   (Cognitive Level: Evaluate)
7. Model Pruning
   O Prune unimportant weights in a trained neural network using PyTorch/TensorFlow
   (Cognitive Level: Create & Evaluate)
8. Quantization Aware Training (QAT)
   o   Train a quantized model to reduce memory usage without losing accuracy
       (Cognitive Level: Apply & Create)
9. Knowledge Distillation
   o Transfer knowledge from a large model to a small one (student-teacher model) (Cognitive Level:
   Analyze & Create)
10. Optimizing Model Inference Time
• Use ONNX, TensorRT, or OpenVINO for faster model inference
   (Cognitive Level: Apply & Evaluate)
11. Automated Machine Learning (AutoML)
• Use Auto-Sklearn, Google AutoML, or TPOT for full pipeline optimization
   (Cognitive Level: Evaluate & Create)
12. Model Deployment Optimization
• Optimize model for deployment using TFLite/ONNX in edge devices
   (Cognitive Level: Create & Evaluate)

Text Books:
1. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow,
   O'Reilly.
2. Sebastian Raschka, Python Machine Learning, Packt Publishing.
3. Francois Chollet, Deep Learning with Python, Manning.

Reference Books:
1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning.
3. Vijay Madisetti, Machine Learning and Optimization Models for Real-Time Applications, Springer.

Mapping of course outcomes with program outcomes

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

Correlation Matrix:

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				Apply	L3	PO1 PO2 PO4 PO5 PO6	PO1: Apply(L3) PO2: Identify(L3) PO4: Analyze(L4) PO5:Apply(L3) PO6:Thumb rule	3 3 2 3 2
2				Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify(L3) PO3: Apply (L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 3 3
3				Create	L6	PO1 PO2 PO4 PO5 PO6	PO1: Apply(L3) PO2: Identify (L3) PO4: Design(L6) PO5: Create(L6) PO6: Thumb rule	3 3 3 3 3
4				Evaluate	L5	PO1 PO2 PO3 PO4	PO1: Apply(L3) PO2: Formulate (L6) PO3: Develop (L6) PO4: Analyze(L4)	3 2 2 3
5				Design	L6	PO1 PO2 PO3 PO5 PO6 PO11	PO1: Apply(L3) PO2: Formulate (L6) PO3: Develop(L6) PO5: Apply(L3) PO6: Thumb rule PO11: Thumb rule	3 3 3 3 3 3

Justification Statements:
CO1: Apply hyperparameter tuning, cross-validation techniques to improve model performance.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action verb is same as PO1 verb. Therefore the correlation is high(3)
PO2 Verb: Identify(L3)
CO1 Action verb is same as PO2 verb. Therefore the correlation is high(3)
PO4: Analyze(L4)
CO1 Action verb is one less than PO4 verb. Therefore the correlation is moderate(2)
PO5:Apply(L3)
CO1 Action verb is same as P51 verb. Therefore the correlation is high(3)
PO6:Thumb rule
Tune hyperparameters and validate models using cross-validation to balance bias, variance, and ensure robust generalization.

CO2: Analyze the model optimization methods like Bayesian optimization, regularization, and early stopping.
Action Verb: Analyze (L4)

PO1: Apply (L3)
CO2 Action verb is more than PO1 verb. Therefore the correlation is high (3)
PO2: Identify (L3)

CO2 Action verb is more than PO1 verb. Therefore the correlation is high (3)
PO3: Apply (L3)
CO2 Action verb is more than PO1 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is same as PO4 verb. Therefore the correlation is high(3)
PO5: Apply (L3)
CO2 Action verb is same as PO5 verb. Therefore the correlation is high (3).

CO3: Create efficient neural networks using pruning, quantization-aware training, and knowledge distillation.
Action Verb: create(L6)
PO1: Apply (L3)
Action verb is greater than PO1 verb. Therefore the correlation is high (3)
PO2: Identify (L3)
Action verb is greater than PO2 verb. Therefore the correlation is high (3).
PO4: Design (L6)
Action verb is greater than PO4 verb. Therefore the correlation is high (3)
PO5: Create (L6)
CO3 Action verb is same as PO5 verb. Therefore the correlation is high (3)
PO6: Thumb rule
Reduce model size and complexity using pruning, quantization, and distillation without compromising accuracy or performance.

CO4: Evaluate model performance using advanced metrics and inference optimization tools.
Action Verb: Evaluate (L5)
PO1:Apply(L3)
CO4 Action verb is more than PO1 verb. Therefore the correlation is high (3)
PO2: Formulate (L6)
CO4 Action verb is less than PO2 verb by one level. Therefore the correlation is moderate (2)
PO3: Develop (L6)
CO4 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate (2)
PO4: Analyze(L4)
CO4 Action verb is greater than PO4 verb . Therefore the correlation is high (3)

CO5: Design automated machine learning workflows, model deployment optimization using TFLite /ONNX in edge devices.
Action Verb: Design(L6)
PO1 Verb: Apply (L3)
CO5 Action verb is greater than PO1 verb . Therefore the correlation is high (3)
PO2 Verb: Formulate (L3)
CO5 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO3: Develop(L6)
CO5 Action verb is same as PO3 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO5 Action verb is greater than PO5 verb . Therefore the correlation is high (3)
PO6: Thumb rule
Design AI workflows and deploy lightweight models that are safe, ethical, and accessible for real-world use in resource-constrained environments.
PO11: Thumb rule
Design and deploy AI systems with a focus on scalability, cost-efficiency, and effective resource management for real-world and edge applications

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem		L	T	P	C
23APC3312	**III-II**	**EDGE COMPUTING LAB**	**0**	**0**	**3**	**1.5**

Course Outcomes:

After studying the course, student will be able to

CO1: Understand Students will be able to practically implement edge computing applications using real-world platforms and tools.

CO2: Apply Students gain experience in deploying lightweight ML models on edge devices, manage data flow between edge and cloud, and ensure system performance under limited computing and networking resources.

CO3: understand the students how to optimize latency, power consumption, and reliability of edge solutions for smart environments.

CO4: Understand the concepts of Machine Learning with different Perspectives.

CO5: Analyze the Decision Tree Representation with different problems& issues.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	Students will be able to practically implement edge computing	using real-world platforms and tools.		L2
CO2	Apply	Students gain experience in deploying lightweight ML models		on edge devices,	L3
CO3	Understand	the students how to optimize latency, power consumption,		for smart environments.	L2
CO4	Understand	the concepts of Machine Learning with different Perspectives.			L2
CO5	Analyze	the Decision Tree Representation with different problems& issues			L4

S.no	List Of Experiments
1	Setup and Configuration of Edge Devices. o Raspberry Pi/Jetson Nano installation, SSH, GPIO control
2	Data Acquisition from Sensors o Reading data from temperature, motion, and environmental sensors
3	Deploying a Lightweight ML Model on Edge o Using TensorFlow Lite or PyTorch Mobile for deployment
4	Real-Time Image Classification at the Edge o Using camera module with edge device for inference
5	MQTT-Based Edge Communication o Setup publisher/subscriber model for edge-to-cloud communication
6	Integrating Edge Devices with Cloud Platforms o AWS IoT, Azure IoT Hub, or Google Cloud IoT integration
7	Edge Device Power and Latency Monitoring o Measuring latency and energy consumption during model inference
8	Edge AI Application – Smart Surveillance System o Face or object detection on live video stream using OpenCV
9	Streaming Data Analytics on Edge o Local aggregation and event processing with Kafka or lightweight alternatives
10	Model Optimization for Edge Deployment

11	Quantization, pruning, and compression for reducing model size TinyML for Microcontroller-Based Inference
12	Deploy a model on Arduino/Nano BLE using TensorFlow Lite Micro Edge-Orchestrated Federated Learning Prototype • Basic FL setup using two edge devices sharing a model

Textbooks

Perry Lea, Edge Computing: From Hype to Reality, Manning Publications.

Reference Books:

Flavio Bonomi, Fog and Edge Computing: Principles and Paradigms, Wiley.

