

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE (DATA SCIENCE)
(Effective for the batches admitted in 2023-24)**

INDUCTION PROGRAM - Semester I (First year)

S. No	Course Name	Category	L-T-P-C
1	Physical Activities--Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counseling	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

Semester I (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits C	CIE	SEE	Total
				L	T / CLC	P				
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	23ABS9904	Linear Algebra and Calculus	2	1	0	3	30	70	100
4	ES	23AES0101	Basic Civil and Mechanical Engineering	2	1	0	3	30	70	100
5	ES	23AES0501	Introduction to Programming	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	ES	23AES0502	Computer Programming 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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Semester II (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits C	CIE	SEE	Total
				L	T / CLC	P				
1	BS	23ABS9903	Engineering Physics	2	1	0	3	30	70	100
2	BS	23ABS9905	Differential Equations and Vector Calculus	2	1	0	3	30	70	100
3	ES	23AES0201	Basic Electrical and Electronics Engineering	2	1	0	3	30	70	100
4	ES	23AES0301	Engineering Graphics	1	0	4	3	30	70	100
5	ES	23AES0503	IT Workshop	0	0	2	1	30	70	100
6	PC	23APC0501	Data Structures	2	1	0	3	30	70	100
7	BS	23ABS9908	Engineering Physics Lab	0	0	2	1	30	70	100
8	ES	23AES0202	Electrical and Electronics 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	23AHM9904	NSS/NCC/Scouts and Guides/Community Service	0	0	1	0.5	50	-	50
Total				9	4	15	20.5	320	630	950

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Semester III (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits C	CIE	SEE	Total
				L	T / CLC	P				
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	23APC3201	Introduction to Data Science	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	23APC3202	Data Science using python 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	0	1	2	2	30	70	100
9	MC	23AMC9901	Environmental Science	2	0	0	-	30	-	30
Total				12	06	8	20	270	560	830

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Semester IV (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits C	CIE	SEE	Total
				L	T / CLC	P				
1	HM	23AES0305	Optimization Techniques	2	0	0	2	30	70	100
2	BS	23ABS9915	Statistical Methods for Data Science	2	1	0	3	30	70	100
3	PC	23APC3203	Data Engineering	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	23APC3204	Data Engineering 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	23ASC3201	Exploratory Data Analysis with Python	0	1	2	2	30	70	100
9	ES	23AES0304	Design Thinking & Innovation	0	1	2	2	30	70	100
Total				10	06	10	21	270	630	900
Mandatory Community Service Project Internship of 08 weeks duration during summer vacation										

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Semester V (Third year I Semester)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits C	CIE	SEE	Total
				L	T / CLC	P				
1	PC	23APC3205	Machine Learning	2	1	0	3	30	70	100
2	PC	23APC3206	Operating Systems	2	1	0	3	30	70	100
3	PC	23APC3207	Software Engineering	2	1	0	3	30	70	100
4	PE-I	23APE3201	Automata Theory & Compiler Design	2	1	0	3	30	70	100
		23APE3202	Object Oriented Analysis and Design							
		23APE3203	Soft computing							
		23APE3204	Internet of Things							
5	OE-1		*Open Elective-I	2	1	0	3	25	75	100
6	PC	23APC3208	Machine Learning Lab	0	0	3	1.5	30	70	100
7	PC	23APC3209	Operating Systems Lab	0	0	3	1.5	30	70	100
8	SC	23ASC9901	Soft skills	0	1	2	2	30	70	100
9	ES	23AES0404	Tinkering Lab	0	0	2	1	30	70	100
10	ES	23AES0504	Introduction To Quantum Technologies and Applications	2	1	0	3	30	70	100
11	PR	23APR3201	Community Service Internship	-	-	-	2	100	-	100
Total				12	07	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	Mathematical Foundations 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.	20AOEMB01	Entrepreneurship and New Venture Creation	

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Semester VI (Third year II Semester)

Sl. No.	Category	Course Code (Actual)	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P				
1	PC	23APC3210	Natural Language Processing	2	1	0	3	30	70	100
2	PC	23APC3211	Predictive Analytics	2	1	0	3	30	70	100
3	PC	23APC3212	Data Visualization	2	1	0	3	30	70	100
4	PE-II	23APE3205	Social Network Analysis	2	1	0	3	30	70	100
		23APE3206	Cryptography & NS							
		23APE3207	Computer Networks							
		23APE3208	Recommender Systems							
		23APE3209	Deep Learning							
5	PE-III (NPTEL)	23APE3210	Software Project Management	2	1	0	3	30	70	100
		23APE3211	Quantum Computing							
		23APE3212	Computer Vision							
		23MOC3201	Cloud Computing							
6	OE-II		*Open Elective-II	2	1	0	3	25	75	100
7	PC	23APC3213	Predictive Analytics Lab	0	0	3	1.5	30	70	100
8	PC	23APC3214	NLP and Data Visualization Lab (Using Power BI / Tableau etc.)	0	0	3	1.5	30	70	100
9	SC	23ASC3202	Full Stack development -I	0	1	2	2	30	70	100
10	AC	23AMC9902	Technical Paper Writing & IPR	2	0	0	-	30	-	30
11	SC	23ASC3203	Technical Workshop	-	-	-	-	-	-	-
Total				14	07	08	23	295	635	930

Note:

Workshop can be conducted either in 3-1 or 3-2 and participation certificate with 90% and above attendance on it should be submitted to department and exam section before 3-2 regular exam notification issued.

***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.	23APE0322	Automation and Robotics	ME
5.	23AOE0402	Digital Electronics	ECE
6.	23AOE9902	Optimization Techniques	Mathematics
7.	23AOE9903	Mathematical Foundation of Quantum Technologies	
8.	23AOE9907	Physics Of Electronic Materials and Devices	Physics
9.	23AOE9912	Chemistry Of Polymers and Applications	Chemistry
10.	23AOE9916	Academic Writing and Public Speaking	Humanities

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Semester VII (Fourth year I Semester)

Sl. No.	Category	Course Code (Actual)	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P				
1	PC	23APC3214	Big Data Analytics	2	1	0	3	30	70	100
2	MC-II	23AHMMB02	1. Business Ethics and Corporate Governance	2	0	0	2	30	70	100
		23AHMMB03	2. E-Business							
		23AHMMB04	3. Management Science							
3	PE-IV	23APE3214	Software Architecture & Design Pattern	2	1	0	3	30	70	100
		23APE3215	Blockchain Technology							
		23APE3216	DevOps							
		23APE3217	NoSQL databases							
4	PE-V	23APE3218	Agile Methodologies	2	1	0	3	30	70	100
		23APE3219	Expert Systems							
		23APE3220	Reinforcement Learning							
		23APE3221	High Performance Computing							
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	23ASC3204	Full Stack Development -II	0	1	2	2	30	70	100
8	MC	23AMC9903	Gender Sensitization	2	0	0	-	30	-	30
9	PR	23APR3202	Industry Internship [SHORT TERM]	-	-	-	2	100		100
				14	06	02	21	340	490	830

***Open Elective – III**

S.No.	Course Code	Course Name	Offered by the Dept.
1	23AOE0105	Building Materials and Services	CIVIL
2		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	23AOE9909	Introduction to Quantum Mechanics	
9	23AOE9913	Green Chemistry And Catalysis For Sustainable Environment	Chemistry
10	23AOE9917	Employability Skills	Humanities

***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

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Semester VIII (Fourth year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P				
1	PR	23APR3203	Industry Internship (Long term)	0	0	12	4	100	-	100
2	PR	23APR3204	Project Work	0	0	12	8	40	160	200
			Total			24	12			300

AIATS TPT-CSE(DS)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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DEPARTMENT OF CSE (DATA SCIENCE)
(Effective for the batches admitted in 2023-24)

HONORS DEGREE IN CSE(DATA SCIENCE)

Eligibility for Honors Degree Registration:

A student is eligible to register for Honors program in the fourth semester, provided the results of the first three semesters have been declared. The student must have an average CGPA of 7.0 or above, with no backlogs in any of the semesters. Upon meeting these criteria, the student may be allowed to register by the end of the third semester and can take a maximum of two Honor-related subjects per semester from the fourth semester onwards.

Restrictions on Course Selection:

A student shall not be allowed to choose Open Electives, Minor courses that have content substantially similar to those already covered in their primary major program.

Course and Credit Requirements for Honors Degree:

Students may select courses from a list approved by the Board of Studies (BoS), choosing either 3-credit or 4-credit courses based on their availability on the SWAYAM-NPTEL platform. To complete an honor, students must earn a minimum of 18 credits through theory courses by successfully passing the selected courses.

S.NO	SUB.CODE	COURSE NAME	WEEKS	CREDITS
1	23AHN03201	ALGORITHMS IN COMPUTATIONAL BIOLOGY AND SEQUENCE ANALYSIS	12 Weeks	3
2	23AHN03202	SOCIAL NETWORK ANALYSIS	12 Weeks	3
3	23AHN03203	ADVANCED R PROGRAMMING FOR DATA ANALYTICS IN BUSINESS	12 Weeks	3
4	23AHN03204	GETTING STARTED WITH COMPETITIVE PROGRAMMING	12 Weeks	3
5	23AHN03205	INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS	12 Weeks	3
6	23AHN03206	ALGORITHMIC GAME THEORY	12 Weeks	3
7	23AHN03207	BUSINESS INTELLIGENCE AND ANALYTICS	12 Weeks	3
8	23AHN03208	GPU ARCHITECTURES AND PROGRAMMING	12 Weeks	3
9	23AHN03209	SELECTED TOPICS IN ALGORITHMS	12 Weeks	3
10	23AHN03210	PRIVACY AND SECURITY IN ONLINE SOCIAL MEDIA	12 Weeks	3
		TOTAL		18

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MINOR DEGREE IN DATA SCIENCE FOR ECE, EEE, CE & ME

Eligibility for Minor Degree Registration:

A student is eligible to register for Minor program in the fourth semester, provided the results of the first three semesters have been declared. The student must have an average CGPA of 7.0 or above, with no backlogs in any of the semesters. Upon meeting these criteria, the student may be allowed to register by the end of the third semester and can take a maximum of two Minor-related subjects per semester from the fourth semester onwards.

Restrictions on Course Selection:

A student shall not be allowed to choose Open Electives or Honors courses that have content substantially similar to those already covered in their primary major program.

Course and Credit Requirements for Minor Degree:

Students may select courses from a list approved by the Board of Studies (BoS), choosing either 3-credit or 4-credit courses based on their availability on the SWAYAM-NPTEL platform. To complete a Minor, students must earn a minimum of 18 credits—15 credits through theory courses and 3 credits for a Minor project—by successfully passing the selected courses.

S.NO	SUB.CODE	COURSE NAME	WEEKS	CREDITS
1	23AMN03201	Algorithms in Computational Biology and Sequence Analysis	12 Weeks	3
2	23AMN03202	Games and Information	12 Weeks	3
3	23AMN03203	Human Computer Interaction	12 Weeks	3
4	23AMN03204	Data Analytics with Python	12 Weeks	3
5	23AMN03205	Affective Computing	12 Weeks	3
6	23AMN03206	Artificial Intelligence: Search Methods for Problem Solving	12 Weeks	3
7	23AMN03207	Reinforcement Learning	12 Weeks	3
8	23AMN03208	Statistical Learning for Reliability Analysis	12 Weeks	3
9	23AMN03209	Cloud computing and Distributed Systems	12 Weeks	3
10	23AMN03210	Introduction to Large Language Models	12 Weeks	3
11	23AMN03201	MINOR DISCIPLINE PROJECT IN CSE(DS) (COMPULSORY)	-	3
		TOTAL		18

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S. No	Course Name	Category	L-T-P-C
1	Physical Activities--Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counseling	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

Semester I (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits C	CIE	SEE	Total
				L	T / CLC	P				
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	23ABS9904	Linear Algebra & Calculus	2	1	0	3	30	70	100
4	ES	23AES0101	Basic Civil& Mechanical Engineering	2	1	0	3	30	70	100
5	ES	23AES0501	Introduction to Programming	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	ES	23AES0502	Computer Programming 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



ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI
(Autonomous)

(Effective for the batches admitted from 2023-24)

Year: I B.Tech

(Common to all branches)

Semester: I

Subject Code 23AHM9901	Subject Name COMMUNICATIVE ENGLISH	L 2	T 0	P 0	Credit: 2	CLC: 2
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Pre-Requisites	Communicative English	Semester	I & II
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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.
5. SUP | 978-93-92184-99-4 | Communication English (JNTU) - Dr. V. B. Chithra

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:

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	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)

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).



ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI
(Autonomous)

(Effective for the batches admitted from 2023-24)

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

- Understand** the interaction of energy levels between atoms and molecules
- Apply** the principle of Band diagrams in the conductors and semiconductors
- Apply** the electrochemical principles to the construction of batteries, fuel cells and sensors
- Analyze** the preparation and mechanism of plastics, Elastomers and conducting polymers
- 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 O₂ 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
4. Seven Hills | 978-93-94122-28-4 | Chemistry (JNTU) - Dr. N. Devenna

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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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 (Effective for the batches admitted from 2023-24)

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
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Course Outcomes (CO):

Student will be able to

- CO1. **Analyze** the matrix algebraic techniques for engineering applications.
- CO2. **Understand** the concept of Eigen values, Eigen vectors and quadratic forms.
- CO3. **Analyze** the mean value theorems for real time applications.
- CO4. **Apply** the concepts of partial differentiation to functions of several variables.
- CO5. **Apply** the multivariable integral calculus for computation of Area and Volume.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	the matrix algebraic techniques	for engineering applications.		L4
2	Understand	the concept of eigen values, eigen vectors and quadratic forms.	-		L2
3	Analyze	the mean value theorems	for real time applications.		L4
4	Apply	the concept of Maxima and Minima	to functions of several variables.		L3
5	Apply	the multivariable integral calculus	for computation of Area and volume.		L3

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:

- B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
- Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.

References:

- Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition.
- Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 25th Edition(9th reprint).
- Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5 th Edition.
- Advanced Engineering Mathematics, Micheal Greenberg, , Pearson publishers, 9 th edition.
- Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications, 2014, Third Edition (Reprint 2021)
- S | 978-93-91421-57-1 | Linear Algebra & Calculus (JNTU) - Dr. M. C. Raju

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 to PO2 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).

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Basic Civil & Mechanical Engineering	L	T	P	C
23AES0101	I-I		2	1	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 and Conveyance 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
6. SPH | 978-93-93196-63-7 | Basic Civil & ME (JNTU) - Dr. S. Krishnaiah

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	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
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).

AIATS TPT-CSE(ODS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	INTRODUCTION TO PROGRAMMING (Common to All branches of Engineering)	L	T / CLC	P	C
23AES0501	I-I		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
4. Amaravathi | 978-93-93199-58-4 | Introduction to Programming (JNTU) - Dr. S. V. Raju

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	CO	Program	PO(s) :Action Verb	Level of
------	----	---------	--------------------	----------

No.	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL	Outcome (PO)	and BTL(for PO1 to PO12)	Correlation (0-3)
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)

AIATS TPT-CSE(CDS)

	ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI (Autonomous) (Effective for the batches admitted from 2023-24)
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Year: I B.Tech

(Common to all branches)

Semester: I & II

Subject Code 23AHM9902	Subject Name COMMUNICATIVE ENGLISH LAB	L T P 0 0 2	Credit: 1
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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.
5. SUP | 978-93-92184-99-4 | Communication English (JNTU) - Dr. V. B. Chithra

Web Resources:

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 PO12 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 PO12 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 PO12 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 PO12 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 PO12 as high (3).



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

Subject Code: 23ABS9906	Subject Name: Chemistry Lab	L 0	T 0	P 2	Credits:1
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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 Publications by J. Mendham, R.C.Denney, J.D.Barnes and B. Sivasankar
- Seven Hills | 978-93-94122-28-4 | Chemistry (JNTU) - Dr. N. Devenna

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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).



ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE (DATA SCIENCE)

Course Code	Year & Sem	Engineering Workshop	L	T	P	C
23AES0302	I-I		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

- Demonstration:** Safety practices and precautions to be observed in workshop.
- Wood Working:** Familiarity with different types of woods and tools used in woodworking and make following joints.
 - Half – Lap joint
 - Mortise and Tenon joint
 - Corner Dovetail joint or Bridlejoint
- Sheet Metal Working:** Familiarity with different types of tools used in sheet metalworking, Developments of following sheet metal job from GI sheets.
 - Tapered tray
 - Conical funnel
 - Elbow pipe
 - Brazing
- Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.
 - V-fit
 - Dovetail fit
 - Semi-circular fit
 - Bicycle tire puncture and change of two-wheeler tyre
- Electrical Wiring:** Familiarity with different types of basic electrical circuits and make the following connections.
 - Parallel and series
 - Two-way switch
 - Godown lighting
 - Tube light
 - Three phase motor
 - Soldering of wires
- Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
- Welding Shop:** Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
- Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

Textbooks:

- Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published, 2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
- A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:

- Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition
- Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
- Amaravathi | 978-93-93199-75-1 | Engineering Workshop - Dr. C. N. Reddy

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					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
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)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE (DATA SCIENCE)**

Course Code	Year & Sem	COMPUTER PROGRAMMING LAB (Common to All Branches of Engineering)	L	T	P	C
23AES0502	I-I		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]

- i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.
- ii) Exposure to Turbo C, gcc
- iii) Writing simple programs using printf(), scanf()

Exercise 2: Problem-solving using Algorithms and Flow charts.[CO1]

- i) Sum and average of 3 numbers
- ii) Conversion of Fahrenheit to Celsius and vice versa
- iii) 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
- iv) 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 on 1D 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]

- i) 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]

- i) 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]

- i) 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
3. Amaravathi | 978-93-93199-58-4 | Introduction to Programming (JNTU) - Dr. S. V. Raju

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	

(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 PO12)	Level of Correlation (0-3)
1	CO1: understand	L2	PO1	PO1: Apply(L3)	2
			PO2	PO2: Review(L2)	3
			PO3	PO3: Develop(L3)	2
			PO4	PO4: Analyze(L4)	2
2	CO2: Create	L6	PO1	PO1: Apply(L3)	3
			PO2	PO2: Review (L3)	3
			PO4	PO4: Analyze (L4)	3
			PO5	PO5: Apply(L3)	3
			PO11	PO11: Thumb rule	2
3	CO3: Apply	L3	PO1	PO1: Apply(L3)	3
			PO2	PO2: Review (L3)	3
			PO4	PO4: Analyze (L4)	2
			PO5	PO5: Apply(L3)	3
			PO11	PO11: Thumb rule	3
4	CO4: Apply	L3	PO1	PO1: Apply(L3)	3
			PO2	PO2: Review (L2)	3
			PO3	PO3: Develop(L3)	3
			PO4	PO4: Analyze (L4)	2
			PO11	PO11: Thumb rule	2
5	CO5: Create	L6	PO1	PO1: Apply(L3)	3
			PO2	PO2: Review(L2)	3
			PO3	PO3: Develop(L3)	3
			PO4	PO4: Analyze (L4)	3
			PO11	PO11: Thumb rule	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)



ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI
(Autonomous)

(Effective for the batches admitted from 2023-24)

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

Course Code: 23AHM9903	HEALTH AND WELLNESS, YOGA AND SPORTS	L 0	T 0	P 1	C 0.5
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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 many as 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, totaling to 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	P06,P07	2
2					Understand	L2	P06,P07	2
3					Apply	L3	P06,P07	2
4					Understand	L2	P06,P07	2
5					Analyze	L4	P06,P07	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)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE (DATA SCIENCE)
(Effective for the batches admitted in 2023-24)

Semester II (First year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits C	CIE	SEE	Total
				L	T / CLC	P				
1	BS	23ABS9903	Engineering Physics	2	1	0	3	30	70	100
2	BS	23ABS9905	Differential Equations & Vector 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	23AES0503	IT Workshop	0	0	2	1	30	70	100
6	PC	23APC0501	Data Structures	2	1	0	3	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	PC	23APC0502	Data Structures 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



Annamacharya Institute of Technology & Sciences (Autonomous), Tirupati

Course Code	ENGINEERING PHYSICS	L	T/CLC	P	C
23ABS9903		2	1	0	3
Regulation: AK23	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 effect and 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).

5. Sun | 978-93-92933-95-0 | Engineering Physics (JNTU) - Dr. K. Ramya

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).



Subject Code: 23ABS9905	Subject Name: Differential Equations & Vector Calculus	L 2	T/CLC 1	P 0	Credits 3
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<p>Course Outcomes (CO): Student will be able to</p> <p>CO1. Apply the concepts of ordinary differential equations of first order and first degree.</p> <p>CO2. Apply the methods of linear differential equations related to various engineering problems.</p> <p>CO3. Analyze the solutions of partial differential equations using Lagrange's method.</p> <p>CO4. Understand the different operators and identities in the vector calculus.</p> <p>CO5. Evaluate the surface integral and volume integral in the vector calculus using various theorems.</p>

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-Exact 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.
5. SriKrishna | 978-93-94246-77-5 | Differential Equations & Vector Calculus (JNTU) - Dr. M. S. Reddy

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).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Basic Electrical & Electronics Engineering	L	T/CLC	P	C
23AES0201	I-II		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: Hydrel, 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. Mehtha, 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. Bhattacharya, Person Publications, 2018, Second Edition.
5. Amaravathi | 978-93-93199-46-1 | Basic Electrical & EE (JNTU) - Dr. K. Gopi

WEB RESOURCES:

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

PART-B

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 INSTRUMENTATION

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	PO 10	PO 11	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)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Engineering Graphics	L	T	P	C
23AES0301	I-II		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, Involute, 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. Kanniah, 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. Kanniah, 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.
4. SPHPL | 978-93-94155-83-1 | Engineering Graphics (JNTU) - Dr. C. N. Reddy

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)

AIATS TPT-CSE(DS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

DEPARTMENT OF CSE(DATA SCIENCE)

Course Code	Year & Sem	IT workshop (Common to CSE, CIC, CSE(DS) & EEE)	L	T	P	C
23AES0503	I-II		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 TeX and 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 PO12)	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: identify(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: identify(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)

AIATS TPT-CSE(CS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Data Structures (Common to CSE, CIC, CSE(DS), AIML & AIDS)	L	T/CLC	P	C
23APC0501	I-II		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 dequeues (double-ended queues), Operations on dequeues 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 6. STP 978-93-93162-18-2 Data Structures (JNTU) - Dr. S. Vasundra

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 PO12)	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)



ANNAMACHARYA INSTITUTE OF TECHNOLOGY SCIENCES: TIRUPATI

(Autonomous)

Common to I Sem ECE/ AI&DS/AI&ML/CE/ME & II Sem CSE/CIC/EEE/CSD

Subject Code: 23ABS9908	Subject Name: Engineering Physics Lab	L T P 0 0 2	Credits: 1
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Course Outcomes

- 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:

1. A Textbook of Practical Physics - S. Balasubramanian, M. N. Srinivasan, S. Chand Publishers, 2017.
2. Sun | 978-93-92933-95-0 | Engineering Physics (JNTU) - Dr. K. Ramya

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).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Electrical & Electronics Engineering Workshop	L	T	P	C
23AES0202	I-II		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:

1. Verification of Kirchhoff's current law and Voltage law-(CO1).
2. Verification of Superposition theorem-(CO1).
3. Measurement of Resistance using Wheat stone bridge-(CO1).
4. Measurement of Power and Power factor using Single-phase watt-meter-(CO2).
5. Measurement of Earth Resistance using Megger-(CO2).
6. Calculation of Electrical Energy for Domestic Premises-(CO2).
7. 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
4. Amaravathi | 978-93-93199-46-1 | Basic Electrical & EE (JNTU) - Dr. K. Gopi

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.
4. Amaravathi | 978-93-93199-46-1 | Basic Electrical & EE (JNTU) - Dr. K. Gopi

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
C01	2	1		1					1			2	
C02	3	2		2					1			2	
C03		3		3					1			2	1
C04	2	3											
C05	3	3											
C06	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).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Data Structures Lab	L	T	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 PO12)	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)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	NSS/NCC/Scouts & Guides/Community Service	L	T	P	C
23AHM9904	I-II		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, careerguidance.

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 PO12)	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)

CO3 Action Verb is of BTL 4. Using Thumb rule, L4 correlates PO10 as moderate (4).

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)
(Effective for the batches admitted in 2023-24)**

Semester III (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits C	CIE	SEE	Total
				L	T / CLC	P				
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	23APC3201	Introduction to Data Science	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	23APC3202	Data Science using python 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	0	1	2	2	30	70	100
9	MC	23AMC9901	Environmental Science	2	0	0	-	30	-	30
Total				12	06	8	20	270	560	830



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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Course Code	Year & Sem	Discrete Mathematics & Graph Theory (Common to CSE,CIC,CSD,AI&DS, AI&ML)	L	T/ CLC	P	C
23ABS9913	II-I		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.		and 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).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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DEPARTMENT OF CSE(DATA SCIENCE)**

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	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
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).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
Department of CSE(DATA SCIENCE)**

Course Code	Year & Sem	Introduction to Data Science (Data Science)	L	T / CLC	P	C
23APC3201	II-I		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO 1: Understand the basic significance of Data Science for data visualization.

CO 2: Analyze the large data sets using python libraries.

CO 3: Apply the ACID Principles of relational data and NOSQL Data

CO 4: Apply the Machine learning techniques for data analytics on standard data sets.

CO 5: Understand the python programs to present and interpret data sets using visualization packages in python.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The basic significance of Data science		for data visualization.	L2
CO2	Analyze	The large data sets	using python libraries		L4
CO3	Apply	The ACID Principles of relational data and NOSQL Data			L3
CO4	Apply	The Machine learning techniques		for data analytics on standard data sets	L3
CO5	Understand	the python programs to present and interpret data sets	using visualization packages in python.		L2

UNIT – I	9 Hrs
Introduction to Data science, benefits and uses, facets of data, data science process in brief, big data ecosystem and data science Data Science process: Overview, defining goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory analysis, model building, presenting findings and building applications on top of them	
UNIT – II	9 Hrs
Applications of machine learning in Data science, role of ML in DS, Python tools like sklearn, modelling process for feature engineering, model selection, validation and prediction, types of ML, semi-supervised learning Handling large data: problems and general techniques for handling large data, programming tips for dealing large data, case studies on DS projects for predicting malicious URLs, for building recommender systems	
UNIT – III	9 Hrs
NoSQL movement for handling Bigdata: Distributing data storage and processing with Hadoop framework, case study on risk assessment for loan sanctioning, ACID principle of relational databases, CAP theorem, base principle of NoSQL databases, types of NoSQL databases, case study on disease diagnosis and profiling	
UNIT – IV	9 Hrs
Tools and Applications of Data Science: Introducing Neo4j for dealing with graph databases, graph query language Cypher, Applications graph databases, Python libraries like nltk and SQLite for handling Text mining and analytics, case study on classifying Reddit posts	
UNIT – V	9 Hrs
Data Visualization and Prototype Application Development: Data Visualization options, Crossfilter, the JavaScript MapReduce library, Creating an interactive dashboard with dc.js, Dashboard development tools. Applying the Data Science process for real world problem solving scenarios as a detailed case study.	
Textbooks:	
1. Davy Cielen, Arno D.B. Meysman, and Mohamed Ali, “Introducing to Data Science using Python tools”, Manning Publications Co, Dreamtech press, 2016 2. Prateek Gupta, “Data Science with Jupyter” BPB publishers, 2019 for basics	
Reference Books:	
1. Joel Grus, “Data Science From Scratch”, OReilly, 2019 2. Doing Data Science: Straight Talk From The Frontline, 1 st Edition, Cathy O’Neil and Rachel Schutt, O’Reilly, 2013	
Online Learning Resources:	

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								1	
CO2	3	3	3	3									2
CO3	3	3	3	2	3				2				2
CO4	3	3	3	2	3							1	
CO5	2	3	2	2	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 PO12)	Level of Correlation (0-3)
	Lesson plan (Hrs)	%	Correlation	Co's Action verb	BTL			
1	9	20	2	CO1: Understand	L2	PO1 PO2 PO4	PO1: Apply(L3) PO2: Review(L2) PO4: Analyze (L4)	2 3 1
2	9	20	2	CO2: Analyze	L4	PO1 PO2 PO3 PO4	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4)	3 3 3 3
3	9	20	2	CO3: Apply	L3	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 2 3 2
4	8	20	2	CO4: 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
5	10	20	2	CO5: Understand	L2	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO11: Thumb rule	2 3 2 2 2 2
	45	100						

Justification Statements:**CO 1: Understand** the basic significance of Data Science for data visualization.**Action Verb: Understand (L2)****PO1 Verb: Apply(L3)**

CO1 Action verb is less than of 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)

PO4: Analyze (L4)

CO1 Action verb is less than PO4 verb. Therefore the correlation is Low (1)

CO 2: Analyze the large data sets using python libraries**Action Verb: Analyze (L4)****PO1: Apply(L3)**

CO2 Action verb is greater than 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)

PO3: Develop (L3)

CO2 Action verb is greater than PO3 verb. Therefore the correlation is high (3)

PO4: Analyze (L4)

CO3 Action verb is same as PO4 verb. Therefore the correlation is high (3)

CO 3 : Apply the ACID Principles of relational data and NOSQL Data**Action Verb: Apply (L3)****PO1: Apply(L3)**

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

PO4: Analyze (L4)

CO3 Action verb is same as PO4 verb. Therefore the correlation is high (3)

PO5: Apply(L3)

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

PO9: Thumb rule

The fundamental tools of data analysis and statistics to solve difficult problems in different data sets

Therefore, the correlation is moderate (2)

CO 4: Apply the Machine learning techniques for data analytics on standard data sets

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 (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. Therefore the correlation is moderate(2)

PO5: Apply(L3)

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

CO 5: Understand the python programs to present and interpret data sets using visualization packages in python

Action Verb: Understand (L2)

PO1: Apply(L3)

CO5 Action verb is Less than of PO1 verb. Therefore, the correlation is moderate (2)

PO2: 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 of PO3 verb. Therefore, the correlation is moderate (2)

PO4: Analyze (L4)

CO5 Action verb is Less than of PO4 verb. Therefore, the correlation is moderate (2)

PO5: Apply(L3)

Action verb is Less than of PO5 verb. Therefore, the correlation is moderate (2)

PO11: Thumb rule

To deployment of application need suitable visualization reports to be generated by project team members. Therefore, the correlation is medium (2)



ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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DEPARTMENT OF CSE(DATA SCIENCE)

Course Code	Year & Sem	Advanced Data Structures and Algorithms Analysis (Common to CSE,CIC,CSE(DS),AIDS & AIML)	L	T/ CLC	P	C
23APC0504	II-I		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 \(youtube.com\)](https://www.youtube.com/watch?v=...)

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					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	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 to 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)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

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	7 Hrs
<p>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.</p> <p>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.</p> <p>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.</p>	
UNIT - II	12 Hrs
<p>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.</p> <p>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.</p>	
UNIT - III	19 Hrs
<p>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.</p> <p>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.</p> <p>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.</p>	
UNIT - IV	19 Hrs

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

19 Hrs

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)

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_012880464547618816347_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	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 PO12)	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: SSelect(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)



ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
Department of CSE(DATA SCIENCE)

Course Code	Year & Sem	Data Science using Python Lab (Data Science)	L	T	P	C
23APC3202	II-I		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the concepts of Data frames in Python programming for solving complex problems.