Mapping of course outcomes with program outcomes

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

Correlation matrix:

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Identify(L3)	3 2
2				Apply	L3	PO1 PO2 PO3 PO4 PO5 PO6	PO1: Apply(L3) PO2: Identify(L3) PO3: Apply (L3) PO4: Analyze (L4) PO5: Apply (L3) PO6: Thumb rule	3 3 3 2 3 2
3				Understand	L2	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3: Design(L6) PO4: Analyze (L4) PO5: Create(L6)	2 2 3 3 1
4				Understand	L2	PO1 PO2 PO3 PO5 PO6	PO1: Apply(L3) PO2: Analysis(L4) PO3: Develop(L3) PO5: Apply (L3) PO6: Thumb Rule	2 2 1 2 2
5				Apply	L3	PO1 PO3 PO5 PO11	PO1: Apply(L3) PO3: Develop(L3) PO5: Apply (L3) PO11:Thumb Rule	3 3 3 2

Justification Statements:
CO1: Understand Students will be able to practically implement edge computing applications using real-world platforms and tools.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)
PO2 Verb: Identify (L3)
CO1 Action verb is less than PO2 verb by one level. Therefore, the correlation is moderate (2)
CO2: Apply Students gain experience in deploying lightweight ML models on edge devices,

manage data flow between edge and cloud, and ensure system performance under limited computing and networking resources.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Identify (L3)
CO2 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
PO3: Apply (L3)
CO2 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is less than PO4 verb by one level. Therefore the correlation is Moderate (2)
PO5: Apply (L3)
CO2 Action verb is same as PO5 verb. Therefore the correlation is high (3)

CO3: understand the students how to optimize latency, power consumption, and reliability of edge solutions for smart environments.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO3 Action verb is more than PO1 verb. Therefore the correlation is high (3)
PO2: Identify (L3)
CO3 Action verb more than PO2 verb. Therefore the correlation is high (3)
PO3: Design (L6)
CO3 Action verb less than PO2 verb by two levels. Therefore the correlation is low (1)
PO4: A nalyze (L4)
CO3 Action verb is same level as PO4 verb. Therefore the correlation is high (3)
PO5: Create (L6)
CO3 Action verb less than PO5 verb by two levels. Therefore the correlation is low (1)

CO4: Understand the concepts of Machine Learning with different Perspectives.
Action Verb: Understand (L2)
PO1: Apply(L3)
CO4 Action verb is less than PO1 verb by one level. Therefore the correlation is Moderate (2)
PO2: Analysis(L4)
CO4 Action verb is less than PO2 verb by two level. Therefore the correlation is Low(1)
PO3: Develop(L3)
CO4 Action verb is less than PO3 verb by one levels. Therefore the correlation is Moderate (2)
PO5: Apply (L3)
CO4 Action verb is less than PO5 verb by two levels. Therefore the correlation is Moderate (2)
PO6: Thumb rule
Since we are developing the machine Learning Models and applications. Therefore the correlation is Moderate (2)

CO5: Analyze the Decision Tree Representation with different problems& issues.
Action Verb: Appy (L3)
PO1: Apply(L3)
CO5 Action verb is same as PO1 verb. Therefore the correlation is High (3)
PO3: Develop(L3)
CO5 Action verb is same as PO3 verb. Therefore the correlation is High (3).
PO5: Apply (L3)
CO5 Action verb is same as PO3 verb. Therefore the correlation is High (3).
PO11: ThumbRule
We are using the Decision Tree in lifelong Learning. Therefore the correlation is moderate (2)

Course Code	Year & Sem	FULL STACK DEVELOPMENT-II Skill Enhancement Course	L	T	P	C
23ASC3301	III-II		1	0	2	2

Course Outcomes:

After Studying the Course Student will able to

CO1: Understand the Structure and working of DOM, basic ES6 concepts.

CO2: Analyze the differences between Real DOM and Virtual DOM in terms of performance.

CO3: Apply key React.js concepts and the Fetch API to develop interactive web applications.

CO4: Apply database connectivity using MySQL in web applications.

CO5: Design dynamic backend systems by integrating MySQL databases with Express.js servers.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	**the** Structure and working of DOM, basic ES6 concepts.			L2
CO2	Analyze	the differences between Real DOM and Virtual DOM		in terms of performance.	L4
CO3	Apply	key React.js concepts and the Fetch API		to develop interactive web applications.	L3
CO4	Apply	database connectivity	using MySQL in web applications.		L3
CO5	Design	dynamic backend systems by integrating MySQL databases		with Express.js servers.	L6

Sample Experiments:

1. Introduction to Modern JavaScript and DOM[CO1]

a. Write a JavaScript program to link JavaScript file with the HTML page

b. Write a JavaScript program to select the elements in HTML page using selectors

c. Write a JavaScript program to implement the event listeners

d. Write a JavaScript program to handle the click events for the HTML button elements

e. Write a JavaScript program to With three types of functions

  i. Function declaration

  ii. Function definition

  iii. Arrow functions

2. Basics of React.js[CO1]

a. Write a React program to implement a counter button using react class components

b. Write a React program to implement a counter button using react functional components

c. Write a React program to handle the button click events in functional component

d. Write a React program to conditionally render a component in the browser

e. Write a React program to display text using String literals

3. Important concepts of React.js[CO3]

a. Write a React program to implement a counter button using React use State hook

b. Write a React program to fetch the data from an API using React use Effect hook

c. Write a React program with two react components sharing data using Props.

d. Write a React program to implement the forms in react

e. Write a React program to implement the iterative rendering using map() function.

4. Introduction to Node.js and Express.js[CO4]

a. Write a program to implement the _hello world' message in the route through the browser using Express

b. Write a program to develop a small website with multiple routes using Express.js

c. Write a program to print the _hello world' in the browser console using Express.js

d. Write a program to implement the CRUD operations using Express.js

e. Write a program to establish the connection between API and Database using Express – MySQL driver

5. Introduction to MySQL[CO5]

a. Write a program to create a Database and table inside that database using MySQL Command line client

b. Write a MySQL queries to create table, and insert the data, update the data in the table

c. Write a MySQL queries to implement the subqueries in the MySQL command line client

d. Write a MySQL program to create the script files in the MySQL workbench

e. Write a MySQL program to create a database directory in Project and initialize a database. sql file to integrate the database into API.

Mapping of course outcomes with program outcomes

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

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

Correlation matrix

Unit No.	Co"s Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
1	CO1:Understand	L2	PO1 PO2 PO5 PO11	PO1: Apply(L3) PO2: Review(L2) PO5: Apply(L3) PO11: Thumb rule	2 3 2 2
2	CO2:Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO9	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO9: Thumb rule	3 3 3 3 3 3
3	CO3: Apply	L3	PO1 PO2 PO3 PO4 PO5 PO11	PO1:Apply(L3) PO2:Review(L2) PO3:Develop(L3) PO4:Analyze (L4) PO5:Apply(L3) PO11: Thumb rule	3 3 3 2 3 2
4	CO4:Apply	L3	PO1 PO2 PO3 PO4 PO5 PO11	PO1:Apply(L3) PO2:Review(L2) PO3:Develop(L3) PO4:Analyze (L4) PO5:Apply(L3) PO11: Thumb rule	3 3 3 2 3 2
5	CO5:Design	L6	PO1 PO2 PO3 PO5 PO9 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO3:Create(L6) PO5: Apply (L3) PO9: Thumb rule PO11: Thumb rule	3 3 3 3 3 3

Justification Statements:

CO1: Understand the Structure and working of DOM, basic ES6 concepts.

Action Verb : Understand (L2)

PO1 Verb : Apply(L3)

CO1 Action verb is less than PO1 verb by one, Therefore the correlation is moderate (2)

PO2 Verb : Review(L2)

CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO5 Verb : Apply(L2)

CO1 Action verb is less than PO5 verb by one, Therefore the correlation is moderate (2)

PO11: Thumb rule

Recognize the structurs and working of DOM as life-long learning . Therefore the correlation is moderate (2)

CO2: Analyze the differences between Real DOM and Virtual DOM in terms of performance.

Action Verb : Analyze (L4)

PO1: Apply(L3)

CO2 Action verb is greater level of PO1 verb. Therefore, the correlation is High (3)

PO2: Review (L2)

CO2 Action verb is greater than level as PO2 verb by one. Therefore, the correlation is high (3)

PO3: Develop (L3)

CO2 Action verb is greater than PO3 verb. Therefore the correlation is high (3)

PO4: Analyze (L4)

CO2 Action verb is same PO4 verb. Therefore the correlation is high (3)

PO5: Apply(L3)

CO2 Action verb is same level as PO5 verb. Therefore, the correlation is high (3)

PO9: Thumb rule

Communicate effectively and inclusively with real and virtual DOM learning differences . Therefore, the correlation is high (3)

CO3: Apply key React.js concepts and the Fetch API to develop interactive web applications.

Action Verb: Apply (L3)

PO1: Apply(L3)

CO3 Action verb is same level of PO1 verb. Therefore the correlation is high (3)

PO2: Review(L2)

CO3 Action verb is greater than PO2 verb. Therefore the correlation is high (3)

PO3: Develop(L2)

CO3 Action verb is greater than PO3 verb. Therefore the correlation is high (3)

PO4: Analyze(L2)

CO3 Action verb is less than of PO4 verb. Therefore the correlation is moderate (2)

PO5: Apply(L3)

CO3 Action verb is greater than PO5 verb. Therefore, the correlation is high (3)

PO11: Thumb rule

Recognize the key concepts to develop interactive web applications as life-long learning . Therefore the correlation is moderate (2)

CO4: Apply database connectivity using MySQL in web applications.

Action Verb: Apply(L3)

PO1: Apply(L3)

CO4 Action verb is same level of PO1 verb. Therefore the correlation is high (3)

PO2: Review(L2)

CO4 Action verb is greater than PO2 verb. Therefore the correlation is high (3)

PO3: Develop(L2)

CO4 Action verb is greater than PO3 verb. Therefore the correlation is high (3)

PO4: Analyze(L2)

CO4 Action verb is less than of PO4 verb. Therefore the correlation is moderate (2)

PO5: Apply(L3)

CO4 Action verb is greater than PO5 verb. Therefore, the correlation is high (3)

PO11: Thumb rule

Learning database connectivity often requires consulting external resources, documentation, updates

independently ,Therefore the correlation is moderate (2)

CO5: Create dynamic backend systems by integrating MySQL databases with Express.js servers.
Action Verb: Create(L6)
PO1: Apply(L3)
CO5 Action verb is same level of PO1 verb. Therefore the correlation is high (3)
PO2: Analyze(L4)
CO5 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO3:Create(L6)
CO5 Action verb is greater than PO3 verb. Therefore the correlation is high (3)
PO5: Apply (L3)
CO5 Action verb is same level of PO5 verb. Therefore the correlation is high (3)
PO9: Thumb rule
Backend projects are often team-based, requiring coordination and shared version control. Therefore the correlation is high (3)
PO11: Thumb rule
Requires continuous learning of evolving Node.js, Express, and MySQL technologies. Therefore the correlation is high (3)

Course Code	Year & Sem	Technical Paper Writing & IPR	L	T	P	C
23AMC9902	III-II	Audit Course	2	0	0	-

Course Outcomes (CO): Student will be able to		
CO1	Understand various principles and styles of technical writing by avoiding confusion, repetition, unclear language and plagiarism.	L2
CO2	Apply the fundamentals of technical research paper writing by organizing abstract, objectives, limitations, literature review to frame effective research questions.	L3
CO3	Apply the research process and publication mechanisms and follow citation rules and proofreading techniques for paper writing.	L3
CO4	Evaluate the rights and responsibilities of the holder of Intellectual Property.	L5
CO5	Apply various forms of copy rights and patents at national and international levels.	L3

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	various principles and styles of technical writing by avoiding confusion, repetition, unclear language and plagiarism.	by avoiding confusion, repetition,unclear language and plagiarism.		L2
2	Apply	the fundamentals of technical research paper writing by organizing abstract, objectives, limitations, literature review to frame effective research questions.	by organizing abstract, objectives, limitations, literature review to frame effective research questions.		L3
3	Apply	the research process and publication mechanisms and follow citation rules and proofreading techniques for paper writing.		for paper writing.	L3
4	Evaluate	rights and responsibilities of holder of Patent, Copyright, trademark, International Trademark etc.			L5
5	Apply	various forms of copy rights and patents at national and international levels		At national and international levels	L3

UNIT – I:

Principles of Technical Writing: styles in technical writing; clarity, precision, coherence and logical sequence in writing-avoiding ambiguity- repetition, and vague language -highlighting your findings-discussing your limitations -hedging and criticizing -plagiarism and paraphrasing.

Technical Research Paper Writing: Abstract- Objectives-Limitations Review of Literature- Problems and Framing Research Questions- Synopsis

UNIT – III:

Process of research: publication mechanism: types of journals- indexing-seminars- conferences-proof reading –plagiarism style; seminar & conference paper writing; Methodology-discussion-results- citation rules

UNIT – IV:

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights
Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting technical evaluating trade mark, trade mark registration processes

UNIT – V:

Law of copy rights: Fundamentals of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law
Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer, Patent law, intellectual property audits.

Textbooks:

1. Deborah. E. Bouchoux, *Intellectual Property Rights*, Cengage Learning India, 2013
2. Meenakshi Raman, Sangeeta Sharma. *Technical Communication: Principles and practices.* Oxford.

Reference Books:

1. R.Myneni, *Law of Intellectual Property*, 9th Ed, Asia law House, 2019.
2. Prabuddha Ganguli, *Intellectual Property Rights* Tata Mcgraw Hill, 2001
3. P.Naryan, *Intellectual Property Law*, 3rd Ed, Eastern Law House, 2007.
4. Adrian Wallwork. *English for Writing Research Papers* Second Edition. Springer Cham Heidelberg New York ,2016
5. Dan Jones, Sam Dragga, *Technical Writing Style*

Online Resources

1. **https://theconceptwriters.com.pk/principles-of-technical-writing/**

2. **https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPa perWriting.h tml**

3. **https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPa perWriting.h tml**

4. **https://www.manuscriptedit.com/scholar-hangout/process-publishing-research-paper- journal/**

5. **https://www.icsi.edu/media/website/IntellectualPropertyRightLaws&Practice.pdf**

6. **https://lawbhoomi.com/intellectual-property-rights-notes/**

7. **https://www.extension.purdue.edu/extmedia/ec/ec-723.pdf**

SCorrelation of COs with the POs & PSOs

Course Title	Course Outcomes COs	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11
TECHNICAL PAPER WRITING AND INTELLECTUAL PROPER RIGHTS (Audit Course)	CO1									2		
	CO2		3									
	CO3									2		2
	CO4											3
	CO5											2

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1							Thumb Rule	
2							Thumb Rule	
3							Thumb Rule	
4							Thumb Rule	
5							Thumb Rule	

CO1: Understand various principles and styles of technical writing by avoiding confusion, repetition, unclear language and plagiarism.
Action Verb: Understand (L2)
CO1 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).

CO2: Apply the fundamentals of technical research paper writing by organizing abstract, objectives, limitations, literature review to frame effective research questions.
Action Verb: Apply (L3)
CO2 Action Verb Apply is of BTL 3. L3 is equal to PO2, then correlation is high (3)

CO3: Apply the research process and publication mechanisms and follow citation rules and proofreading techniques for paper writing.
Action Verb: Apply (L3)
CO3 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2)

CO4: Evaluate the rights and responsibilities of the holder of Intellectual Property.
Action Verb: Evaluate (L5)
CO4 Action Verb Analyze is of BTL 4. Using Thumb rule, L5 correlates PO6 to PO11 as high (3).

CO5: Apply various forms of copy rights and patents at national and international levels.
Action Verb: Apply (L3)
CO5 Action Verb Analyse is of BTL 4. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

Course Code	Year & Sem	DISASTER MANAGEMENT	L	T	P	C
23AOE0103	III-II	**(Open Elective-II)**	2	1	**0**	**3**

Course Outcomes: After studying the course, students will be able to

CO1	Understand the fundamental concepts of natural disasters, their occurrence and disaster risk reduction strategies.
CO2	Understand the impact of cyclones on structures and explore retrofitting techniques for adaptive reconstruction
CO3	Understand engineering principles and computational techniques in designing wind-resistant structures
CO4	Understand earthquake effects on buildings and develop strategies for seismic retrofitting.
CO5	Understand seismic safety planning, design considerations, and innovative construction materials for disaster-resistant structures

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	fundamental concepts of natural disasters, their occurrence		disaster risk reduction strategies	L2
2	Understand	impact of cyclones on structures and explore retrofitting techniques	for adaptive reconstruction	using various strain gauge techniques.	L2
3	Understand	engineering principles and computational techniques		in designing wind resistant structures	L2
4	Understand	earthquake effects on buildings and develop strategies		for seismic retrofitting	L2
5	Understand	seismic safety planning, design considerations, and innovative construction materials		for disaster-resistant structures	L2

UNIT-I
Introduction to Natural Disasters– Brief Introduction to Different Types of Natural Disasters, Occurrence of Disasters in Different Climatic and Geographical Regions, Hazard Maps (Earthquake and Cyclone) of The World and India, Regulations for Disaster Risk Reduction, Post-Disaster Recovery and Rehabilitation (Socioeconomic Consequences).
UNIT-II
Cyclones and Their Impact– Climate Change and Its Impact On Tropical Cyclones, Nature of Cyclonic Wind, Velocities and Pressure, Cyclone Effects, Storm Surges, Floods, and Landslides. Behavior of Structures in Past Cyclones and Windstorms, Case Studies. Cyclonic Retrofitting, Strengthening of Structures, and Adaptive Sustainable Reconstruction. Life-Line Structures Such as Temporary Cyclone Shelters.