CO2: Apply the python libraries for basic statistical and descriptive analytics on the data sets.

CO3: Apply the correlation and regression analytics and standard data sets.

CO4: Analyse the python programs to present and interpret data using visualization reports

CO5: Understand the basic Python libraries for data science to optimize numeric applications

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the concepts of Data frames in Python programming		for solving complex problems.	L2
CO2	Apply	the python libraries for basic statistical and descriptive analytics on the data sets			L3
CO3	Apply	the corelation and regression analytics and standard data sets			L3
CO4	Analyse	the python programs to present and interpret data		Visualization reports	L4
CO5	Understand	the basic Python libraries for data science		to optimize numeric applications	L2

List of Experiments

1. Creating a NumPy Array[CO1]
 - a. Basic ndarray
 - b. Array of zeros
 - c. Array of ones
 - d. Random numbers in ndarray
 - e. An array of your choice
 - f. Imatrix in NumPy
 - g. Evenly spaced ndarray
2. The Shape and Reshaping of NumPy Array[CO1]
 - a. Dimensions of NumPy array
 - b. Shape of NumPy array
 - c. Size of NumPy array
 - d. Reshaping a NumPy array
 - e. Flattening a NumPy array
 - f. Transpose of a NumPy array
3. Expanding and Squeezing a NumPy Array[CO1]
 - a. Expanding a NumPy array
 - b. Squeezing a NumPy array
 - c. Sorting in NumPy Arrays
4. Indexing and Slicing of NumPy Array[CO2]
 - a. Slicing 1-D NumPy arrays
 - b. Slicing 2-D NumPy arrays
 - c. Slicing 3-D NumPy arrays
 - d. Negative slicing of NumPy arrays
5. Stacking and Concatenating Numpy Arrays[CO2]
 - a. Stacking ndarrays
 - b. Concatenating ndarrays
 - c. Broadcasting in Numpy Arrays
6. Perform following operations using pandas[CO3]
 - a. Creating dataframe
 - b. concat()
 - c. Setting conditions

- d. Adding a new column
7. Perform following operations using pandas[CO3]
 - a. Filling NaN with string
 - b. Sorting based on column values
 - c. groupby()
8. Read the following file formats using pandas[CO4]
 - a. Text files
 - b. CSV files
 - c. Excel files
 - d. JSON files
9. Read the following file formats[CO4]
 - a. Pickle files
 - b. Image files using PIL
 - c. Multiple files using Glob
 - d. Importing data from database
10. Demonstrate web scraping using python[CO4]
11. Perform following preprocessing techniques on loan prediction dataset[CO5]
 - a. Feature Scaling
 - b. Feature Standardization
 - c. Label Encoding
 - d. One Hot Encoding
12. Perform following visualizations using matplotlib[CO5]
 - a. Bar Graph
 - b. Pie Chart
 - c. Box Plot
 - d. Histogram
 - e. Line Chart and Subplots
 - f. Scatter Plot
13. Getting started with NLTK, install NLTK using PIP[CO5]
14. Python program to implement with Python Sci Kit-Learn & NLTK[CO5]
15. Python program to implement with Python NLTK/Spicy/Py NLPI. [CO5]

Web References:

1. <https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-data-science-beginners/>
2. <https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutes-guide-to-key-concepts/>
3. <https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formats-python/>
4. <https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessing-python-scikit-learn/>
5. <https://www.analyticsvidhya.com/blog/2020/02/beginner-guide-matplotlib-data-visualization-exploration-python/6.https://www.nltk.org/book/ch01.html>

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	1	2						2	1	
CO2	3	3	3	3	2							1	
CO3	3	3	3	2									2
CO4	3	3	3	3								1	
CO5	2	3	2	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 PO12)	Level of Correlation (0-3)
1	CO1: Understand	L2	PO1	PO1: Apply(L3)	2
			PO2	PO2: Review(L2)	3
			PO3	PO3: Develop (L3)	2
			PO4	PO4: Analyze (L4)	1
			PO5	PO5 : Apply(L3)	2
			PO11	PO11: Thumb rule	2
2	CO2: Apply	L3	PO1	PO1: Apply(L3)	3
			PO2	PO2: Review(L2)	3
			PO3	PO3: Develop (L3)	3
			PO4	PO4: Analyze (L4)	2
			PO5	PO5 : Apply(L3)	3
3	CO3: Apply	L3	PO1	PO1: Apply(L3)	3
			PO2	PO2: Review(L2)	3
			PO3	PO3: Develop (L3)	3
			PO4	PO4: Analyze (L4)	2
4	CO4:Analyze	L4	PO1	PO1: Apply(L3)	3
			PO2	PO2: Review(L2)	3
			PO3	PO3: Develop (L3)	3
			PO4	PO4: Analyze (L4)	3
5	CO5: Understand	L2	PO1	PO1: Apply(L3)	2
			PO2	PO2: Review(L2)	3
			PO3	PO3: Develop (L3)	2
			PO4	PO4: Analyze (L4)	1
			PO11	PO11: Thumb rule	2

Justification Statements:

CO1: Understand the concepts of Data frames in Python programming for solving complex problems.

Action Verb: Understand (L2)

PO1 Verb: Apply(L3)

CO1 Action verb is less than level of 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: Develop (L3)

CO1 Action verb is less than PO3 verb. Therefore the correlation is moderate (2)

PO4: Analyze (L4)

CO1 Action verb is greater than PO4 verb. Therefore the correlation is Low (1)

PO5 Verb: Apply(L3)

CO1 Action verb is less than PO5 verb. Therefore, the correlation is moderate (2)

PO11: Thumb rule

To solve the different mathematical functions by using python data science predefine libraries to writing simple programs. Therefore, the correlation is moderate (2)

CO 2: Apply the python libraries for basic statistical and descriptive analytics on the data sets.

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)

PO3: Develop (L3)

CO2 Action verb is same as 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 less than PO5 verb. Therefore, the correlation is moderate (2)

CO 3: Apply the correlation and regression analytics and standard data sets.

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 greater than 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 PO4 verb. Therefore the correlation is moderate (2)

CO 4: Analyze the python programs to present and interpret data using visualization reports

Action Verb: Analyze (L4)

PO1: Apply(L3)

CO5 Action verb is greater level of PO1 verb. Therefore, the correlation is High (3)

PO2: Review (L2)

CO5 Action verb is greater level of PO2 verb. Therefore, the correlation is High (3)

PO3: Develop (L3)

CO5 Action verb is greater level of 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)

CO 5: Understand the basic Python libraries for data science to optimize numeric applications

Action Verb: Understand (L2)

PO1 Verb: Apply(L3)

CO5 Action verb is less than of PO1 verb by one level. Therefore, the correlation is moderate (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 PO3 verb. Therefore the correlation is moderate (2)

PO4: Analyze (L4)

CO5 Action verb is less than PO4 verb. Therefore the correlation is low (1)

PO11: Thumb rule

To deployment of application need suitable visualization reports to be generated by project team members.

Therefore, the correlation is moderate (2)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Object-Oriented Programming Through Java Lab (common to CSE,CIC, CSE(DS), AIDS & AIML)	L	T	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 $ax^2+bx=0$. 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:

- JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
- Joy with JAVA, Fundamentals of Object Oriented Programming, DebasisSamanta, MonalisaSarma, Cambridge, 2023.
- JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

Reference Books:

- The complete Reference Java, 11th edition, Herbert Schildt, TMH
- Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Online Resources:

- <https://nptel.ac.in/courses/106/105/106105191/>
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_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 PO12)	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)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

DEPARTMENT OF CSE(DATA SCIENCE)

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

- Write a program to find the largest element among three Numbers.
- Write a Program to display all prime numbers within an interval
- Write a program to swap two numbers without using a temporary variable.
- Demonstrate the following Operators in Python with suitable examples.
 - Arithmetic Operators
 - Relational Operators
 - Assignment Operators
 - Logical Operators
 - Bit wise Operators
 - Ternary Operator
 - Membership Operators
 - Identity Operators
- Write a program to add and multiply complex numbers
- Write a program to print multiplication table of a given number.

UNIT - II	9 Hrs
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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:

- Write a program to define a function with multiple return values.
- Write a program to define a function using default arguments.
- Write a program to find the length of the string without using any library functions.
- Write a program to check if the substring is present in a given string or not.
- Write a program to perform the given operations on a list:
 - Addition
 - Insertion
 - slicing
- Write a program to perform any 5 built-in functions by taking any list.

UNIT - III	9 Hrs
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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, 2nd Edition, 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.	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			
1	9	20	2	CO1 : Understand	L2	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO5: Apply (L3)	2 3 2 2
2	9	20	2	CO2 : Apply	L3	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: 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: 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: 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 high (3)

PO3 Verb : Develop (L3)

CO3 Action verb is greater than PO3 verb. Therefore the correlation 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)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Environmental Science (common to CSE, CIC, CSD & EEE)	L	T	P	C
23AMC9901	II-I		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: Analyze the population explosion and impact of environmental health issues on human being.

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-spots 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.Text book of Environmental Studies for Undergraduate Courses by ErachBharucha for University Grants Commission, Universities Press.
 2.Environmental Studies by Kaushik, New Age Publishers.
 3.Environmental Studies by Sri Krishna Hitech publishing Pvt. Ltd

Reference Books:

1.Environmental studies by R.Rajagopalan, Oxford University Press.
 2. Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.
 3. Introduction to Environmental engineering and science by Gilbert M. Masters and Wendell P. Ela - Printice hall of India Private limited.
 4. Environmental studies by A. Ravi Krishnan, G. Sujatha Sri Krishna Hitech publications.

Mapping of course outcomes with program outcomes

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, CO1 correlates PO6 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)

AIATS TPT-CSE(DS)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)
(Effective for the batches admitted in 2023-24)

Semester IV (Second year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits C	CIE	SEE	Total
				L	T / CLC	P				
1	HM	23AES0305	Optimization Techniques	2	0	0	2	30	70	100
2	BS	23ABS9915	Statistical Methods for Data Science	2	1	0	3	30	70	100
3	PC	23APC3203	Data Engineering	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	23APC3204	Data Engineering 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	23ASC3201	Exploratory Data Analysis with Python	0	1	2	2	30	70	100
9	ES	23AES0304	Design Thinking & Innovation	0	1	2	2	30	70	100
Total				10	06	10	21	270	630	900
Mandatory Community Service Project Internship of 08 weeks duration during summer vacation										



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Optimization Techniques	L	T	P	C
23AES0305	II-II		2	0	0	2

Course Outcomes:

After studying the course, student will be able to

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.

Mapping of COs to POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
	CO1	3		3									2
CO2	3		3		3							2	2
CO3	2	2										3	2
CO4	3		3		3							2	2
CO5	2	2										3	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 PO12)	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).

AIATS TPT-CSE(CDS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Statistical Methods for Data Science	L	T / CLC	P	C
23ABS9915	II-II		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: **Apply** the discrete and continuous probability distributions to the given random data

CO2: **Evaluate** the estimators using Methods of point estimation for given data.

CO3: **Apply** the methods of Interval estimation to the given data.

CO4: **Analyze** the techniques for testing of hypothesis and types of errors for large samples.

CO5: **Analyze** the techniques for testing of hypothesis for small samples.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
1	Apply	the discrete and continuous probability distributions	to the given random data		L3
2	Evaluate	the estimators using Methods of point estimation	for given data		L5
3	Apply	the methods of Interval estimation	to the given data		L3
4	Analyze	the techniques for testing of hypothesis and types of errors	for large samples		L4
5	Analyze	the techniques for testing of hypothesis	for small samples		L4

Unit I: Random Variables and Sampling Theory

9 Hrs

Random variables (discrete and continuous), probability density functions, properties, mathematical expectation. Probability distributions: Binomial, Poisson and Normal-their properties.

Sampling Theory: Population, sample, parameter and statistic; characteristics of a good estimator; Consistency – Invariance property of Consistent estimator, Sufficient condition for consistency; Unbiasedness; Sufficiency.

UNIT II: Point Estimation

10 Hrs

Point Estimation- Estimator, Estimate, Methods of point estimation – Maximum likelihood method (the asymptotic properties of ML estimators are not included), Large sample properties of ML estimator (without proof)- applications, Method of moments, method of least squares, method of minimum chi-square and modified minimum chi-square-Asymptotic Maximum Likelihood Estimation and applications.

UNIT III: Interval Estimation

10 Hrs

Confidence limits and confidence coefficient; Duality between acceptance region of a test and a confidence interval; Construction of confidence intervals for population proportion (small and large samples) and between two population proportions(large samples); Confidence intervals for mean and variance of a normal population; Difference between the mean and ratio of two normal populations.

Unit IV: Testing of hypotheses

9 Hrs

Types of errors, power of a test, most powerful tests; Neyman-Pearson Fundamental Lemma and its applications; Notion of Uniformly most powerful tests; Likelihood Ratio tests: Description and property of LR tests - Application to standard distributions.

Unit V: Small sample tests

9 Hrs

Student's t-test, test for a population mean, equality of two population means, paired t-test, F-test for equality of two population variances, Chi-square test for goodness of fit and test for independence of attributes, χ^2 test for testing variance of a normal distribution.

Textbooks:

1. Miller and Freunds, Probability and Statistics for Engineers, 7/e, Pearson, 2008.
2. Manoj Kumar Srivastava and Namita Srivastava, Statistical Inference – Testing of Hypotheses, Prentice Hall of India, 2014
3. 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.

- Robert V Hogg, Elliot A Tannis and Dale L.Zimmerman, Probability and Statistical Inference, 9th edition, Pearson publishers,2013
- S.Chand ,Probability and Statistics, Dr.T.K.V.Iyengar, Dr.B.Krishna Gandhi, S.Ranganatham, Dr.M.V.S.S.N.Prasad

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc21_ma74/preview
- https://onlinecourses.nptel.ac.in/noc22_mg31/preview

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									

(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	13	18	2	Apply	L3	PO1	Apply (L3)	3
2	15	21	3	Evaluate	L5	PO1	Apply (L3)	3
3	14	20	3	Apply	L3	PO1	Apply (L3)	3
4	15	21	3	Analyze	L4	PO2	Analyze (L4)	3
5	15	21	3	Analyze	L4	PO2	Analyze (L4)	3

CO1:Apply the discrete and continuous probability distributions to the given random data.

CO Action Verb: Apply (L3)

PO2 Verb: Apply(L3)

CO1 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

CO2: Evaluate the estimators using Methods of point estimation for given data..

CO Action Verb: Evaluate (L5)

PO2 Verb: Apply(L3)

CO2 Action Verb high level to PO1 verb; Therefore correlation is high (3).

CO3: Analyze the methods of Interval estimation to the given data.

CO 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 techniques for testing of hypothesis and types of errors for large samples.

CO Action Verb: Analyze (L4)

PO1 Verb: Analyze (L4)

CO4 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

CO5: Apply the techniques for testing of hypothesis for small samples.

CO Action Verb: Analyze (L4)

PO1 Verb: Analyze (L4)

CO5 Action verb is equal to PO2 verb ; therefore the correlation is high (3).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
Department of CSE (Data Science)**

Course Code	Year & Sem	Data Engineering (Data Science)	L	T / CLC	P	C
23APC3203	II-II		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the Data Engineering Life cycle to prepare analytical data

CO2: Analyze the data engineering technologies to execute data processing tasks

CO3: Apply the appropriate data modeling techniques for different types of data

CO4: Understand the concepts of Data Storage Systems and Data Ingestion techniques.