UNIT-III
Wind Engineering and Structural Response– Basic Wind Engineering, Aerodynamics of Bluff Bodies, Vortex Shedding, and Associated Unsteadiness Along and Across Wind forces. Lab: Wind Tunnel Testing and Its Salient Features. Introduction to Computational Fluid Dynamics (CFD). General Planning and Design Considerations Under Windstorms and Cyclones. Wind Effects On Buildings, towers, Glass Panels, Etc., and Wind-Resistant Features in Design. Codal Provisions, Design Wind Speed, Pressure Coefficients. Coastal Zoning Regulations for Construction and Reconstruction in Coastal Areas. Innovative Construction Materials and Techniques, Traditional Construction Techniques in Coastal Areas.
UNIT-IV
Seismology and Earthquake Effects– Causes of Earthquakes, Plate Tectonics, Faults, Seismic Waves; Magnitude, Intensity, Epi center, Energy Release, and Ground Motions. Earthquake Effects– On Ground, Soil Rupture, Liquefaction, Landslides. Performance of Ground and Buildings in Past Earthquakes– Behavior of Various Types of Buildings and Structures, Collapse Patterns; Behavior of Non-Structural Elements Such as Services, Fixtures, and Mountings – Case Studies. Seismic Retrofitting– Weakness in Existing Buildings, Aging, Concepts in Repair, Restoration, and Seismic Strengthening.
UNIT-V
Planning and Design Considerations for Seismic Safety– General Planning and Design Considerations; Building forms, Horizontal and Vertical Eccentricities, Mass and Stiffness Distribution, Soft Storey Effects, Etc.; Seismic Effects Related to Building Configuration. Plan and Vertical Irregularities, Redundancy, and Setbacks. Construction Details– Various Types of Foundations, Soil Stabilization, Retaining Walls, Plinth Fill, Flooring, Walls, Openings, Roofs, Terraces, Parapets, Boundary Walls, Underground and Overhead Tanks, Staircases, and Isolation of Structures. Innovative Construction Materials and Techniques. Local Practices– Traditional Regional Responses. Computational Investigation Techniques.

TEXTBOOKS:
1. David Alexander, *Natural Disasters*, 1st Edition, CRC Press, 2017.
2. Edward A. Keller and Duane E. DeVecchio, *Natural Hazards: Earth's Processes as Hazards, Disasters, and Catastrophes*, 5th Edition, Routledge, 2019.

REFERENCES:
1. Ben Wisner, J.C. Gaillard, andIlanKelman (Editors), *Handbook of Hazards and Disaster Risk Reduction and Management,* 2nd Edition, Routledge, 2012.
2. Damon P. Coppola, *Introduction to International Disaster Management*, 4th Edition, Butterworth-Heinemann, 2020.
3. BimalKanti Paul, *Environmental Hazards and Disasters: Contexts, Perspectives and Management*, 2nd Edition, Wiley-Blackwell, 2020.

WEB RESOUCES:
https://nptel.ac.in/courses/124107010
https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

CORRELATION OF COS WITH THE POS & PSOS:

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

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1	Apply (L3)	2
						PO2	Analyze (L4)	2
						PO6	Thumb Rule	2
2				Understand	L2	PO1	Apply (L3)	2
						PO2	Analyze (L4)	2
						PO6	Thumb Rule	2

								PO1	Apply (L3)	2
3					Understand	L2		PO2	Analyze (L4)	2
								PO6	Thumb Rule	2
4					Understand	L2		PO1	Apply (L3)	2
								PO2	Analyze (L4)	2
								PO6	Thumb Rule	2
5					Understand	L2		PO1	Apply (L3)	2
								PO2	Analyze (L4)	2
								PO6	Thumb Rule	2

JUSTIFICATION STATEMENTS:
CO1: **Understand the fundamental concepts of natural disasters, their occurrence and disaster risk reduction strategies.**
Action Verb: Understand (L2)
PO1: Apply(L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO2: **Understand the impact of cyclones on structures and explore retrofitting techniques for adaptive reconstruction.**
Action Verb: Understand (L2)
PO1: Apply(L3)
CO2 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO2 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO2 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO3: **Understand engineering principles and computational techniques in designing wind-resistant structures**
Action Verb: Understand (L2)
PO1: Apply(L3)
CO3 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO3 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO3 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO4: **Understand earthquake effects on buildings and develop strategies for seismic retrofitting.**
Action Verb: Understand (L2)
PO1: Apply(L3)
CO4 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO4 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO4 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).
CO5: **Understand seismic safety planning, design considerations, and innovative construction materials for disaster-resistant structures**
Action Verb: Understand (L2)
PO1: Apply(L3)
CO5 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO5 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO5Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

Course Code	Year & Sem	SUSTAINABILITY IN ENGINEERING PRACTICES	L	T	P	C
23AOE0104	III-II	(Open Elective-II)	2	1	0	3

Course Outcomes: After studying the course, students will be able to

CO1	Understand concept of sustainability in the context of construction and CO_2 contribution of building materials along with their environmental impact
CO2	Understand the relation between construction materials and indoor air quality
CO3	Apply concepts to calculate embodied energy for commonly used construction materials using standard methodologies
CO4	Apply concepts of energy codes and green building rating systems for building envelops
CO5	Understand the environmental impacts and control methods of non-renewable energy sources

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	Concept of sustainability and CO_2 contribution of building materials along with their environmental impact		in the context of construction	L2
2	**Understand**	The relation between construction materials and indoor air quality			L2
3	**Apply**	concepts to calculate embodied energy for commonly used construction materials	using standard methodologies		L3
4	**Apply**	concepts of energy codes and green building rating systems		for building envelops	L3
5	**Understand**	the environmental impacts and control methods		of non-renewable energy sources	L2

UNIT-I

INTRODUCTION

Introduction and Definition of Sustainability - Carbon Cycle - Role of Construction Material: Concrete and Steel, Etc. - CO_2 Contribution from Cement and Other Construction Materials.

UNIT-II

MATERIALS USED in SUSTAINABLE CONSTRUCTION

Construction Materials and Indoor Air Quality - No/Low Cement Concrete - Recycled and Manufactured Aggregate - Role of QC and Durability - Life Cycle and Sustainability.

UNIT-III

ENERGY CALCULATIONS

Components of Embodied Energy - Calculation of Embodied Energy for Construction Materials - Energy Concept and Primary Energy - Embodied Energy Via-A-Vis Operational Energy in Conditioned Building - Life Cycle Energy Use

UNIT-IV

GREEN BUILDINGS

Control of Energy Use in Building - ECBC Code, Codes in Neighbouring Tropical Countries - OTTV Concepts and Calculations – Features of LEED and TERI – GRIHA Ratings – Role of Insulation and Thermal Properties of Construction Materials - Influence of Moisture Content and Modeling - Performance Ratings of Green Buildings - Zero Energy Building

UNIT-V

ENVIRONMENTAL EFFECTS

Non-Renewable Sources of Energy and Environmental Impact– Energy Norm, Coal, Oil, Natural Gas - Nuclear Energy - Global Temperature, Green House Effects, Global Warming - Acid Rain: Causes, Effects and Control Methods - Regional Impacts of Temperature Change.

TEXTBOOKS:
1. Charles J Kibert, Sustainable Construction: Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.

REFERENCES:
1. Craig A. Langston & Grace K.C. Ding, Sustainable Practicesin the Built Environment, Butterworth Heinemann Publishers, 2011.
2. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2012.

WEB RESOUCES:

https://archive.nptel.ac.in/courses/105/105/105105157/

CORRELATION OF COS WITH THE POS & PSOS:

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

CO-PO MAPPING JUSTIFICATION:

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
2				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
3				Apply	L3	PO1 PO2 PO4 PO6	Apply (L3) Analyze (L4) Analyze (L4) Thumb Rule	3 2 2 2
4				Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
5				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2

JUSTIFICATION STATEMENTS:

CO 1: Understand concept of sustainability in the context of construction and CO_2 contribution of building materials along with their environmental impact

Action Verb: Understand (L2)

PO1: Apply(L3)

CO 1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).

CO 1 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 2: Understand the relation between construction materials and indoor air quality

Action Verb: Understand (L2)

PO1: Apply(L3)

CO 2 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO 2 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).

CO 2 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

CO 3: Apply concepts to calculate embodied energy for commonly used construction materials using standard methodologies
Action Verb: Apply (L3)
PO1: Apply(L3)
CO 3 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 3: Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
PO4: Analyze (L4)
CO 3: Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO 3 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 4: Apply concepts of energy codes and green building rating systems for building envelops
Action Verb: Apply (L3)
PO1: Apply(L3)
CO 4 Action verb is equal to PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO 4: Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)
CO 4 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 5: Understand the environmental impacts and control methods of non-renewable energy sources
Action Verb: Understand (L2)
PO1: Apply(L3)
CO 5 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO 5 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
CO 5 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

Course Code	Year & Sem	RENEWABLE ENERGY SOURCES	L	T	P	C
23AOE0202	III-II	(Open Elective-II)	2	1	0	3

	After completion of the course, students will be able to:
CO1	Understand solar radiation concepts, solar angles, and solar energy collection and storage methods.
CO2	Analyze the working principles, technologies, characteristics, and configurations of solar PV systems.
CO3	Analyze the components, design, and performance factors of wind energy conversion systems.
CO4	Understand Geothermal energy sources, applications, and their potential in India.
CO5	Understand the working principles, technologies, and limitations of ocean, biomass, and fuel cell energy systems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
CO1	Understand	Solar radiation concepts, solar angles, and solar energy collection and storage methods			L2
CO2	Analyze	Working principles, technologies, characteristics, and configurations of solar PV systems			L4
CO3	Analyze	Components, design, and performance factors of wind energy conversion systems			L4
CO4	Understand	Geothermal energy sources, applications, and potential in India			L2
CO5	Understand	Working principles, technologies, and limitations of ocean, biomass, and fuel cell energy systems			L2

SYLLABUS

UNIT-I

TITLE: Solar Energy

Solar radiation - beam and diffuse radiation, solar constant, Sun at Zenith, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunset and day length. Flat plate collectors, concentrating collectors, storage of solar energy-thermal storage.