CO5: Analyze the data quality checks and governance processes to ensure data reliability and compliance

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The Data Engineering Life cycle		to prepare analytical data	L2
CO2	Analyze	the data engineering technologies		to execute data processing tasks	L4
CO3	Apply	The appropriate data modeling techniques		for different types of data	L3
CO4	Understand	the concepts of Data Storage Systems and Data Ingestion techniques			L2
CO5	Analyze	the data quality checks and governance processes		to ensure data reliability and compliance	L4

UNIT – I	8 Hrs
Introduction to Data Engineering: Definition, Data Engineering Life Cycle, Evolution of Data Engineer, Data Engineering Versus Data Science, Data Engineering Skills and Activities, Data Maturity, Data Maturity Model, Skills of a Data Engineer, Business Responsibilities, Technical Responsibilities, Data Engineers and Other Technical Roles.	
UNIT – II	9 Hrs
Data Engineering Life Cycle: Data Life Cycle Versus Data Engineering Life Cycle, Generation: Source System, Storage, Ingestion, Transformation, Serving Data. Major undercurrents across the Data Engineering Life Cycle: Security, Data Management, DataOps, Data Architecture, Orchestration, Software Engineering.	
UNIT – III	9 Hrs
Designing Good Data Architecture: EnterpriseArchitecture,Data Architecture, Principles of Good Data Architecture, Major Architecture Concepts. Data Generation in Source Systems: Sources of Data, Files and Unstructured Data, APIs, Application Databases (OLTP), OLAP, Change Data Capture, Logs, Database Logs, CRUD, Source System Practical Details.	
UNIT – IV	9 Hrs
Storage:Raw Ingredients of Data Storage, Data Storage Systems, Data Engineering Storage Abstractions, Data warehouse, Data Lake, Data Lakehouse. Ingestion: Data Ingestion, Key Engineering considerations for the Ingestion Phase, Batch Ingestion Considerations, Message and Stream Ingestion Considerations, Ways to Ingest Data	
UNIT – V	10 Hrs
Queries, Modeling and Transformation: Queries, Life of a Query, Query Optimizer, Queries on Streaming Data, Data Modelling, Modeling Streaming Data, Transformations, Streaming Transformations and Processing. Serving Data for Analytics, Machine Learning and Reverse ETL: General Considerations for serving Data, Business Analytics, Operational Analytics, Embedded Analytics, Ways to serve data for analytics and ML, Reverse ETL.	

Textbooks:

1.Joe Reis, Matt Housley, Fundamentals of Data Engineering, O'Reilly Media, Inc.,June 2022,ISBN: 9781098108304

Reference Books:

1.Paul Crickard , Data Engineering with Python,Packt Publishing, October 2020.

2.Ralph Kimball, Margy Ross, The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling, Wiley, 3rd Edition, 2013

3. James Densmore, Data Pipelines Pocket Reference: Moving and Processing Data for Analytics, O'Reilly Media, 1st Edition, 2021

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	1	
CO2	3	3	3	3	3							1	
CO3	3	3	3	2	3						2		2
CO4		3	2	1								2	
CO5	3	3	3	3	3						2		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 PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	8	20	2	CO1: Understand	L2	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review(L2) PO11: Thumb rule	2 3 2
2	9	20	2	CO2: Analyze	L4	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
3	9	20	2	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	9	20	2	CO4: Understand	L2	PO2 PO3 PO4	PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4)	3 2 1
5	10	20	2	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 3 2
	45	100						

Justification Statements:

CO1: Understand the Data Engineering Life cycle to prepare analytical data

Action Verb : Understand (L2)

PO1 Verb : Apply(L3)

CO1 Action verb is less than of 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)

PO11: Thumb rule

Data Engineering Life cycle **is** applied to solve various problems, where the work is distributed to many members to complete that task. Therefore the correlation is moderate (2)

CO2: Analyze the data engineering technologies to execute data processing tasks

Action Verb : Analyze (L4)

PO1: Apply(L3)

CO2 Action verb is greater than 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)

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: Apply(L3)

CO2 Action verb is greater than PO5 verb. Therefore the correlation is high(3)

CO3: Apply the appropriate data modeling techniques for different types of data

Action Verb : Apply (L3)

PO1: Apply(L3)

CO3 Action verb is same as level of PO1 verb. Therefore, the correlation is High (3)

PO2: Review (L2)

CO3 Action verb is greater level 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 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

Data engineering techniques were applied to real time applications . Therefore the correlation is medium(2)

CO4: Understand the concepts of Data Storage Systems and Data Ingestion techniques.

Action Verb : Understand (L2)

PO2: Review(L2)

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

PO3: Develop (L3)

CO4 Action verb is less than PO3 verb. Therefore the correlation is moderate(2)

PO4: Analyze (L4)

CO4 Action verb is less than as PO4 verb. Therefore the correlation is low(1)

CO5: Analyze data quality checks and governance processes to ensure data reliability and compliance

Action Verb : Analyze (L4)

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 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 real time governance processes to ensure data reliabilitychecks. Therefore the correlation is moderate (2)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES,
TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Database Management Systems	L	T/CLC	P	C
23APC0508	II-II	Common to CSE,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
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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
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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
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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(uptdatable and non-uptdatable), 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
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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
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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:

- Database Management Systems, 3rd edition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2, 3, 4)
- Database System Concepts, 5th edition, Silberschatz, Korth, Sudarsan, TMH (For Chapter 1 and Chapter 5)

Reference Books:													
1. Introduction to Database Systems, 8th edition, 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_01275806667282022456_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					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	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 rule PO8: 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 rule PO8: 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)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	DIGITAL LOGIC & COMPUTER ORGANIZATION	L	T/ CLC	P	C
23APC0503	II-II		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, Zvonko Vranesic, Safwat Zaky, 6 th edition, McGraw Hill, 2023.	
2. Digital Design, 6 th Edition, M. Morris Mano, Pearson Education, 2018.	
3. Computer Organization and Architecture, William Stallings, 11 th Edition, Pearson, 2022.	
Reference Books	
1. Computer Systems Architecture, M. Moris Mano, 3 rd Edition, Pearson, 2017.	
2. Computer Organization and Design, David A. Paterson, John L. Hennessy, Elsevier, 2004.	
3. Fundamentals of Logic Design, Roth, 5 th Edition, Thomson, 2003.	
4. Computer Organization & Architecture, William Stallings, 11 th 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 PO12)	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)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

Department of CSE (Data Science)

Course Code	Year & Sem	Data Engineering Lab (Data Science)	L	T	P	C
23APC3204	II-II		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: Apply the Apache NIFI to process and distribute data between disparate systems

CO2: Apply the data cleansing and transform techniques to clean data

CO3: Analyze the version control systems to track and manages software code

CO4: Create the data pipeline and Dashboards to visualization reports

CO5: Analyze the real time pipelines to perform validation and deployment in production system

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Apply	the Apache NIFI to process and distribute data between disparate systems			L3
CO2	Apply	the data cleaning and transform techniques		to clean data	L3
CO3	Analyze	the version control systems		to track and manages software code	L4
CO4	Create	the data pipeline and Dashboards		to visualization reports	L6
CO5	Analyze	the real time pipelines with staging areas		that perform validation and deployment in production environment	L4

List of Experiments

1. Installing and configuring Apache NiFi, Apache Airflow[CO1]
2. Installing and configuring Elasticsearch, Kibana, PostgreSQL, pgAdmin 4 [CO1]
3. Reading and Writing files [CO1]
 - a. Reading and writing files in Python
 - b. Processing files in Airflow
 - c. NiFi processors for handling files
 - d. Reading and writing data to databases in Python
 - e. Databases in Airflow
 - f. Database processors in NiFi
4. Working with Databases [CO2]
 - a. Inserting and extracting relational data in Python
 - b. Inserting and extracting NoSQL database data in Python
 - c. Building database pipelines in Airflow
 - d. Building database pipelines in NiFi
5. Cleaning, Transforming and Enriching Data[CO2]
 - a. Performing exploratory data analysis in Python
 - b. Handling common data issues using pandas
 - c. Cleaning data using Airflow
6. Building the Data Pipeline[CO2]
7. Building a Kibana Dash Board[CO2]
8. Perform the following operations[CO3]
 - a. Staging and validating data
 - b. Building idempotent data pipelines
 - c. Building atomic data pipelines
9. Version Control with the NiFi Registry[CO3]
 - a. Installing and configuring the NiFi Registry
 - b. Using the Registry in NiFi
 - c. Versioning your data pipelines
 - d. Using git-persistence with the NiFi Registry
10. Monitoring Data Pipelines[CO4]
 - a. Monitoring NiFi in the GUI
 - b. Monitoring NiFi using processors

- c. Monitoring NiFi with Python and the REST API
- 11. Deploying Data Pipelines[CO5]
 - a. Finalizing your data pipelines for production
 - b. Using the NiFi variable registry
 - c. Deploying your data pipelines
- 12. Building a Production Data Pipeline[CO5]
 - a. Creating a test and production environment
 - b. Building a production data pipeline
 - c. Deploying a data pipeline in production

Reference Books:

1. Paul Crickard, Data Engineering with Python, Packt Publishing, October 2020.

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							1	
CO2	3	3		2		3						1	
CO3	3	3	3	3	3								2
CO4	3	3									3	1	
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 PO12)	Level of Correlation (0-3)
1	CO1: Apply	L3	PO1 PO2 PO5	PO1: Apply(L3) PO2: Review(L2) PO5 : Apply(L3)	3 3 3
2	CO2: Apply	L3	PO1 PO2 PO4 PO6	PO1: Apply(L3) PO2: Review(L2) PO4: Analyze (L4) PO6: Apply(L3)	3 3 2 3
3	CO3: Analyze	L4	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
4	CO4: Create	L6	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review(L2) PO11: Thumb rule	3 3 3
5	CO5: Analyze	L4	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:

CO 1: Apply the Apache NIFI to process and distribute data between disparate systems

Action Verb: Apply (L3)

PO1 Verb: Apply(L3)

CO1 Action verb is less than level of PO1 verb by one level. Therefore, the correlation is high (3)

PO2 Verb: Review(L2)

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

PO5 Verb: Apply(L3)

CO1 Action verb is less than PO5 verb. Therefore, the correlation is high (3)

CO 2: Apply the data cleansing and transform techniques to clean data

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)

PO4: Analyze (L4)

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

PO6: Thumb rule

By using Apache NiFi, Apache Airflow open-source library for python programming is used for scientific computing applications. Therefore, the correlation is moderate (2)

CO 3: Analyze the version control systems to track and manages software code

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 greater than PO4 verb. Therefore the correlation is high (3)

PO5: Apply(L3)

CO3 Action verb is greater than level as PO5 verb. Therefore, the correlation is high (3)

CO 4: Create the data pipeline and Dashboards to visualization reports

Action Verb: Create (L6)

PO1: Apply(L3)

CO4 Action verb is less than PO1 verb. Therefore the correlation is high (3)

PO2: Review(L2)

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

PO11: Thumb rule

To deployment of application need suitable visualization reports to be generated by project team real time scenarios. Therefore, the correlation is high (3)

CO 5: Analyze the real time pipelines to perform validation and deployment in production system

Action Verb: Analyze (L4)

PO1: Apply(L3)

CO5 Action verb is greater level of PO1 verb. Therefore, the correlation is High (3)

PO2: Review (L2)

CO5 Action verb is greater level of PO2 verb. Therefore, the correlation is High (3)

PO3: Develop (L3)

CO5 Action verb is greater level of 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)

Action verb is greater level of PO5 verb. Therefore, the correlation is High (3)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Database Management Systems Lab (Common to CSE,CIC,CSE(DS),AIML)	L	T	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 dropping 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 PO12)	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)
Department of CSE(DATA SCIENCE)**

Course Code	Year & Sem	EXPLORATORY DATA ANALYSIS WITH PYTHON (Skill Enhancement Course) CSE[DATA SCIENCE]	L	T	P	C
23ASC3201	II-II			0	1	2

Course Outcomes:

After studying the course, student will be able to

CO1: Analyze the fundamental concepts of Exploratory Data Analysis for generating reports

CO2: Apply the data visualization techniques to identify hidden data patterns

CO3: Apply the various data transformation techniques to reduce data dimensionality

CO4: Analyze the distribution techniques to uncover relationships between datasets

CO5: Analyze the ML workflow, EDA Models to classify the data models

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	the fundamental concepts of Exploratory Data Analysis		for generating reports	L4
CO2	Apply	the data visualization techniques		to identify hidden data patterns	L3
CO3	Apply	the various data transformation techniques		to reduce data dimensionality	L3
CO4	Analyze	the distribution techniques		to uncover relationships between datasets	L4
CO5	Analyze	the ML workflow, EDA Models		to classify the data models	L4

UNIT – I		9 Hrs
<p>Exploratory Data Analysis Fundamentals: Understanding data science, The significance of EDA, Steps in EDA, Making sense of data, Numerical data, Categorical data, Measurement scales, Comparing EDA with classical and Bayesian analysis, Software tools available for EDA, Getting started with EDA.</p> <p>Sample Experiments:</p> <ol style="list-style-type: none"> 1. a) Download Dataset from Kaggle using the following link : https://www.kaggle.com/datasets/sukhmanibedi/cars4u b) Install python libraries required for Exploratory Data Analysis (numpy, pandas, matplotlib, seaborn) 2. Perform Numpy Array basic operations and Explore Numpy Built-in functions. 3. Loading Dataset into pandas dataframe 4. Selecting rows and columns in the dataframe 		
UNIT – II		9 Hrs
<p>Visual Aids for EDA: Technical requirements, Line chart, Bar charts, Scatter plot using seaborn, Polar chart, Histogram, Choosing the best chart</p> <p>Case Study: EDA with Personal Email, Technical requirements, Loading the dataset, Data transformation, Data cleansing, Applying descriptive statistics, Data refactoring, Data analysis.</p> <p>Sample Experiments:</p> <ol style="list-style-type: none"> 5. Apply different visualization techniques using sample dataset <ol style="list-style-type: none"> a) Line Chart b) Bar Chart c) Scatter Plots d) Bubble Plot 6. Generate Scatter Plot using seaborn library for iris dataset 7. Apply following visualization Techniques for a sample dataset <ol style="list-style-type: none"> a) Area Plot b) Stacked Plot c) Pie chart d) Table Chart 8. Generate the following charts for a dataset. <ol style="list-style-type: none"> a) Polar Chart b) Histogram c) Lollipop chart 		

9. Case Study: Perform Exploratory Data Analysis with Personal Email Data		
UNIT – III		11 Hrs
<p>Data Transformation: Merging database-style dataframes, Concatenating along with an axis, Merging on index, Reshaping and pivoting, Transformation techniques, Handling missing data, Mathematical operations with NaN, Filling missing values, Discretization and binning, Outlier detection and filtering, Permutation and random sampling, Benefits of data transformation, Challenges.</p> <p>Sample Experiments:</p> <ol style="list-style-type: none"> 10. Perform the following operations <ol style="list-style-type: none"> a) Merging Data frames b) Reshaping with Hierarchical Indexing c) Data Deduplication d) Replacing Values 11. Apply different Missing Data handling techniques <ol style="list-style-type: none"> a) NaN values in mathematical Operations b) Filling in missing data c) Forward and Backward filling of missing values d) Filling with index values e) Interpolation of missing values 12. Apply different data transformation techniques <ol style="list-style-type: none"> a) Renaming axis indexes b) Discretization and Binning c) Permutation and Random Sampling d) Dummy variables 		
UNIT – IV		10 Hrs
<p>Descriptive Statistics: Distribution function, Measures of central tendency, Measures of dispersion, Types of kurtosis, Calculating percentiles, Quartiles, Grouping Datasets, Correlation, Understanding univariate, bivariate, multivariate analysis, Time Series Analysis</p> <p>Sample Experiments:</p> <ol style="list-style-type: none"> 13. Study the following Distribution Techniques on a sample data <ol style="list-style-type: none"> a) Uniform Distribution b) Normal Distribution c) Gamma Distribution d) Exponential Distribution e) Poisson Distribution f) Binomial Distribution 14. Perform Data Cleaning on a sample dataset. 15. Compute measure of Central Tendency on a sample dataset <ol style="list-style-type: none"> a) Mean b)Median c)Mode 16. Explore Measures of Dispersion on a sample dataset <ol style="list-style-type: none"> a) Variance b) Standard Deviation c) Skewness d) Kurtosis 17. a) Calculating percentiles on sample dataset b) Calculate Inter Quartile Range(IQR) and Visualize using Box Plots 18. Perform the following analysis on automobile dataset. <ol style="list-style-type: none"> a) Bivariate analysis b)Multivariate analysis 19. Perform Time Series Analysis on Open Power systems dataset 		
UNIT – V		9 Hrs
<p>Model Development and Evaluation: Unified machine learning workflow, Data preprocessing, Data preparation, Training sets and corpus creation, Model creation and training, Model evaluation, Best model selection and evaluation, Model deployment</p> <p>Case Study: EDA on Wine Quality Data Analysis</p> <p>Sample Experiments:</p> <ol style="list-style-type: none"> 20. Perform hypothesis testing using statsmodels library <ol style="list-style-type: none"> a) Z-Test b) T-Test 		