UNIT-II

TITLE: PV Energy Systems

Introduction, The PV effect in crystalline silicon basic principles, the film PV, Other PV technologies, Solar PV modules from solar cells, mismatch in series and parallel connections design and structure of PV modules, Electrical characteristics of silicon PV cells and modules, Stand-alone PV system configuration, Grid connected PV systems.

UNIT-III

TITLE: Wind Energy

Principle of wind energy conversion; Basic components of wind energy conversion systems; wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind mill blades; wind data and

energy estimation and site selection considerations.

UNIT-IV	
TITLE : **Geothermal Energy**	
Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application of geothermal energy, prospects of geothermal energy in India.	

UNIT-V	
TITLE: Miscellaneous Energy Technologies	
Ocean Energy: Tidal Energy-Principle of working, Operation methods, advantages and limitations. Wave Energy-Principle of working, energy and power from waves, wave energy conversion devices, advantages and limitations. Bio mass Energy: Biomass conversion technologies, Biogas generation plants, Classification, advantages and disadvantages, constructional details, site selection, digester design consideration. Fuel cell: Principle of working of various types of fuel cells and their working, performance and limitations.	

Text books:

1	G. D. Rai, ―Non-Conventional Energy Sources‖, 4th Edition, Khanna Publishers, 2000.
2	Chetan Singh Solanki ―Solar Photovoltaics fundamentals, technologies and applications‖ 2nd Edition PHI Learning Private Limited. 2012.

Reference books:

1	Stephen Peake, ―Renewable Energy Power for a Sustainable Future‖, Oxford International Edition, 2018.
2	S. P. Sukhatme, ―Solar Energy‖, 3rd Edition, Tata Mc Graw Hill Education Pvt. Ltd, 2008.
3	B H Khan, ― Non-Conventional Energy Resources‖, 2nd Edition, Tata Mc Graw Hill Education Pvt Ltd, 2011.
4	S. Hasan Saeed and D.K.Sharma, ―Non-Conventional Energy Resources‖, 3rd Edition, S.K.Kataria& Sons, 2012.
5	G. N. Tiwari and M.K.Ghosal, ―Renewable Energy Resource: Basic Principles and Applications‖, Narosa Publishing House, 2004.

Web Resources:

1	https://nptel.ac.in/courses/103103206
2	https://nptel.ac.in/courses/108108078

Mapping of Course outcomes with Program outcomes (High-3, Medium-2, Low-1)

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

Mapping of Course outcomes with Program outcomes Justification Table

CO No.	Lesson Plan (Hrs.)	%	CO correlation	Verb	BTL	Program Outcomes(PO)	PO(s): Action verb and BTL(for PO1 to PO5)	Level of correlation (1-3)
1				Understand	L2	**PO1, PO2, PO4, PO6**	**PO1:Apply(L3)** **PO2:Analyze(L4)** **PO4:Analyze(L4)** **PO6: Analyze(L4)**	2 1 1 1

2				Analyze	L4	**PO1, PO2, PO3, PO6**	**PO1:Apply(L3) PO2:Analyze(L4) PO3:Design(L6) PO6:Analyze(L4)**	3 3 1 3
3				Analyze	L4	**PO1, PO2, PO3, PO6**	**PO1:Apply(L3) PO2:Analyze(L4) PO3:DesignL6) PO6:Analyze(L4)**	3 3 1 3
4				Understand	L2	**PO1, PO6**	**PO1:Apply(L3) PO6:Analyze(L4)**	2 1
5				Understand	L2	**PO1, PO6**	**PO1:Apply(L3) PO6:Analyze(L4)**	2 1

CO1: Understand solar radiation concepts, solar angles, and solar energy collection and storage methods.
Action Verb: Understand (L2)
PO1Verbs: Apply (L3)
CO1 ActionVerb is less than PO1 verb by one level; Therefore, correlation is Moderate (2).
PO2 Verbs: Analyze (L4)
CO1 ActionVerb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO4 Verbs: Analyze (L4)
CO1 ActionVerb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO6 Verbs: Analyze (L4)
CO1 ActionVerb is Less than PO2 verb by two level; Therefore, correlation is low (1).
CO2: Analyze the working principles, technologies, characteristics, and configurations of solar PV systems.
Action Verb: Analyze (L4)
PO1Verbs: Apply (L3)
CO2 ActionVerb is Greater than PO1 verb by one level; Therefore, correlation is High (3).
PO2 Verbs: Analyze (L4)
CO2 ActionVerb is Same to PO2 verb ; Therefore, correlation is High (3).
PO3Verbs: Design (L6)
CO2 ActionVerb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO6 Verbs:Analyze (L4)
CO2 ActionVerb is Same to PO6 verb ; Therefore, correlation is High (3).
CO3: Analyze the components, design, and performance factors of wind energy conversion systems.
Action Verb: Analyze (L4)
PO1Verbs: Apply (L3)
CO3 ActionVerb is Greater than PO1 verb by one level; Therefore, correlation is High (3).
PO2 Verbs: Analyze (L4)
CO3 ActionVerb is Same to PO2 verb ; Therefore, correlation is High (3).
PO3Verbs: Design (L6)
CO3 ActionVerb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO6 Verbs:Analyze (L4)
CO3 ActionVerb is Same to PO6 verb ; Therefore, correlation is High (3).
CO4: Understand Geothermal energy sources, applications, and their potential in India.
Action Verb: Understand (L2)
PO1Verbs: Apply (L3)
 CO4 ActionVerb is less than PO1 verb by one level; Therefore, correlation is Moderate (2).
PO6 Verbs: Analyze (L4)
CO4 ActionVerb is less than PO2 verb by two level; Therefore, correlation is low (1).

CO5: Understand the working principles, technologies, and limitations of ocean, biomass, and fuel cell energy systems.

Action Verb: Understand (L2)

PO1Verbs: Apply (L3)

CO4 ActionVerb is less than PO1 verb by one level; Therefore, correlation is Moderate (2).

PO6 Verbs: Analyze (L4)

CO4 ActionVerb is less than PO2 verb by two level; Therefore, correlation is low (1).

Course Code	Year & Sem	Automation and Robotics	L	T	P	C
23AOE0302	III-II	(Open Elective-II)	2	1	0	3

Course Outcomes:

CO: 1	Explain the need, types, and elements of automation systems and analyze different levels of automation strategies in industry.
CO: 2	Demonstrate the operation of automated flow lines and apply methods for assembly line balancing and optimization.
CO: 3	Identify robotic components and describe their configuration, degrees of freedom, and industrial applications in various processes.
CO: 4	Apply transformation techniques and D-H notation to solve problems in robot kinematics and evaluate actuator and sensor selection.
CO: 5	Analyze robot dynamics using Jacobians and Euler formulations and develop suitable trajectories for obstacle-free motion.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	structure and functions of automated		manufacturing systems	L2
CO2	Analyze	automated flow lines with or without buffer storage		assembly line balancing	L3
CO3	Understand	robot configurations	production efficiency		L2
CO4	Apply	kinematic and dynamic modeling		real-world industrial scenario	L3
CO5	Create	program, and implement robotic systems		Manufacturing.	L6

Unit I: Introduction to Automation: Introduction to Automation, Need, Types, Basic elements of an automated system, Manufacturing Industries, Types of production, Functions in manufacturing, Organization and information processing in manufacturing, Automation strategies and levels of automation, Hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

Unit II
Automated flow lines: Automated flow lines, Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage, Quantitative analysis of flow lines. Assembly line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

Unit III
Introduction to Industrial Robotics: Introduction to Industrial Robotics, Classification of Robot Configurations, functional line diagram, degrees of freedom. Components common types of arms, joints grippers, factors to be considered in the design of grippers. Robot actuators and Feedback components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

Unit IV
Manipulator Kinematics: Manipulator Kinematics, Homogenous transformations as applicable to rotation and transition - D-H notation, Forward inverse kinematics. Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton – Euler formations. Trajectory Planning: Trajectory Planning and avoidance of obstacles path planning, skew motion, joint integrated motion - straight line motion.

Unit V
Robot Programming: Robot Programming, Methods of programming - requirements and features of programming languages, software packages. Problems with programming languages. Robot Application

in Manufacturing: Material Transfer - Material handling, loading and unloading - Process - spot and continuous arc welding & spray painting - Assembly and Inspection.