21. Develop model and Perform Model Evaluation using different metrics such as prediction score, R2 Score, MAE Score, MSE Score.
22. Case Study: Perform Exploratory Data Analysis with Wine Quality Dataset
Textbooks:
1. Suresh Kumar Mukhiya, Usman Ahmed, Hands-On Exploratory Data Analysis with Python, Packt Publishing, 2020.
Reference Books:
1. Ronald K. Pearson, Exploratory Data Analysis Using R, CRC Press, 2020
2. Radhika Datar, Harish Garg, Hands-On Exploratory Data Analysis with R: Become an expert in exploratory data analysis using R packages, 1st Edition, Packt Publishing, 2019
Web References:
1. https://github.com/PacktPublishing/Hands-on-Exploratory-Data-Analysis-with-Python
2. https://www.analyticsvidhya.com/blog/2022/07/step-by-step-exploratory-data-analysis-eda-using-python/#h-conclusion
3. https://github.com/PacktPublishing/Exploratory-Data-Analysis-with-Python-Cookbook

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		3							1	
CO2	3	3	3	2	3							1	
CO3	3	3	3	2	3						2		2
CO4	3	3	3	3	3						3	2	
CO5	3	3	3	3	3								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 PO12)	Level of Correlation (0-3)
	Lesson plan (Hrs)	%	Correlation	Co's Action verb	BTL			
1	09	19%	2	CO1: Analyze	L4	PO1 PO2 PO3 PO5	PO1: Apply (L3) PO2: Review (L2) PO3: Develop (L3) PO5: Apply (L3)	3 3 3 3
2	09	19%	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	11	23%	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	10	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 3

5	09	19%	2	CO5: Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply (L3) PO2: Analyze (L4) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 3 3
	48	100%						

Justification Statements :

CO1: Analyze the fundamental concepts of Exploratory Data Analysis for generating reports

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

CO1 Action verb is less than PO1 verb by one level. 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 less than PO3 verb by one level. Therefore, the correlation is high (3)

PO5 Verb: Apply (L3)

CO1 Action verb is less than PO5 verb by one level. Therefore, the correlation is high (3)

CO2: Apply the data visualization techniques using Matplotlib

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: Review (L2)

CO2 Action verb is more than 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)

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 level as PO5 verb. Therefore, the correlation is high (3)

CO3: Apply the various data transformation techniques for data manipulation

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 more than 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)

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 level as PO5 verb. Therefore, the correlation is high (3)

PO11: Thumb rule

For some of Data Transformation, Permutation and Random sampling techniques are used to solve problems. Therefore, the correlation is moderate (2)

CO4: Analyze the various distribution techniques, EDA and Time series

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

CO4 Action verb is more than PO1 verb by one level. Therefore, the correlation is high (3)

PO2 Verb: Review (L2)

CO4 Action verb is more than PO2 verb by two levels. Therefore, the correlation is high (3)

PO3 Verb: Develop (L3)

CO4 Action verb is more than PO3 verb by one level. Therefore, the correlation is high (3)

PO4 Verb: Analyze (L4)

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

PO5 Verb: Apply (L3)

CO4 Action verb is more than PO5 verb by one level. Therefore, the correlation is high (3)

PO11: Thumb rule

For real time applications Descriptive statistics and distribution techniques are used.
Therefore, the correlation is high (3)

CO5: Evaluate the ML workflow, EDA Model Creation and Deployment

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3)

CO5 Action verb is more than PO1 verb by two levels. Therefore, the correlation is high (3)

PO2 Verb: Analyze (L4)

CO5 Action verb is more than PO2 verb by one level. Therefore, the correlation is high (3)

PO3 Verb: Develop (L3)

CO5 Action verb is more than PO3 verb by two levels. Therefore, the correlation is high (3)

PO4 Verb: Analyze (L4)

CO5 Action verb is more than PO4 verb by one level. Therefore, the correlation is high (3)

PO5 Verb: Apply (L3)

CO5 Action verb is more than PO5 verb by two levels. Therefore, the correlation is high (3)

AIATS TPT-CSE(CS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Design Thinking & Innovation	L	T	P	C
23AES0304	II-II		0	1	2	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

Online Learning Resources:

1. <https://nptel.ac.in/courses/110/106/110106124/>
2. <https://nptel.ac.in/courses/109/104/109104109/>
3. https://swayam.gov.in/nd1_noc19_mg60/preview

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)

PO1 Verb: **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)

AIITS TPT-CSE(DS)

COMMUNITY SERVICE PROJECT

.....Experiential learning through community engagement

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.

Procedure

- 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

EXPECTED OUTCOMES

BENEFITS OF COMMUNITY SERVICE PROJECT TO STUDENTS

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. Flourey 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

12. 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
 - vi. Fisheries
 - vii. Sericulture
 - viii. Revenue and Survey
 - ix. Natural Disaster Management
 - x. Irrigation
 - xi. Law & Order
 - xii. Excise and Prohibition
 - xiii. Mines and Geology
 - xiv. 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 secretariats 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 programmes to 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)
DEPARTMENT OF CSE(DATA SCIENCE)
(Effective for the batches admitted in 2023-24)
Semester V (Third year I Semester)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T / CLC	P				
1	PC	23APC3205	Machine Learning	2	1	0	3	30	70	100
2	PC	23APC3206	Operating Systems	2	1	0	3	30	70	100
3	PC	23APC3207	Software Engineering	2	1	0	3	30	70	100
4	PE-I	23APE3201	Automata Theory & Compiler Design	2	1	0	3	30	70	100
		23APE3202	Object Oriented Analysis and Design							
		23APE3203	Soft computing							
		23APE3204	Internet of Things							
5	OE-1		*Open Elective-I	2	1	0	3	25	75	100
6	PC	23APC3208	Machine Learning Lab	0	0	3	1.5	30	70	100
7	PC	23APC3209	Operating Systems Lab	0	0	3	1.5	30	70	100
8	SC	23ASC9901	Soft skills	0	1	2	2	30	70	100
9	ES	23AES0404	Tinkering Lab	0	0	2	1	30	70	100
10	ES	23AES0504	Introduction To Quantum Technologies and Applications	2	1	0	3	30	70	100
11	PR	23APR3201	Community Service Internship	-	-	-	2	100	-	100
Total				12	07	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	Mathematical Foundations 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.	20AOEMB01	Entrepreneurship and New Venture Creation	



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	MACHINE LEARNING	L	T / CLC	P	C
23APC3205	III-I			2	1	0

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the types of Machine Learning and preparing to model.

CO2: Evaluate the hypotheses by comparing its learning algorithms

CO3: Evaluate the decision making problems by using SVM and graphical models

CO4: Apply the supervised learning techniques for few machine learning problems.

CO5: Analyze the Unsupervised learning methods using clustering methods.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Understand	the types of Machine Learning and preparing to model.			L2
CO2	Evaluate	the hypotheses	by comparing its learning algorithms		L5
CO3	Evaluate	The decision making problems	by using SVM and graphical models		L5
CO4	Apply	The supervised learning techniques		for few machine learning problems	L3
CO5	Analyze	The Unsupervised learning methods	using clustering methods.		L4

UNIT – I	Introduction to Machine Learning & Preparing to Model	9 Hrs
Introduction: What is Human Learning? Types of Human Learning, what is Machine Learning? Types of Machine Learning, Problems Not to Be Solved Using Machine Learning, Applications of Machine Learning, State-of-The-Art Languages/Tools in Machine Learning, Issues in Machine Learning Preparing to Model: Introduction, Machine Learning Activities, Basic Types of Data in Machine Learning, Exploring Structure of Data, Data Quality and Remediation, Data Pre-Processing		
UNIT – II	Modelling and Evaluation & Basics of Feature Engineering	9 Hrs
Introduction, selecting a Model, training a Model (for Supervised Learning), Model Representation and Interpretability, Evaluating Performance of a Model, Improving Performance of a Model Basics of Feature Engineering: Introduction, Feature Transformation, Feature Subset Selection		
UNIT – III	Bayesian Concept Learning & Supervised Learning: Classification	10 Hrs
Introduction, Why Bayesian Methods are Important? Bayes' Theorem, Bayes' Theorem and Concept Learning, Bayesian Belief Network Supervised Learning: Classification: Introduction, Example of Supervised Learning, Classification Model, Classification Learning Steps, Common Classification Algorithms- <i>k</i> -Nearest Neighbour(<i>k</i> NN), Decision tree, Random forest model, Support vector machines		
UNIT – IV	Supervised Learning: Regression	10 Hrs
Introduction, Example of Regression, Common Regression Algorithms-Simple linear regression, Multiple linear regression, Assumptions in Regression Analysis, Main Problems in Regression Analysis, Improving Accuracy of the Linear Regression Model, Polynomial Regression Model, Logistic Regression, Maximum Likelihood Estimation.		
UNIT – V	Unsupervised Learning	9 Hrs
Introduction, Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering – Clustering as a machine learning task, Different types of clustering techniques,		

Partitioning methods, K-Medoids: a representative object-based technique, Hierarchical clustering, Density-based methods-DBSCAN Finding Pattern using Association Rule- Definition of common terms, Association rule, The apriori algorithm for association rule learning, Build the apriori principle rules

Textbooks:

1. Machine Learning, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson, 2019.

Reference Books:

1. EthernAlpaydin, –Introduction to Machine Learningl, MIT Press, 2004.
2. Stephen Marsland, –Machine Learning -An Algorithmic Perspectivel, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series,2014.
3. Andreas C. Müller and Sarah Guido –Introduction to Machine Learning with Python: A Guide for Data Scientistsl, Oreilly.

Online Resources:

1. <https://www.deeplearning.ai/machine-learning-yearning/>
2. <https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html>

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							3	3
CO2	3	3	3	3	3			3			3	2	2
CO3	3	3	2	2	2		3				3	2	2
CO4	3	3	3	2	3	2						2	
CO5	3	3	3	3	3			3			3		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			
1	9	19%	2	Understand	L2 PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO5: Apply(L3)	2 3 2 2
2	9	19%	2	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	10	21%	3	Evaluate	L5 PO1 PO2 PO3 PO4 PO5 PO7 PO11	PO1: Apply(L3) PO2: Analyze(L4) PO3: Design (L6) PO4: Design (L6) PO5: Create(L6) PO7: Thumb rule PO11: Thumb rule	3 3 2 2 2 3 3

4	10	21%	3	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
5	9	19%	2	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
	47	100%						

Justification Statements:

CO1: Understand the types of Machine Learning and preparing to model.

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)

PO3: Develop(L3)

CO2 Action verb is less than PO3 verb by one level. Therefore, the correlation is moderate (2)

PO5: Apply(L3)

CO2 Action verb is less than PO5 verb by one level. Therefore, the correlation is moderate (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: Evaluate the decision making problems by using SVM and graphical models

Action Verb : Evaluate (L5)

PO1: Apply(L3)

CO3 Action verb is greater level of PO1 verb. Therefore, the correlation is High (3)

PO2: Analyze (L4)

CO3 Action verb is greater level as PO2 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 medium(2)

PO4: Design (L6)

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

PO5: Create(L6)

CO3 Action verb is less than PO5 verb by one level. Therefore the correlation is medium(2)

PO7: Thumb rule

While making decisions for solving real world problems one must follow the ethical principles.

Therefore, the

correlation is High (3)

PO11: Thumb rule

For developing solutions for future problems a continuous study is need. Therefore, the correlation is high (3)

CO4: Apply the supervised learning techniques for few machine learning problems

Action Verb : Apply (L3)

PO1 Verb : Apply(L3)

CO4 Action verb is same 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 same level of PO3 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 medium(2)

PO5 Verb : Apply(L3)

CO4 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)

CO5: Analyze the Unsupervised learning methods using clustering methods.

Action Verb : Analyze (L4)

PO1: Apply(L3)

CO5 Action verb is greater level of PO1 verb. Therefore, the correlation is High (3)

PO2 Verb : 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 PO4 verb. Therefore the correlation is High(3)

PO5 Verb : Apply(L3)

CO5 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 methods.

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)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Operating Systems	L	T / CLC	P	C
23APC3206	III-I			2	1	0

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the basic concepts of Operating Systems and its services.

CO2: Apply the concepts of process synchronization and CPU scheduling by drawing Gantt chart

CO3: Analyze the memory management and its allocation policies.

CO4: Apply the different conditions for deadlock handling and solve various disk scheduling algorithms.

CO5: Understand the various System Security and Protection mechanisms.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the basic concepts of Operating Systems and its services			L2
CO2	Apply	the concepts of process synchronization and CPU scheduling	by drawing Gantt chart		L3
CO3	Analyze	the memory management and its allocation policies			L4
CO4	Apply	the different conditions		for deadlock handling	L3
CO5	Understand	The various System Security and Protection mechanisms.			L2

UNIT - I	Operating Systems Overview, System Structures	8 Hrs
Operating Systems Overview: Introduction, Operating system functions, Operating systems operations, Computing environments, Open-Source Operating Systems System Structures: Operating System Services, User and Operating-System Interface, systems calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Operating system debugging, System Boot.		
UNIT - II	Process Concept, Multithreaded Programming, Process Scheduling, Inter-process Communication	10 Hrs
Process Concept: Process scheduling, Operations on processes, Inter-process communication, Communication in client server systems. Multithreaded Programming: Multithreading models, Thread libraries, Threading issues, Examples. Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Thread scheduling, Examples. Inter-process Communication: Race conditions, Critical Regions, Mutual exclusion with busy waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing, Barriers, Classical IPC Problems - Dining philosophers problem, Readers and writers problem.		
UNIT - III	Memory-Management Strategies, Virtual Memory Management	8 Hrs
Memory-Management Strategies: Introduction, Swapping, Contiguous memory allocation, Paging, Segmentation, Examples. Virtual Memory Management: Introduction, Demand paging, Copy on-write, Page replacement, Frame allocation, Thrashing, Memory-mapped files, Kernel memory allocation, Examples.		
UNIT - IV	Deadlocks, File Systems	9 Hrs
Deadlocks: Resources, Conditions for resource deadlocks, Ostrich algorithm, Deadlock detection And recovery, Deadlock avoidance, Deadlock prevention. File Systems: Files, Directories, File system implementation, management and optimization. Secondary-Storage Structure: Overview of disk structure, and attachment, Disk scheduling, RAID structure, Stable storage implementation.		
UNIT - V	System Protection, System Security	8 Hrs

System Protection: Goals of protection, Principles and domain of protection, Access matrix, Access control, Revocation of access rights. System Security: Introduction, Program threats, System and network threats, Cryptography as a security, User authentication, implementing security defenses, firewalling to protect systems and networks, Computer security classification. Case Studies: Linux, Microsoft Windows

Textbooks:

1. Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 9th edition, Wiley, 2016.
2. Tanenbaum A S, Modern Operating Systems, 3rd edition, Pearson Education, 2008. (Topics: Interprocess Communication and File systems.)

Reference Books:

1. Tanenbaum A S, Woodhull A S, Operating Systems Design and Implementation, 3rd edition, PHI, 2006.
2. Dhamdhare D M, Operating Systems A Concept Based Approach, 3rd edition, Tata McGraw Hill, 2012.
3. Stallings W, Operating Systems -Internals and Design Principles, 6th edition, Pearson Education, 2009
4. Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004

Online Learning Resources:

1. <https://nptel.ac.in/courses/106/106/106106144/>
2. <http://peterindia.net/OperatingSystems.html>

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	8	19%	2	CO1 :Understand	L2	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review(L2) PO11: Thumb rule	2 3 2
2	10	23%	3	CO2 :Apply	L3	PO1 PO2 PO6 PO11	PO1: Apply(L3) PO2: Review(L2) PO6: Thumb rule PO11: Thumb rule	3 3 2 3
3	8	19%	2	CO3 : Analyze	L4	PO1 PO2 PO4 PO5 PO6	PO1: Apply(L3) PO2: Review(L2) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule	3 3 3 3 3
4	9	21%	3	CO4 :Apply	L3	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule PO7: Thumb rule PO11: Thumb rule	3 3 3 2 3 2 2 2
5	8	19%	2	CO5 :Understand	L2	PO1 PO2 PO7 PO11	PO1: Apply(L3) PO2: Review(L2) PO7: Thumb rule PO11: Thumb rule	2 3 3 2
	43	100%						

Justification Statements :

CO1: Understand the basic concepts of Operating Systems and its services. 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 : Review(L2)

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

PO11: Thumb rule

In today's world operating system services are updating, those services needs to understand.

Therefore the correlation is medium (2)

CO2: Apply the concepts of process synchronization and CPU scheduling by drawing Gantt chart

PO1: Apply(L3)

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

PO2 Verb : Review(L2)

CO1 Action verb is greater than PO2 verb by one level. Therefore the correlation is high (3)

PO6: Thumb rule

Most of the scheduling algorithm were used to solve some of the societal problems like forming Queue line. Therefore the correlation is Moderate (2)

PO11: Thumb rule

Scheduling is the one of the daily activity done in many sectors. Therefore the correlation is High(3)

CO3: Analyze the memory management and its allocation policies.: Analyze (L4)

PO1: Apply(L3)

CO3 Action verb is greater level as 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 (L3)

CO3 Action verb is greater than PO3 verb by one level. Therefore the correlation is high(3)

PO4: Analyze (L4)

CO3 Action verb is same as PO4 verb. Therefore the correlation is high(3)

PO5: Apply(L3)

CO3 Action verb is greater than PO5 verb by one level. Therefore the correlation is high(3)

PO6: Thumb rule

Most of the memory management policies were used to solve some of the societal problems.

Therefore the correlation is Moderate (2)

CO4: Apply the different conditions for deadlock handling and solve various disk scheduling algorithms:Apply(L3)

PO1: Apply(L3)

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

PO2: Review (L2)

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

PO3: Develop (L3)

CO4 Action verb is same as PO1 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 medium (2)

PO5: Apply(L3)

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

PO6: Thumb rule

Disk scheduling and file system interfaces are applied to provide solutions for E-Commerce database access . Therefore the correlation is medium (2)

PO7: Thumb rule

Since ethical principles shall be followed in file manipulations and data storage. Therefore the correlation is high(3)

PO11: Thumb rule

File manipulation of data and storage of data is playing major role in current scenario.

Therefore, the correlation is medium (2)

CO5: Understand the various System Security and Protection mechanisms:Understand(L2)

PO1: Apply(L3)

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

PO2: Review (L2)

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

PO7: Thumb rule

Ethical principles should be followed for various security issues. Therefore the correlation is high(3)

PO11: Thumb rule

Security services and principles are keep on updating in the today's world. Therefore, the correlation is medium (2)

AIATS TPT-CSE(ODS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

COMPUTER SCIENCE AND ENGINEERING (CSE)

Course Code	Year & Sem	Software Engineering	L	T / CLC	P	C
23APC3207	III-I		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the different Software Engineering Models

CO2: Analyze the Parameters and prerequisites of software project management.

CO3: Analyze the Design Methodologies of Software Project

CO4: Apply the Coding and Testing Methods for Quality Assurance of the Software project

CO5: Analyze the Software Quality Management Systems (standards) for reliability

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The different Software Engineering Models			L2
CO2	Analyze	The Parameters and prerequisites of SPM			L4
CO3	Analyze	The Design Methodologies of Software Project			L4
CO4	Apply	The Coding and Testing Methods		for Quality Assurance of the Software project	L3
CO5	Analyze	The Software Quality Management Systems (standards)		for reliability	L4

UNIT - I	8 Hrs
Basic concepts: Abstraction versus decomposition, evolution of software engineering techniques, Software development life cycle (SDLC) models: Iterative waterfall model, Prototype model, Evolutionary model, Spiral model, RAD model, Agile models, Software project management: project planning, project estimation, COCOMO, Halstead's Software Science, project scheduling, staffing, Organization and team structure, risk management, configuration management.	
UNIT - II	8 Hrs
Requirements analysis and specification: The nature of software, The Unique nature of Webapps, Software Myths, Requirements gathering and analysis, software requirements specification, Traceability, Characteristics of a Good SRS Document, IEEE 830 guidelines, representing complex requirements using decision tables and decision trees, overview of formal system development techniques, axiomatic specification, algebraic specification.	
UNIT - III	9 Hrs
Software Design: Good Software Design, Cohesion and coupling, Control Hierarchy: Layering, Control Abstraction, Depth and width, Fan-out, Fan-in, Software design approaches, object oriented vs. function oriented design. Overview of SA/SD methodology, structured analysis, Data flow diagram, Extending DFD technique to real life systems, Basic Object oriented concepts, UML Diagrams, Structured design, Detailed design, Design review, Characteristics of a good user interface, User Guidance and Online Help, Mode-based vs Mode-less Interface, Types of user interfaces, Component-based GUI development, User interface design methodology: GUI design methodology.	
UNIT - IV	9 Hrs
Coding and Testing: Coding standards and guidelines, code review, software documentation, Testing, Black Box Testing, White Box Testing, debugging, integration testing, Program Analysis Tools, system testing, performance testing, regression testing, Testing Object Oriented Programs. Software Security Testing: Contrasting Software Testing and Software Security Testing, Functional Testing, Risk-Based Testing.	
UNIT - V	9 Hrs
Software quality, reliability, and other issues: Software reliability, Statistical testing, Software quality and management, ISO 9000, SEI capability maturity model (CMM), Personal software process (PSP), Six sigma, Software quality metrics, CASE and its scope, CASE environment, CASE support in software life cycle, Characteristics of software maintenance, Software reverse engineering, Software maintenance processes model, Estimation maintenance cost. Basic issues in any reuse program, Reuse approach, Reuse at organization level.	

Textbooks:
1. Rajib Mall, "Fundamentals of Software Engineering", 5th Edition, PHI, 2018. 2. Pressman R, "Software Engineering- Practioner Approach", McGraw Hill.
Reference Books:
1. Somerville, "Software Engineering", Pearson 2. Richard Fairley, "Software Engineering Concepts", Tata McGraw Hill. 3. Jalote Pankaj, "An integrated approach to Software Engineering", Narosa
Online Learning Resources:
1. https://nptel.ac.in/courses/106/105/106105182/ 2. http://peterindia.net/SoftwareDevelopment.html

Mapping of course outcomes with program outcomes

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

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

Correlation matrix

Unit No.	CO			CO's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation					
1	8	19%	2	CO1:Understand	L2	PO1	PO1:Apply(L3)	2
2	8	19%	2	CO2 : Analyze	L4	PO1 PO4 PO5	PO1: pply(L3) PO4:Analyze(L4) PO5:Apply(L3)	3 3 3
3	9	21%	3	CO3 : Analyze	L4	PO1 PO3	PO1:Apply(L3) PO3:Develop(L3)	3 3
4	9	21%	3	CO4 :Apply	L3	PO1 PO3 PO4	PO1:Apply(L3) PO3:Develop(L3) PO4:Analyze(L4)	3 3 2
5	9	21%	3	CO5 : Analyze	L4	PO1 PO3 PO4 PO5 PO6 PO9 PO10	PO1:Apply(L3) PO3:Develop(L3) PO4:Analyze(L4) PO5:Apply(L3) PO6:Thumb rule PO9:Thumb rule PO10:Thumb rule	3 3 3 3 2 2 2
	43	100%						

Justification Statements :

CO1: Understand the different Software Engineering Models

Action Verb : Understand(L2)

PO1: Apply(L3)

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

CO2: Analyze the Parameters and prerequisites of Software project management

Action Verb : Analyze(L4)

PO1: Apply(L3)

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

PO4: Analyze (L4)

CO2 Action verb is same level as PO4 verb. Therefore the correlation is high (3)

PO5: Apply(L3)

CO2 Action verb is greater than PO5 verb. Therefore the correlation is high (3)

CO3:Analyze the Design Methodologies of Software Project

Action Verb : Analyze(L4)

PO1: Apply(L3)

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

PO3: Develop (L3)

CO3 Action verb is greater than PO3 verb. Therefore the correlation is high (3)

CO4:Apply the Coding and Testing Methods for Quality Assurance of the Software project

Action Verb : Apply(L3)

PO1: Apply(L3)

CO4 Action verb is same level as PO1 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: Analyze (L4)

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

CO5:Analyze the Software Quality Management Systems (standards) for reliability

Action Verb : Analyze (L4)

PO1: Apply(L3)

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

PO3: Develop (L3)

CO5 Action verb is greater than PO2 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)

PO6 : Thumb rule

For some software projects ,Various projects are evaluated for understanding ,therefore the correlation is Medium(2)

PO9: Thumb rule

Team work is required for software project, therefore the correlation is Medium(2)

PO10: Thumb rule

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, therefore the correlation is Medium(2)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Automata Theory & Compiler Design (Professional Elective-I)	L	T/ CLC	P	C
23APE3201	III-I		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the finite state machines for modelling and their power to recognize the languages

CO2: Analyze the basic concept of compiler design, and to construct new tools like LEX.

CO3: Design the parsing tables for different types of parsing techniques to analyze the syntax of programming languages

CO4: Apply the different representations of intermediate code generation to transform high-level source code into a machine-independent, lower-level representation.

CO5: Apply the code optimization techniques to different programming languages to improve code quality.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the finite state machines for modelling and their power		to recognize the languages	L2
CO2	Analyze	the basic concept of compiler design		to construct new tools like LEX	L4
CO3	Design	the parsing tables for different types of parsing techniques.		to analyze the syntax of programming languages	L6
CO4	Apply	the different representations of intermediate code generation		to transform high-level source code into a machine-independent, lower-level representation	L3
CO5	Apply	the code optimization techniques to different programming languages		to improve code quality	L3

UNIT - I	12 Hrs
Fundamentals: Formal Languages, Strings, Alphabets, Languages, Chomsky Hierarchy of languages. Finite Automata: Introduction to Finite State machine, Acceptance of strings and languages, Deterministic finite automaton (DFA) and Non-deterministic finite automaton (NFA), Equivalence of NFA and DFA- Equivalence of NDFAs with and without ϵ -moves, Minimization of finite automata, Finite automata with output- Moore and Mealy machines	
UNIT - II	10 Hrs
Introduction to Compilers: Definition of compiler, interpreter and its differences, the phases of a compiler, Input Buffering, Specification of Tokens, Recognition of Tokens, LEX-lexical analyser generator. Syntax Analyser: Parsing, role of parser, context free grammar, derivations, parse trees, ambiguity, elimination of left recursion, left factoring, Top down parsing - LL(1) grammars.	
UNIT - III	10 Hrs
Bottom Up Parsing: Introduction, Shift-reduce parsing, LR grammars, LR parsers-simple LR, Canonical LR (CLR) and Look Ahead LR (LALR) parsers, YACC-automatic parser generator. Syntax Directed Translation: Syntax directed definition, construction of syntax trees, S- Attributed and L-Attributed definitions.	
UNIT - IV	8 Hrs

Run Time Environments: Storage organization, storage-allocation Strategies, parameter passing, and symbol tables.	
Intermediate Code Generation: Intermediate forms of source programs– abstract syntax tree, polish notation and three address code, types of three address statements and its implementation	
UNIT - V	10 Hrs
Code Optimization: Basic block, Flow graph, Principal sources of optimization, Directed Acyclic Graph (DAG). Code Generation: Issues in the design of code generation, Machine dependent code generation, Peephole optimization, Register and Address Descriptors, Simple Code generation Algorithm.	
Textbooks:	
1. John E Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, –Introduction to Automata Theory Languages and Computation, 3rd Edition, Pearson Education, 2011. 2. Alfred Aho, Monica S Lam, RaviSethi, JeffreyD.Ullman, –Compilers- Principles Techniques and Tooll, 2ndEdition, Pearson Education India, 2013.	
Reference Books:	
1. Peter Linz, –An introduction to Formal Languages and Automata, 6th Edition, Jones & Bartlett, 2016. 2. V. Raghavan, –Principles of Compiler Design, 1st Edition, McGraw Hill Education, 2017. 3. Mishra and Chandra Shekaran, –Theory of Computer Science– Automata Languages and Computation, 3rd Edition, PHI, 2009 4. K.V.N.Sunitha , N.Kalyani, –Formal Languages and Automata Theory, 1st Edition, TMH, 2010.	
Online Learning Resources:	
1. https://nptel.ac.in/courses/106/106/106106049/	

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				1	3	3
CO2	3	3	3	3	3							2	2
CO3	3	3	3	3	3							2	2
CO4	3	3									2	2	2
CO5	3	2				2					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	12	24%	3	CO1: Understand	L2	PO1 PO2 PO3 PO5 PO7 PO11	PO1: Apply(L3) PO2:Review(L2) PO3:Develop(L3) PO5:Apply(L3) PO7:Thumb Rule PO11:Thumb Rule	2 3 2 2 1 1
2	10	20%	2	CO2: Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Analyze(L4) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3)	3 3 3 3 3
3	10	20%	2	CO3: Design	L6	PO1 PO2 PO3	PO1: Apply(L3) PO2: Analyze(L4)	3 3 3

						PO4 PO5	PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3)	3 3
4	8	16%	2	CO4: Apply	L3	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review(L2) PO11:Thumb Rule	3 3 2
5	10	20%	2	CO5: Apply	L3	PO1 PO2 PO6 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO6:Thumb Rule PO11:Thumb Rule	3 2 2 2
	50	100 %						

Justification Statements :

CO1: Understand the finite state machines for modelling and their power to recognize the languages.

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)

PO3: Develop(L3)

CO2 Action verb is less than PO3 verb by one level. Therefore, the correlation is moderate (2)

PO5: Apply(L3)

CO2 Action verb is less than PO5 verb by one level. Therefore, the correlation is moderate (2)

PO7: Thumb rule

While constructing the compiler, it is necessary to follow ethics as per norms of engineering practice. Therefore, the correlation is low(1)

PO11: Thumb rule

For compiler design process, it is required to update all phases of compiler. Therefore, the correlation is low(1)

CO2:Analyze the basic concept of compiler design, and to construct new tools like LEX.