Text Books:
1. Automation, Production systems and CIM, M.P. Groover /4thEdition, Pearson education (2016)
2. Industrial Robotics - M.P. Groover, TMH (1996)

Reference Books:
1. Robotics, Fu K S, McGraw Hill, 4th edition, 2010.
2. An Introduction to Robot Technology, P. Coiffet and M. Chaironze, Kogam Page Ltd. 1983 London.
3. Robotic Engineering, Richard D. Klafter, Prentice Hall
4. Robotics, Fundamental Concepts and analysis – Ashitave Ghosal, Oxford Press, 1/e, 2006
5. Robotics and Control, Mittal R K & Nagrath I J, TMH.

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Automation & Robotics	CO1	3	3				3							
	CO2	3	3											
	CO3	3	3			3	2							
	CO4	3	3	3		2								
	CO5	3	3			3	1							

Correlation Matrix

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1				Understand	L2	PO1 PO2 PO6	Apply (L3) Identify (L3) Develop (L3)	2 2 2
2				Analyze	L3	PO1 PO2	Apply (L3) Identify (L3)	3 3
3				Understand	L2	PO1 PO2 PO5 PO6	Apply (L3) Identify (L3) Select (L1) Apply (L3)	2 2 3 2
4				Apply	L3	PO1 PO2 PO3 PO5	Apply (L3) Identify (L3) Create (L6) Create (L6)	3 3 3 3
5				Create	L6	PO1 PO2 PO5 PO6	Apply (L3) Identify (L3) Create (L6) Apply (L3)	3 3 3 3

Justification Statements:
CO1: Understand the structure and functions of automated manufacturing systems for efficient production.
Action Verb: Understand (L2)
PO1 Verb: **Apply (L3)**
CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**
CO1: Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO6 Verb: **Develop (L3)**
CO1 Action verb is same level as PO6 verb. Therefore, the correlation is high (3)
CO2: Analyze automated flow lines with or without buffer storage, perform quantitative evaluations, assembly line balancing techniques.
Action Verb: Understand (L2)
PO1 Verb: **Apply (L3)**
CO2: Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO2: Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
CO3: Understand robot configurations and select suitable actuators and sensors to optimize production efficiency and flexibility.
Action Verb: **Creating (L6)**
PO1 Verb: **Apply (L3)**
CO3: Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO3: Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO5 Verb: **select (L6)**
CO3: Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO6 Verb: **Apply (L3)**
CO3: Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)

CO4: Apply kinematic and dynamic modeling using D-H notation and select appropriate hardware and control strategies for real-world industrial scenario.
Action Verb: **Evaluate (L5)**
PO1 Verb: **Apply (L3)**
CO2: Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO2: Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Creating (L6)**
CO3: Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: **Creating (L6)**
CO3: Action verb is same level as PO5 verb. Therefore, the correlation is high (3)
CO5: Create program, and implement robotic systems to perform manufacturing tasks.
Action Verb: **Creating (L6)**
PO1 Verb: **Apply (L3)**
CO2: Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO2: Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO5 Verb: **Creating (L6)**
CO3: Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO6 Verb: **apply (L3)**
CO3: Action verb is same level as PO6 verb. Therefore, the correlation is high (3)

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Year : III B.Tech II Semester   Branch of Study : Common to All

Subject Code: 23AOE9902	Subject Name: ADVANCED OPERATIONS RESEARCH (Open Elective II)	L 2	T 1	P 0	Credits 3	CLC 3

Course Outcomes (CO): Student will be able to
1. Understand the concepts of linear programming in solving practical problems in industry.
2. Analyze the transportation models to trace the solutions to the real-world problems.
3. Apply mathematical skills to solve nonlinear programming models arising from a wide range of applications.
4. Apply the concept of non-linear programming for solving non-linear constraints.
5. Apply the concept of unconstrained geometric programming for solving the non-linear constraints.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the concepts of linear programming	in solving practical problems in industry.		**L2**
2	**Analyze**	the transportation models	to trace the solutions	to the real-world problems.	**L4**
3	**Apply**	mathematical skills	to solve nonlinear programming models	arising from a wide range of applications.	**L3**
4	**Apply**	the concept of non-linear programming	for solving non-linear constraints.		**L3**
5	**Apply**	the concept of unconstrained geometric programming	for solving the non-linear constraints.		**L3**

UNIT – I: Linear programming I   **8 hours**

Introduction, Applications of Linear Programming, Standard form of a Linear Programming Problem, Geometry of Linear Programming Problems, Basic Definitions in Linear Programming.

UNIT–II : Linear programming II: Duality in Linear Programming   **8 hours**

Simplex Method, Simplex Algorithm and, Big-M method. Symmetric Primal-Dual Relations, General Primal-Dual Relations, Duality Theorem, Dual Simplex Method.

UNIT – III : Linear programming III

Transportation Problem and assignment problem, Complementary slackness Theorem.

UNIT – IV : Non-linear programming: Unconstrained optimization techniques   **8 hours**

Introduction: Classification of Unconstrained minimization methods,

Direct Search Methods: Random Search Methods: Descent Method and Fletcher Powell Method, Grid Search Method.

UNIT – V : Non-linear programming: Constrained optimization techniques   **8 hours**

Introduction, Characteristics of a constrained problem, Random Search Methods, complex method, Sequential linear programming, Basic approach in methods of Feasible directions, Zoutendijk's method of feasible directions: direction finding problem, determination of step length, Termination criteria.

TEXT BOOK:

1. Singiresu S Rao., Engineering Optimization: Theory and Practices, New Age Int. (P) Ltd. Publishers, New Delhi.
2. J. C. Panth, Introduction to Optimization Techniques, (7-e) Jain Brothers, New Delhi.

REFERENCES:

- Harvey M. Wagner, Principles of Operation Research, Printice-Hall of India Pvt. Ltd. New Delhi.
- Peressimi A.L., Sullivan F.E., Vhl, J. J. Mathematics of Non-linear Programming, Springer – Verlag.

Web Reference:

- https://onlinecourses.nptel.ac.in/noc24_ee122/preview
- https://archive.nptel.ac.in/courses/111/105/111105039/
- https://onlinecourses.nptel.ac.in/noc21_ce60/preview

Mapping of COs to POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1		1									
2		3									
3	3										
4	3										
5	3										

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1				Understand	L2	PO2	Analyze	1
2				Analyze	L4	PO2	Analyze	3
3				Apply	L3	PO1	Apply	3
4				Apply	L3	PO1	Apply	3
5				Apply	L3	PO1	Apply	3

CO1: Understand the concepts of linear programming in solving practical problems in industry.
Action Verb: Understand (L2)
PO2 Verbs: Analyze (L4)
   CO1 Action Verb is two levels low to PO2 verb ; Therefore correlation is low (1).
CO2: Analyze the transportation models to trace the solutions to the real-world problems.
Action Verb: Analyze (L4)
PO2 Verbs: Analyze (L4)
   CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
CO3: Apply mathematical skills to solve nonlinear programming models arising from a wide range of applications.
Action Verb: Apply **(L3)**
PO1 Verb: Apply (L3)
   CO3 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).
CO4: Apply the concept of non-linear programming for solving non-linear constraints.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
   CO4 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).
CO5: Apply the concept of unconstrained geometric programming for solving the non-linear constraints.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
   CO5 Action verb is equal to PO1 verb; therefore the correlation is high (3).

Course Code	Year & Sem	PHYSICS OF ELECTRONIC MATERIALS AND DEVICES	L	T	P	C
23AOE9907	**III-II**	**(Open Elective-II)**	**2**	**1**	**0**	**3**

Course Outcomes (CO): At the end of the course students will be able to
1. **Understand the fundamentals of crystal growth and thin films.**
2. **Analyze the charge carrier dynamics in semiconductors by implementing the equations of state.**
3. **Understand the basics of Semiconductors for Engineering Applications.**
4. **Analyze the concepts of excitons and luminescence in Semiconductors.**
5. **Apply the fundamentals of semiconductors for various display devices.**

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	**The fundamentals of crystal growth and thin films.**			**L2**
2	**Analyze**	**The charge carrier dynamics in semiconductors by implementing the equations of state.**			**L4**
3	**Understand**	**The basics of Semiconductors for Engineering Applications.**			**L2**
4	**Analyze**	**The concepts of excitons and luminescence in Semiconductors.**			**L4**
5	**Apply**	**The fundamentals of semiconductors for various display devices.**			**L3**

UNIT I   Fundamentals of Materials Science   9 Hrs
Introduction, Phase rule, Phase Diagram, Elementary idea of Nucleation and Growth, Methods of crystal growth. The basic idea of point, line, and planar defects. Concept of thin films, preparation of thin films, Deposition of thin film using sputtering methods (RF and glow discharge).