Action Verb: Analyze(L4)

PO1: Apply(L3)

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

PO2: Analyze(L4)

CO2 Action verb is same level as 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 same level as PO4 verb. Therefore, the correlation is high (3)

PO5: Apply(L3)

CO2 Action verb is greater than PO5 verb. Therefore, the correlation is high (3)

CO3: Design the parsing tables for different types of parsing techniques to analyze the syntax of programming languages

Action Verb: Design(L6)

PO1: Apply(L3)

CO3 Action verb is greater than PO1 verb by one level. Therefore, the correlation is high (3)

PO2: Analyze(L4)

CO3 Action verb is same level as PO2 verb. 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 level as PO4 verb. Therefore, the correlation is high (3)

PO5: Apply(L3)

CO3 Action verb is greater than PO5 verb. Therefore, the correlation is high (3)

CO4: Apply the different representations of intermediate code generation to transform high-level source code into a machine-independent, lower-level representation

Action Verb: Apply(L3)

PO1: Apply(L3)

CO4 Action verb is less than PO1 verb by one level. Therefore, the correlation is high (3)

PO2: Review(L2)

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

PO11: Thumb rule

Data storage and management are continuously updating. Therefore, the correlation is moderate(2)

CO5: Apply the code optimization techniques to different programming languages to improve code quality.

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 moderate (2)

PO6: Thumb rule

Various code generation and code optimization techniques are going to solving societal issues.

Therefore, the correlation is moderate (2).

PO11: Thumb rule

It is necessary for designers to learn optimization techniques for reducing lines of code in programming environment. Therefore, the correlation is moderate (2)



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DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	OBJECT ORIENTED ANALYSIS AND DESIGN (Professional Elective-I)	L	T/ CLC	P	C
23APE3202	III-I		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the fundamental characteristics and components to define a "complex system"

CO2: Apply the principles of modeling to represent real-world entities in software design.

CO3: Apply the modelling techniques to identify relationships and interactions in system design

CO4: Analyze the use cases and activities in a system to model a Web Application.

CO5: Design the complex systems using state chart, component and deployment diagrams to model a system like Weather Forecasting.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the fundamental characteristics and components		to define a "complex system"	L2
CO2	Apply	the principles of modeling		to represent real-world entities in software design	L3
CO3	Apply	the modelling techniques		to identify relationships and interactions in system design	L3
CO4	Analyze	the use cases and activities in a system		to model a Web Application	L4
CO5	Design	the complex systems	using state chart, component and deployment diagrams	to model a system like Weather Forecasting	L6

UNIT - I		9 Hours
Introduction: The Structure of Complex systems, The Inherent Complexity of Software, Attributes of Complex System, Organized and Disorganized Complexity, Bringing Order to Chaos, Designing Complex Systems. Case Study: System Architecture: Satellite-Based Navigation.		
UNIT - II		9 Hours
Introduction to UML: Importance of modelling, principles of modelling, object oriented modelling, conceptual model of the UML, Architecture, and Software Development Life Cycle. Basic Structural Modelling: Classes, Relationships, common Mechanisms, and diagrams. Case Study: Control System: Traffic Management		
UNIT - III		9 Hours
Class & Object Diagrams: Terms, concepts, Modelling techniques for Class & Object Diagrams. Advanced Structural Modelling: Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages. Case Study: AI: Cryptanalysis.		
UNIT - IV		9 Hours
Basic Behavioural Modelling-I: Interactions, Interaction diagrams Use cases, Use case Diagrams, Activity Diagrams. Case Study: Web Application: Vacation Tracking System.		
UNIT - V		9 Hours
Advanced Behavioural Modelling: Events and signals, state machines, processes and Threads, time		

and space, state chart diagrams. **Architectural Modelling:** Component, Deployment, Component diagrams and Deployment diagrams Case Study: Weather Forecasting

Textbooks:

1. Grady Booch, James Rumbaugh, Ivar Jacobson: The Unified Modelling Language User Guide, Pearson Education 2nd Edition.
2. Object-Oriented Analysis and Design with the Unified Process By John W. Satzinger, Robert B Jackson and Stephen D Burd, Cengage Learning.

Reference Books:

1. Meilir Page-Jones: Fundamentals of Object-Oriented Design in UML, Pearson Education.
2. Pascal Roques: Modelling Software Systems Using UML2, WILEY-Dreamtech India Pvt. Ltd.
3. Atul Kahate: Object Oriented Analysis & Design, The McGraw-Hill Companies.
4. Mark Priestley: Practical Object-Oriented Design with UML, TMH.
5. Applying UML and Patterns: An introduction to Object – Oriented Analysis and Design and Unified Process, Craig Larman, Pearson Education.

Online Learning Resources:

<https://shorturl.at/Edyex>

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			2	3							3	
CO3	3		3									3	
CO4	3		3	3								2	2
CO5	3		3	3	3	3			3	3		2	2

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

Correlation matrix

Unit No.	CO			Co's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation					
1	9	20%	2	CO1:Understand	L2	PO1	PO1: Apply(L3)	2
2	9	20%	2	CO2 : Apply	L3	PO1 PO4 PO5	PO1: Apply(L3) PO4: Analyze (L4) PO5:Apply(L3)	3 2 3
3	9	20%	2	CO3 : Apply	L3	PO1 PO3	PO1: Apply(L3) PO3: Develop (L3)	3 3
4	9	20%	2	CO4 :Analyze	L4	PO1 PO3 PO4	PO1: Apply(L3) PO3: Develop (L3) PO4: Analyze (L4)	3 3 3
5	9	20%	2	CO5 : Design	L6	PO1 PO3 PO4 PO5 PO6 PO9 PO10	PO1: Apply(L3) PO3: Develop (L3) PO4: Analyze (L4) PO5:Apply(L3) PO6:Thumb rule PO9: Thumb rule PO10: Thumb rule	3 3 3 3 3 3
	45	100						

		%						
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Justification Statements :

CO1: Understand the fundamental characteristics and components to define a "complex system"

Action Verb : Understand(L2)

PO1: Apply(L3)

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

CO2: Apply the principles of modeling to represent real-world entities in software design

Action Verb : Apply(L3)

PO1: Apply(L3)

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

PO4: Analyze (L4)

CO2 Action verb is same level as PO4 verb. Therefore the correlation is moderate (2)

PO5: Apply(L3)

CO2 Action verb is greater than PO5 verb. Therefore the correlation is high (3)

CO3: Apply the modelling techniques to identify relationships and interactions in system design

Action Verb : Apply(L3)

PO1: Apply(L3)

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

PO3: Develop (L3)

CO3 Action verb is greater than PO3 verb. Therefore the correlation is high (3)

AIATS TPT-CSE(ODS)

CO4: Analyze the use cases and activities in a system to model a Web Application

Action Verb : Analyze (L4)

PO1: Apply(L3)

CO4 Action verb is same level as PO1 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: Analyze (L4)

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

CO5: Design the complex systems using state chart, component and deployment diagrams to model a system like Weather Forecasting.

Action Verb : Design (L6)

PO1: Apply(L3)

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

PO3: Develop (L3)

CO5 Action verb is greater than PO2 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)

PO6 : Thumb rule

For some software projects ,Various projects are evaluated for understanding ,therefore the correlation is high (3)

PO9: Thumb rule

Team work is required for software project, therefore the correlation is high (3)

PO10: Thumb rule

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, therefore the correlation is high (3)



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DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	SOFT COMPUTING (Professional Elective-I)	L	T / CLC	P	C
23APE3203	III-I		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the soft computing techniques to solve unclear real world problems.

CO2: Analyze various neural network architectures to make predictions and generate content.

CO3: Apply the fuzzy sets and rules to perform approximate reasoning in decision making process.

CO4: Understand the genetic algorithm concepts for finding cost-effective solutions to complex problems

CO5: Analyze the architectural components and operational principles of hybrid soft computing systems to solve complex problems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the soft computing techniques		to solve unclear real world problems	L2
CO2	Analyze	various neural network architectures		to make predictions and generate content	L4
CO3	Apply	the fuzzy sets and rules to perform approximate reasoning in decision making process.			L3
CO4	Understand	the genetic algorithm concepts		finding cost-effective solutions to complex problems	L2
CO5	Analyze	the architectural components and operational principles of hybrid soft computing systems	using state chart, component and deployment diagrams	to solve complex problems.	L4

UNIT - I	INTRODUCTION TO SOFT COMPUTING	9 Hours
Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.		
UNIT - II	ARTIFICIAL NEURAL NETWORKS	9 Hours
Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory - Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.		
UNIT - III	FUZZY SYSTEMS	9 Hours
Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.		
UNIT - IV	GENETIC ALGORITHMS	9 Hours
Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators - Convergence of Genetic Algorithm.		

UNIT - V	HYBRID SYSTEMS	9 Hours
Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction – Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller.		
Textbooks:		
1. S. Rajsekaran& G.A. VijayalakshmiPai, –Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and ApplicationsI, 4th Edition, Prentice Hall of India,2003.		
Reference Books:		
1. Timothy J Ross ,"Fuzzy Logic with Engineering Applications", 3rd Edition, John Wiley and Sons,2016.		
2. David E. Goldberg ,"Genetic Algorithm in Search Optimization and Machine Learning "Adission Wesley,2009.		
3. Karray, –Soft Computing and Intelligent Systems Design: Theory, Tools and ApplicationsI, 1st Edition, Pearson Education,2009.		
Online Learning Resources:		
https://rb.gy/vcigd4		

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					2	2	
CO3	3	3		2	3	2					2	3	
CO4	2	3									2	2	
CO5	3	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: Review(L2) PO11: Thumb rule	2 3 2
2	9	20%	2	CO2 : Analyze	L4	PO1 PO2 PO6 PO11	PO1: Apply(L3) PO2: Review(L2) PO6: Thumb rule PO11: Thumb rule	3 3 2 2
3	9	20%	2	CO3 : Apply	L3	PO1 PO2 PO4 PO5 PO6	PO1: Apply(L3) PO2: Review(L2) PO4:	3 3 2 3 2

						PO11	Analyze (L4) PO5: Apply(L3) PO6: Thumb rule PO11: Thumb rule	2
4	9	20%	2	CO4:Understand	L2	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review(L2) PO11: Thumb rule	2 3 2
5	9	20%	2	CO5 : Analyze	L4	PO1 PO2 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO4: Analyze (L4) PO5: Apply(L3)	3 3 3 3
	45	100 %						

Justification Statements :

CO1: Understand the soft computing techniques to solve unclear real world problems.

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 : Review(L2)

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

PO11: Thumb rule

Various trends in soft computing are applied to solve different problems, where the work is distributed to many systems to minimize the response time. Therefore the correlation is medium (2)

CO2: Analyze various neural network architectures to make predictions and generate content.

Action Verb : Analyze (L4)

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)

PO6: Thumb rule

Support vector machines are truly helpful for the society to solve various network issues . Therefore, the correlation is medium (2)

PO11: Thumb rule

Spike neural networks in a decision making process is a continuous activity. Therefore the correlation is medium (2)

CO3: Apply the fuzzy sets and rules to perform approximate reasoning in decision making process.

Action Verb : Apply (L3)

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 level as PO2 verb. Therefore, the correlation is High (3)

PO4: Analyze (L4)

CO3 Action verb is same level 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)

PO6 : Thumb rule

Efficient file systems and sharing methods are useful for successful executions.

Therefore, the correlation is medium (2)

PO11: Thumb rule

Fuzzy logic in various domains, such as control systems, decision support systems, and artificial intelligence are applied to solve the real world problems. Therefore, the correlation is medium (2)

CO4: Understand the genetic algorithm concepts for finding cost-effective solutions to complex problems

Action Verb : understand (L2)

PO1: Apply(L3)

CO4 Action verb is same level of PO1 verb. Therefore the correlation is moderate (2)

PO2: Review(L2)

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

PO11: Thumb rule

New algorithms and techniques are in genetic are applied to complex problems. Therefore the correlation is medium(2)

CO5: Analyze the architectural components and operational principles of hybrid soft computing systems to solve complex problems.

Action Verb : Analyze (L4)

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)

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)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	INTERNET OF THINGS (Professional Elective-I)	L	T / CLC	P	C
23APE3204	III-I			2	1	0

Course Outcomes:

After studying the course, student will be able to

CO1: **Understand** the application and characteristics of IoT

CO2: **Apply** design concept to build IoT solutions

CO3: **Analyze** various M2M and IoT architectures to optimize device communication

CO4: **Analyze** design issues to address the challenges in IoT applications

CO5: **Design** IoT solutions using sensors, actuators and Devices

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the application and characteristics of IoT			L2
CO2	Apply	design concept to build IoT solutions			L3
CO3	Analyze	various M2M and IoT architectures		to optimize device communication	L4
CO4	Analyze	design issues to address the challenges in IoT applications			L4
CO5	Design	IoT solutions	using sensors, actuators and Devices		L6

UNIT – I	8 Hrs
Introduction to IoT Definition and Characteristics of IoT, physical design of IoT, IoT protocols, IoT communication models, IoT Communication APIs, Communication protocols, Embedded Systems, IoT Levels and Templates.	
UNIT – II	9 Hrs
Prototyping IoT Objects using Microprocessor/Microcontroller: Working principles of sensors and actuators, setting up the board – Programming for IoT, Reading from Sensors, Communication: communication through Bluetooth, Wi-Fi.	
UNIT – III	8 Hrs
IoT Architecture and Protocol: Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, Protocols- 6LowPAN, RPL, CoAP, MQTT, IoT frameworks- Thing Speak	
UNIT – IV	8 Hrs
Device discovery capabilities- Registering a device, Deregister a device, Introduction to Cloud Storage models and communication APIs Web-Server, Web server for IoT.	
UNIT – V	10 Hrs
UAV IoT : Introduction to Unmanned Aerial Vehicles/Drones, Drone Types. Applications: Defense, Civil, Environmental Monitoring; UAV elements and sensors- Arms, motors, Electronic Speed Controller(ESC), GPS, IMU, Ultra sonic sensors; UAV Software –Arudpilot, Mission Planner, Internet of Drones(IoD)- Case study FlytBase.	
Textbooks:	
1. Vijay Madiseti and ArshdeepBahga, –Internet of Things (A Hands-on-Approach)l, 1st Edition, VPT, 2014. 2. Handbook of unmanned aerial vehicles, K Valavanis; George J Vachtsevanos, New York, Springer, Boston, Massachusetts : Credo Reference, 2014. 2016.	
Reference Books:	
1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatias Karnouskos, David Boyle, – From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014. 2. Arshdeep Bahga, Vijay Madiseti - Internet of Things: A Hands-On Approach, Universities Press, 2014. 3. The Internet of Things, Enabling technologies and use cases – Pethuru Raj, Anupama C. Raman, CRC Press. 4. Francis daCosta, –Rethinking the Internet of Things: A Scalable Approach to Connecting Everythingl,	

1st Edition, Apress Publications, 2013
 5. CunoPfister, Getting Started with the Internet of Things, O'Reilly Media, 2011, ISBN: 9781-4493- 9357-1
 6. DGCA RPAS Guidance Manual, Revision 3 – 2020
 7. Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs, John Baichtal

Online Learning Resources:
 1. <https://www.arduino.cc/>
 2. <https://www.raspberrypi.org/>
 3. <https://nptel.ac.in/courses/106105166/5>
 4. <https://nptel.ac.in/courses/108108098/4>

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

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

Correlation Matrix

Unit No.	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)
	Lesson plan(Hrs)	%						
1	8	19%	2	CO1:Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Interpret(L2)	2 3
2	9	21%	3	CO2 :Apply	L3	PO1 PO3 PO4 PO5 PO6	PO1: Apply(L3) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3) PO6: Thumb rule	3 3 2 3 2
3	8	19%	2	CO3 : Analyze	L4	PO1 PO2 PO3 PO4 PO6 PO7	PO1: Apply(L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze(L4) PO6: Thumb rule PO7: Thumb rule	3 3 3 3 3 3
4	8	19%	2	CO4 : Analyze	L4	PO1 PO2 PO3 PO4 PO6	PO1: Apply(L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze(L4) PO6: Thumb rule	3 3 3 3 3
5	10	23%	3	CO5 : Design	L6	PO2 PO3 PO4 PO5 PO6 PO11	PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3) PO6: Thumb rule PO11: Thumb rule	3 3 3 3 3 3
	43	100%						

Justification Statements :

CO1: Understand the application and characteristics of IoT

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 : Interpret(L2)