UNIT II Semiconductors   9 Hrs
Introduction, charge carriers in semiconductors, effective mass, Diffusion and drift, Diffusion and recombination, Diffusion length. The Fermi level & Fermi-Dirac distribution, Electron and Hole in quantum well, Change of electron-hole concentration- Qualitative analysis, Temperature dependency of carrier concentration, Conductivity and mobility, Effects of temperature and doping on mobility, High field effects.

UNIT III Physics of Semiconductor Devices: 9 Hrs
Introduction, Band structure, PN junctions and their typical characteristics under equilibrium and under bias, Heterojunctions, Transistors, MOSFETs.

UNIT IV Excitons and Luminescence: 9 Hrs
Luminescence: Different types of luminescence, basic definitions, Light emission in solids, Inter-band luminescence, Direct and indirect gap materials. Photoluminescence : General Principles of photoluminescence, Excitation and relaxation, OLED, Quantum-dot. Electro-luminescence : General Principles of electroluminescence, light emitting diode, diode laser.

UNIT V Display devices :   9 Hrs
LCD, three-dimensional display: Holographic display, light-field displays: Head-mounted display, MOEMS (Micro-Opto-Electro-Mechanical Systems) and MEMS displays.

Textbooks:
1. Principles of Electronic Materials and Devices-S.O. Kasap, McGraw-Hill Education (India) Pvt. Ltd.,4thedition, 2021.
2. Semiconductor physics & devices: basic principles, 4th Edition, McGraw-Hill, 2012.
Reference Books:
1. Solid State Electronic Devices -B.G. Streetman and S. Banerjee, PHI Learning,6th edition
2. Electronic Materials Science- Eugene A. Irene, Wiley, 2005
3. Electronic Components and Materials, Grover and Jamwal, DhanpatRai and Co., New Delhi., 2012. 4.

An Introduction to Electronic Materials for Engineers-Wei Gao, Zhengwei Li, Nigel Sammes, World Scientific Publishing Co. Pvt. Ltd. 2nd Edition,2011

NPTEL course links:
1. **https://nptel.ac.in/courses/113/106/113106062/**
2. **https://onlinecourses.nptel.ac.in/noc20_ph24/preview**

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1				Understand	L2	PO1, PO5	PO1: Apply (L3)	2
2				Analyze	L4	PO1, PO2	PO1: Apply (L3)	3
3				Understand	L2	PO1, PO5	PO1, PO5: Apply (L3)	2
4				Analyze	L4	PO1, PO5	PO1, PO5: Apply (L3)	3
5				Apply	L3	PO1	PO1: Apply (L3)	3

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2				2								
2	3	3											
3	2				2								
4	3				3								
5	3												

CO1: Understand the fundamentals of crystal growth and thin films.
Action Verb: Understand (L2)
PO1 & PO5 Verbs: Apply (L3)
CO1 Action Verb is lesser than PO1 and PO5 verbs by one level; Therefore,correlation is moderate (2).
CO2: Analyze the charge carrier dynamics in semiconductors by implementing the equations of state.
Action Verb: Analyze (L4)
PO1 & PO2 Verbs: Apply (L3)
CO2 Action Verb is greater than PO1 and PO2 verbs; Therefore correlation is high (3).
CO3: Understand the basics of Semiconductors for Engineering Applications.
Action Verb: Understand (L2)
PO1 and PO5 Verbs: Apply (L3)
CO3 Action Verb is less than PO1 and PO5 verb by one level; Therefore correlation is moderate (2).
CO4: Analyze the concepts of excitons and luminescence in Semiconductors.
Action Verb: Analyze (L4)
PO1 Verb and PO5 verbs: Apply (L3)
CO4 Action Verb is greater than PO1 and PO5 verbs by one level; Therefore, correlation is high (3).
CO5: Apply the fundamentals of semiconductors for various display devices.
Action Verb: Analyze (L4)
PO1 : Apply (L3)
CO5 Action verb is equal to PO1 verb; therefore, the correlation is high (3).

Course Code	Year & Sem	Chemistry of Polymers and Applications	L	T	P	C
23AOE9912	III-II	(Open Elective-II)	2	1	0	3

Course Outcomes (CO): At the end of the course students will be able to

CO1: Understand polymer fundamentals and classification systems.
CO2: Analyze the chemical and physical properties of natural polymers and their applications.
CO3: Apply the knowledge of thermoplastic and thermoset polymers in practical situations.
CO4: Understand the fundamental principles of hydrogel in polymer networks.
CO5: Analyze the preparation and mechanism of conducting and degradable polymers.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	polymer fundamentals and classification systems.			L2
2	**Analyze**	the chemical and physical properties of natural polymers and their applications.			L4
3	**Apply**	the knowledge of thermoplastic and thermoset polymers in practical situations			L3
4	**Understand**	the fundamental principles of hydrogel in polymer networks.			L2
5	**Analyze**	the fundamental principles of hydrogel in polymer networks			L4

Unit – I: Polymers-Basics and Characterization:-

Basic concepts: monomers, repeating units, degree of polymerization, linear, branched and network polymers, classification of polymers, Polymerization: addition, condensation, copolymerization and coordination polymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution. Measurement of molecular weight: End group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

Unit – II: Natural Polymers & Modified cellulosics

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.

Modified cellulosics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEA.

Unit – III: Synthetic Polymers

Addition and condensation polymerization processes– Bulk, Solution, Suspension and Emulsion polymerization. Preparation and significance, classification of polymers based on physical properties. Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications. Preparation of Polymers based on different types of monomers, Olefin polymers(PE,PVC), Butadiene polymers(BUNA-S,BUNA-N), nylons, Urea-formaldehyde, phenol – formaldehyde, Melamine Epoxy and Ion exchange resins.

Unit-IV: Hydrogels of Polymer networks

Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, Applications of hydrogels in drug delivery.

Unit – V: Conducting and Degradable Polymers:

Conducting polymers: Introduction, Classification, Mechanism of conduction in

Poly Acetylene, Poly Aniline, Poly Thiophene, Doping,Applications.
Degradable polymers: Introduction, Classifications, Examples, Mechanism of degradation, poly lactic acid, Nylon-6, Polyesters, applications.

Text Books:
1. A Text book of Polymer science, Billmayer
2. Polymer Chemistry – G.S.Mishra
3. Polymer Chemistry – Gowarikar

References Books:
1. Organic polymer Chemistry, K.J.Saunders, Chapman and Hall
2. Advanced Organic Chemistry, B.Miller, Prentice Hall
3. Polymer Science and Technology by Premamoy Ghosh, 3rd edition, McGraw-Hill, 2010.

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3												
2	3												
3	3												
4	3												
5	3												

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours				CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Register (Hrs)	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1					Understand	L2	PO1	PO1: Apply (L3)	2
2					Analyze	L4	PO1	PO1: Apply (L3)	3
3					Apply	L3	PO1	PO1: Apply (L3)	3
4					Understand	L2	PO1	PO1: Apply (L3)	3
5					Analyze	L4	PO1	PO1: Apply (L3)	3

CO1: Understand polymer fundamentals and classification systems.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
CO2: Analyze the chemical and physical properties of natural polymers and their applications
Action Verb: Analyze(L4)
PO1 Verbs: Apply (L3)
CO2 Action Verb is less than PO1 verb; Therefore correlation is moderate (2).
CO3: Apply the knowledge of thermoplastic and thermoset polymers in practical situations.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO3 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).
CO4: Understand the fundamental principles of hydrogel in polymer networks.
 Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO3 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
CO5 Analyze the preparation and mechanism of conducting and degradable polymers
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO5 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING (AI&ML)

Course Code	Year & Sem	ACADEMIC WRITING AND PUBLIC SPEAKING	L	T	P	C
23AOE9916	III-II	(Open Elective-II)	2	1	0	3

Course Outcomes (CO): Student will be able to

CO1: Apply the essential features of Academic Writing in scholarly works.L3

CO2: Apply the strategies of writing skills in research paper writing without plagiarism.L3

CO3: Create a coherent and well-organized paragraphs in essays, reports, reviews and SOP. L6

CO4: Analyze the characteristics and strategies of public speaking skills for impactful speeches.L4

CO5: Apply non-verbal communication skills for effective public speaking. L3

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	the essential features of Academic Writing in scholarly works			L3
2	Apply	the strategies of writing skills in research paper writing without plagiarism.	without plagiarism.		L3
3	Create	a coherent and well-organized paragraphs in essays, reports, reviews and SOP			L6
4	Analyze	the characteristics and strategies of public speaking skills for impactful speeches.		for impactful speeches.	L4
5	Apply	non-verbal communication skills for effective public speaking..		for effective public speaking..	L3

UNIT – I	Introduction to Academic Writing	Lecture Hrs
Introduction to Academic Writing – Essential Features of Academic Writing – Courtesy – Clarity – Conciseness – Correctness – Coherence – Completeness – Types – Descriptive, Analytical, Persuasive, Critical writing		
UNIT – II	**Academic Journal Article**	Lecture Hrs
Art of condensation- summarizing and paraphrasing - Abstract Writing, writing Project Proposal, writing application for internship, Technical/Research/Journal Paper Writing – Conference Paper writing - Editing, Proof Reading - Plagiarism		
UNIT – III	**Essay & Writing Reviews**	Lecture Hrs
Compare and Contrast – Argumentative Essay – Exploratory Essay – Features and Analysis of Sample Essays – Writing Book Report, Summarizing, Book/film Review- SoP		
UNIT – IV	**Public Speaking**	Lecture Hrs
Introduction, Nature, characteristics, significance of Public Speaking – Presentation – 4 Ps of Presentation – Stage Dynamics – Answering Strategies –Analysis of Impactful Speeches- Speeches for Academic events		
UNIT – V	**Public Speaking and Non-Verbal Delivery**	Lecture Hrs
Body Language – Facial Expressions-Kinesics – Oculesics – Proxemics – Haptics – Chronomics - Paralanguage – Signs		
Textbooks:		
Critical Thinking, Academic Writing and Presentation Skills: MG University Edition Paperback – 1 January 2010 Pearson Education; First edition (1 January 2010) 2. Pease, Allan & Barbara. *The Definitive Book of Body Language*RHUS Publishers, 2016		

reference Books:
1. Alice Savage, Masoud Shafiei *Effective Academic Writing,* ***2Ed.,*** 2014 .sserP ytisrevinU drofxO
2. Shalini Verma, *Body Language*, S Chand Publications 2011.
3. Sanjay Kumar and Pushpalata, *Communication Skills* 2E 2015, Oxford.
4. Sharon Gerson, Steven Gerson, *Technical Communication Process and Product,* Pearson, New Delhi, 2014
5. *Elbow, Peter. Writing with Power. OUP USA, 1998*

Online Learning Resources:
1. https://youtu.be/NNhTIT81nH8
2. phttps://www.youtube.com/watch?v=478ccrWKY-A
3. https://www.youtube.com/watch?v=nzGo5ZC1gMw
4. https://www.youtube.com/watch?v=Qve0ZBmJMh4
5. https://courses.lumenlearning.com/publicspeakingprinciples/chapter/chapter-12-nonverbal- aspects-of-delivery/
6. https://onlinecourses.nptel.ac.in/noc21_hs76/preview
7. https://archive.nptel.ac.in/courses/109/107/109107172/#
8. https://archive.nptel.ac.in/courses/109/104/109104107/

Correlation of COs with the POs & PSOs f

Course Title	Course Outcomes COs	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11
ACADEMIC WRITING AND PUBLIC SPEAKING OPEN ELECTIVE – II	CO1									2		
	CO2									2		
	CO3									3		
	CO4									3		3
	CO5									2		2

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1							Thumb Rule	
2							Thumb Rule	
3							Thumb Rule	
4							Thumb Rule	
5							Thumb Rule	

CO1: Apply the essential features of Academic Writing in scholarly works.
Action Verb: Apply (L3)
CO1 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).
CO2: Apply the strategies of writing skills in research paper writing without plagiarism.
CO2 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2)
CO3: Create a coherent and well-organized paragraphs in essays, reports, reviews and SOP.
CO3 Action Verb Create is of BTL 6. Using Thumb rule, L6 correlates PO6 to PO11 as high (3).
CO4: Analyze the characteristics and strategies of public speaking skills for impactful speeches.
Action Verb: Analyze (L4)
CO4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).
CO5: Apply non-verbal communication skills for effective public speaking.
Action Verb: Apply (L3)
CO5 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate.

Course Code	Year & Sem	MATHEMATICAL FOUNDATION OF QUANTUM TECHNOLOGIES	L	T	P	C
23AOE9903	III-II	(Open Elective-II)	2	1	0	3

Course Outcomes (CO): Student will be able to

1. Apply the applications to quantum systems through the study of vector spaces, inner products, and linear operators.
2. Analyze the transition from finite to infinite dimensional systems with linear algebra concepts to function spaces.
3. Analyze the quantum mechanical formalism including measurement theory, uncertainty relations, and time evolution.
4. Evaluate the statistical interpretations through quantum mechanical principles to solve problems in simple quantum systems.
5. Create the understanding of measurement processes and modern quantum theory from the advanced concepts in composite systems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Apply**	the applications to quantum systems	through the study of vector spaces, inner products, and linear operators.		**L3**
2	**Analyze**	the transition from finite to infinite dimensional systems	with linear algebra concepts to function spaces.		**L4**
3	**Analyze**	the quantum mechanical formalism including measurement theory, uncertainty relations, and time evolution.	.		**L4**
4	**Evaluate**	statistical interpretations through quantum mechanical principles	to solve problems in simple quantum systems.		**L5**
5	**Create**	the understanding of measurement processes and modern quantum theory	from the advanced concepts in composite systems.		**L6**

UNIT I: Linear Algebra Foundation for Quantum Mechanics   10 hours

Vector spaces definition and examples (R^2, R^3, function spaces), Inner products (dot product, orthogonality, normalization), Linear operators (matrices, eigen values, eigen vectors), Finite-dimensional examples (2×2 matrices, spin-1/2 systems), Dirac notation introduction ($|\psi\rangle$, $\langle\varphi|$, $\langle\varphi|\psi\rangle$), Change of basis (transformations, unitary matrices).

UNIT II: From Finite to Infinite Dimensions   8 hours

Function spaces (L^2 space, square-integrable functions), Inner products for functions ($\int\psi^*\varphi \, dx$), Orthogonal function sets (Fourier series, basis functions), Introduction to Hilbert space concept (complete inner product spaces), Position and momentum representations (wave functions), Operators on functions (d/dx, multiplication by x).

UNIT III: Quantum Mechanical Formalism   8 hours

Mathematical formulation (states as vectors, observables as operators), Measurement theory (Born rule, expectation values, probabilities), Uncertainty relations (mathematical derivation from commutators), Time evolution (Schrödinger equation, unitary evolution).

UNIT IV: Applications and Statistical Interpretation   6 hours

Simple applications (infinite square well, harmonic oscillator), Statistical interpretation (ensembles, pure vs mixed states), Measurement process (von Neumann measurement scheme).

UNIT V: Advanced Topics   8 hours

Composite systems (tensor products basic introduction), Reversibility and irreversibility (unitary

evolution vs measurement), Thermodynamic connections (equilibrium states, entropy), Modern perspectives (decoherence, measurement problem conceptual).

Textbooks:

- David J. Griffiths, Darrell F. Schroeter, "Introduction to Quantum Mechanics", 3rd Edition, Cambridge University Press (2018).
- R. Shankar, Principles of Quantum Mechanics, 2nd Edition, Kluwer Academy/Plenum Publishers (1994).

  Reference Books:

- George. F. Simmons, "Introduction to Topology and Modern Analysis",MedTech Science Press.
- Gilbert Strang, Linear Algebra and Its Applications, 4th Edition, Cengage Learning (2006).
- John von Neumann and Robert T Beyer, Mathematical Foundations of Quantum Mechanics, Princeton Univ. Press (1996).

Web Resources

1. https://eclass.uoa.gr/modules/document/file.php/CHEM248/Griffiths%20%20Introduction%20to%20Quantum%20Mechanics%203rd%20ed%202018.pdf
2. https://fisica.net/mecanica-quantica/Shankar%20 %20Principles%20of%20quantum%20mechanics.pdf

Mapping of COs to POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1	3										
2		3									
3		3									
4			3								
5			3								

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1				**Apply**	**L3**	PO1	**Apply**	3
2				**Analyze**	**L4**	PO2	**Analyze**	3
3				**Analyze**	**L4**	PO2	**Analyze**	3
4				**Evaluate**	**L5**	PO3	**Evaluate**	3
5				**Create**	**L6**	PO3	**Create**	3

CO1: Apply the applications to quantum systems through the study of vector spaces, inner products, and linear operators.
 Action Verb: Apply(L3)
PO1 Verbs: Apply (L3)
CO1 Action Verb is equal to PO1 verb ; Therefore correlation is high(3).
CO2: Analyze the transition from finite to infinite dimensional systems with linear algebra concepts to function spaces.
 Action Verb: Analyze (L4)
PO2 Verbs: Analyze (L4)
CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
CO3: Analyze the quantum mechanical formalism including measurement theory, uncertainty relations, and time evolution.
 Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO3 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).
CO4: Evaluate the statistical interpretations through quantum mechanical principles to solve problems in simple quantum systems.
 Action Verb: Evaluate (L5)
PO3 Verb: Evaluate (L5)

CO4 Action Verb level is equal to PO3 verb; Therefore correlation is high (3).
CO5: Create the understanding of measurement processes and modern quantum theory from the advanced concepts in composite systems.
Action Verb: Create (L6)
PO3 Verb: Create (L6)
CO5 Action verb is equal to PO3 verb; therefore the correlation is high (3).