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

CO2: Apply design concept to build IoT solutions

Action Verb : Apply (L3)

PO1: Apply(L3)

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

PO6: Thumb rule

Some of IoT applications are used in society for health ,safety, legal and cultural issues, . Therefore the correlation is moderate(2)

CO3: Analyze various M2M and IoT architectures to optimize device communication

Action Verb : Analyze(L4)

PO1: Apply(L3)

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

PO2: Identify (L3)

CO3 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 same as PO4 verb . Therefore the correlation is high(3)

PO6 : Thumb rule

It is used to Illustrating the IoT design in Home automation, Cities, Environment, agriculture, productivity applications Therefore the correlation is high(3)

PO7: Thumb rule

Since ethical principles should be followed by IoT Technologies. Hence the correlation is high(3)

CO4: Analyze design issues to address the challenges in IoT applications

Action Verb : Analyze(L4)

PO1: Apply(L3)

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

PO2: Identify (L3)

CO3 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 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)

PO6: Thumb rule

Since ethical principles shall be followed in IEEE protocols. Therefore the correlation is high(3)

CO5: Design IoT solutions using sensors, actuators and Devices

Action Verb : Design(L6)

PO2: Review (L2)

CO3 Action verb is greater than PO2 verb . Therefore the correlation is high(3)

PO3: Develop(L3)

CO2 Action verb is greater than PO2 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: Apply(L3)

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

PO6 : Thumb rule

Since ethical principles should be followed to Zigbee devices. Therefore the correlation is high(3)

PO11: Thumb rule

To create robust and scalable networks by Zigbee. Therefore the correlation is high(3)

AIATS TPT-CSE(CDS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	GREEN BUILDING (Open Elective I)	L	T	P	C
23AOE0101	III-I		2	1	0	3

Course Outcomes (CO)

Student will be able to	
CO1	Understand the fundamental concepts and significance of green buildings, including their necessity, benefits and sustainable features.
CO2	Apply knowledge of typical energy-saving approaches and sustainable practices to enhance the design and performance of green buildings.
CO3	Analyze strategies for maximizing system efficiency in energy usage by integrating renewable energy sources in buildings and industrial process
CO4	Apply principles of energy modeling to assess building performance in terms of energy consumption and savings.
CO5	Analyze indoor environmental quality parameters such as air conditioning systems, indoor air quality, and control of tobacco smoke for healthy building environments.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the fundamental concepts and significance, including their necessity, benefits and sustainable features.	of green buildings		L2
2	Apply	Knowledge of typical energy saving approaches and sustainable practices	Of green buildings	To enhance and design performance	L3
3	Analyze	Strategies for maximizing system efficiency in energy usage by integrating renewable energy sources	In building and industrial process		L4
4	Apply	principles of energy modeling to assess building performance		in terms of energy consumption and savings.	L3
5	Analyze	indoor environmental quality parameters such as air conditioning systems, indoor air quality, and control of tobacco smoke		for healthy building environments.	L4

UNIT - I	INTRODUCTION TO GREEN BUILDING	9 Hrs
Necessity of Green Buildings, Benefits of Green Buildings, Green Building Materials and Equipment in India, Key Requisites for Constructing A Green Building, Important Sustainable Features for Green Buildings.		
UNIT - II	GREEN BUILDING CONCEPTS AND PRACTICES	9 Hrs
Indian Green Building Council, Green Building Movement in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Green Building Opportunities and Benefits: Opportunities of Green Buildings, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy-Saving Approaches in Buildings, LEED India Rating System, and Energy Efficiency.		
UNIT - III	GREEN BUILDING DESIGN	9 Hrs
Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximizing System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources, Eco-Friendly Captive Power Generation for Factories, Building Requirements.		
UNIT - IV	AIR CONDITIONING	9 Hrs
Introduction, CII Godrej Green Business Centre, Design Philosophy, Design Interventions, Energy Modeling, HVAC System Design, Chiller Selection, Pump Selection, Selection of Cooling towers, Selection of Air Handling Units, Pre-Cooling of Fresh Air, Interior Lighting Systems, Key Features of The Building, Eco-Friendly Captive Power Generation for Factories, Building Requirements.		
UNIT - V	MATERIAL CONSERVATION	9 Hrs
Handling of Non-Process Waste, Waste Reduction During Construction, Materials with Recycled Content, Local Materials, Material Reuse, Certified Wood, Rapidly Renewable Building Materials and Furniture. Indoor Environment Quality and Occupational Health- Air Conditioning, Indoor Air Quality, Sick Building Syndrome, tobacco Smoke.		
Textbooks:		
1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.		
2. Green Building Hand Book by tom woolley and Sam kimings, 2009		
Reference Books:		
1. Complete Guide to Green Buildings by Trish riley		
2. Standard for the design for High Performance Green Buildings by Kent Peterson, 2009		
3. Energy Conservation Building Code –ECBC-2020, published by BEE		
Online Learning Resources:		
https://archive.nptel.ac.in/courses/105/102/105102195/		

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	2				2							
CO3	2	3		3		3							
CO4	3	2				3							
CO5	2	3		3		3							

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

Correlation matrix

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	12	20	2	Understand	L2	PO1 PO2	Apply (L3) Analyze (L4)	2 2

						PO6	Thumb Rule	2
2	12	20	2	Apply	L3	PO1	Apply (L3)	3
						PO2	Analyze (L4)	2
						PO6	Thumb Rule	2
3	12	20	2	Analyze	L4	PO1	Apply (L3)	2
						PO2	Analyze (L4)	3
						PO4	Analyze (L4)	3
						PO6	Thumb Rule	3
4	12	20	2	Apply	L3	PO1	Apply (L3)	3
						PO2	Analyze (L4)	2
						PO6	Thumb Rule	2
5	12	20	2	Analyze	L4	PO1	Apply (L3)	2
						PO2	Analyze (L4)	3
						PO4	Analyze (L4)	3
						PO6	Thumb Rule	3

CO-PO MAPPING JUSTIFICATION:

JUSTIFICATION STATEMENTS:

CO 1: Understand the fundamental concepts and significance of green buildings, including their necessity, benefits and sustainable features.

Action Verb: Understand (L2)

PO1: Apply(L3)

CO Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO 1 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: Apply knowledge of typical energy-saving approaches and sustainable practices to enhance the design and performance of green buildings.

Action Verb: Apply (L3)

PO1: Apply(L3)

CO Action verb is equal to PO1 verb. Therefore, the correlation is high (3)

PO2: Analyze (L4)

CO 2: Action Verb is low to PO2 verb. Therefore, the correlation is medium (2)

CO 2 Action verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 as moderate (2).

CO 3: Analyze strategies for maximizing system efficiency in energy usage by integrating renewable energy sources in buildings and industrial process

Action Verb: Analyze (L4)

PO1: Apply(L3)

CO 3 Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2)

PO2: Analyze (L4)

CO Action verb is equal to PO2 verb. Therefore, the correlation is high (3)

PO 4: Analysis (L4)

CO 3 Action Verb is equal to PO4; Therefore, correlation is high (3)

CO 3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

CO4: Apply principles of energy modeling to assess building performance in terms of energy consumption and savings.

Action Verb: Apply (L3)

PO1: Apply(L3)

CO 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: Analyze indoor environmental quality parameters such as air conditioning systems, indoor air quality, and control of tobacco smoke for healthy building environments.

Action Verb: Analyze (L4)

PO1: Apply(L3)

CO Action verb is greater than PO1 verb. Therefore, the correlation is moderate (2).

PO2: Analyze (L4)

CO Action verb is equal to PO2 verb. Therefore, the correlation is high (3)

PO 4: Analysis (L4)

CO 5 Action Verb is equal to PO4; Therefore, correlation is high (3)

CO 5 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 as high (3).

AIITS TPT-CSE(DS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	CONSTRUCTION TECHNOLOGY AND MANAGEMENT (Professional Elective-1)	L	T / CLC	P	C
23AOE0102	III-I		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

Student will be able to	
CO1	Understand the project management fundamentals, organizational structures, and leadership principles in construction.
CO2	Understand the manpower planning, equipment management, and cost estimation in civil engineering projects.
CO3	Apply the planning, scheduling, and project management techniques such as CPM and PERT.
CO4	Understand the various contract types, contract formation, and legal aspects in construction management
CO5	Understand the safety management practices, accident prevention strategies, and quality management systems in construction.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the project management fundamentals, organizational structures, and leadership principle		in construction	L2
CO2	Understand	the manpower planning, equipment management, and cost estimation		in civil engineering projects.	L2
CO3	Apply	the planning, scheduling, and project management techniques such as CPM and PERT.		in construction projects	L3
CO4	Understand	the various contract types, contract formation, and legal aspects		in construction management	L2
CO5	Understand	the safety management practices, accident prevention strategies, and quality management systems		in construction	L2

UNIT - I		9 Hrs
INTRODUCTION: Project forms, Management Objectives and Functions; Organizational Chart of A Construction Company; Manager's Duties and Responsibilities; Public Relations; Leadership and Team - Work; Ethics, Morale, Delegation and Accountability.		
UNIT - II		9Hrs
MAN AND MACHINE: Man-Power Planning, Training, Recruitment, Motivation, Welfare Measures and Safety Laws; Machinery for Civil Engineering., Earth Movers and Hauling Costs, Factors Affecting Purchase, Rent, and Lease of Equipment, and Cost Benefit Estimation.		
UNIT - III		9 Hrs

PLANNING, SCHEDULING AND PROJECT MANAGEMENT: Planning Stages, Construction Schedules and Project Specification, Monitoring and Evaluation; Bar-Chart, CPM, PERT, Network- formulation and Time Computation.

UNIT - IV **9 Hrs**

CONTRACTS: Types of Contracts, formation of Contract – Contract Conditions – Contract for Labour, Material, Design, Construction – Drafting of Contract Documents Based On IBRD/MORTH Standard Bidding Documents – Construction Contracts – Contract Problems – Arbitration and Legal Requirements Computer Applications in Construction Management: Software for Project Planning, Scheduling and Control.

UNIT - V **9 Hrs**

SAFETY MANAGEMENT: Implementation and Application of QMS in Safety Programs, ISO 9000 Series, Accident Theories, Cost of Accidents, Problem Areas in Construction Safety, Fall Protection, Incentives, Zero Accident Concepts, Planning for Safety, Occupational Health and Ergonomics.

Textbooks:

1. Construction Project Management, SK. Sears, GA. Sears, RH. Clough, John Wiley and Sons, 6th Edition, 2016.
 2. Construction Project Scheduling and Control by Saleh Mubarak, 4th Edition, 2019
- Pandey, I.M (2021) Financial Management 12th edition. Pearson India Education Services Pvt. Ltd.

Reference Books:

1. Brien, J.O. and Plotnick, F.L., CPMin Construction Management, Mcgraw Hill, 2010.
2. Punmia, B.C., and Khandelwal, K.K., Project Planning and control with PERT and CPM, Laxmi Publications, 2002.
3. Construction Methods and Management: Pearson New International Edition 8 th Edition Stephens Nunnally.
4. Rhoden, M and Cato B, Construction Management and Organisational Behaviour, Wiley-Blackwell, 2016.

Online Learning Resources:

- <https://archive.nptel.ac.in/courses/105/104/105104161/>
<https://archive.nptel.ac.in/courses/105/103/105103093/>

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			
CO2	2					2				2			
CO3	3	2				2				2			
CO4	2					2				2			
CO5	2					2				2			

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

Correlation matrix

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	10	18.18	3	Understand	L1	PO1 PO6 PO7 PO10	Apply (L3) Thumb Rule Thumb Rule Thumb	2 2 2 2

							Rule	
2	10	18.18	3	Understand	L1	PO1 PO6 PO10	Apply (L3) Thumb Rule Thumb Rule	2 2 2
3	15	27.27	3	Apply	L3	PO1 PO2 PO6 PO10	Apply (L3) Analyze (L4) Thumb Rule Thumb Rule	3 2 2 2
4	10	18.18	3	Understand	L1	PO1 PO6 PO10	Apply (L3) Thumb Rule Thumb Rule	2 2 2
5	10	18.18	3	Understand	L1	PO1 PO6 PO10	Apply (L3) Thumb Rule Thumb Rule	2 2 2

JUSTIFICATION STATEMENTS:

AIATS TPT



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	ELECTRICAL SAFETY PRACTICES AND STANDARDS (Open Elective-1)	L	T / CLC	P	C
23AOE0201	III-I		2	1	0	3

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

CO1	Understanding the Fundamentals of Electrical Safety -L2
CO2	Identifying and Applying Safety Components -L3
CO3	Analyzing Grounding Practices and Electrical Bonding-L4
CO4	Applying Safety Practices in Electrical Installations and Environments- L4
CO5	Evaluating Electrical Safety Standards and Regulatory Compliance -L5

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
CO1	Understand	Fundamentals of Electrical Safety			L2
CO2	Identify	Applying Safety Components			L3
CO3	Analyze	Grounding Practices and Electrical Bonding			L4
CO4	Apply	Safety Practices in Electrical Installations and Environments			L4
CO5	Evaluate	Electrical Safety Standards and Regulatory Compliance			L5

UNIT - I	Introduction To Electrical Safety	9 Hrs
Fundamentals of Electrical safety-Electric Shock- physiological effects of electric current - Safety requirements –Hazards of electricity- Arc - Blast- Causes for electrical failure.		
UNIT - II	Safety Components	9Hrs
Introduction to conductors and insulators- voltage classification -safety against over voltages- safety against static electricity-Electrical safety equipment's - Fire extinguishers for electrical safety.		
UNIT - III	Grounding	9 Hrs
General requirements for grounding and bonding- Definitions- System grounding-Equipment grounding - The Earth - Earthing practices- Determining safe approach distance-Determining arc hazard category.		
UNIT - IV	Safety Practices	9 Hrs
General first aid- Safety in handling hand held electrical appliances tools- Electrical safety in train stations-swimming pools, external lighting installations, medical locations-Case studies.		
UNIT - V	Standards For Electrical Safety	9 Hrs
Electricity Acts- Rules & regulations- Electrical standards-NFPA 70 E-OSHA standards-IEEE standards-National Electrical Code 2005 – National Electric Safety code NESC-Statutory requirements from electrical inspectorate		
Textbooks:		
1. Massimo A.G.Mitolo, –Electrical Safety of Low-Voltage Systems , McGraw Hill, USA, 2009.		
2. Mohamed El-Sharkawi, –Electric Safety - Practice and Standards , CRC Press, USA, 2014		
Reference Books:		
1. Kenneth G.Mastrullo, Ray A. Jones, –The Electrical Safety Program Book , Jones and Bartlett Publishers, London, 2nd Edition, 2011		
2. Palmer Hickman, –Electrical Safety-Related Work Practices , Jones & Bartlett Publishers, London, 2009.		

3. Fordham Cooper, W., –Electrical Safety Engineering, Butterworth and Company, London, 1986.
4. John Cadick, Mary Capelli-Schellpfeffer, Dennis K. Neitzel, –Electrical Safety Hand book, McGraw-Hill, New York, USA, 4th edition, 2012.

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	1	2
CO2	3	3	–	–	–	2	–	–	–	–	2	2	3
CO3	3	–	1	–	3	3	–	–	–	–	3	3	3
CO4	3	2	–	–	3	2	–	–	–	–	2	2	3
CO5	3	3	2	–	3	3	1	–	–	–	2	3	3

Mapping of Course outcomes with Program outcomes Justification Table								
CO No.	Lesson Plan (Hrs.)	%	C O			Program Outcomes(PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of correlation (1-3)
			correlation	Verb	BTL			
1				Understand	L2	PO1 PO2 PO6	Apply-L3 Analyse-L4 Analyse-L4	Medium-2 Low-1 Low-1
2				Identify	L3	PO1 PO2 PO6	Apply-L3 Analyse-L4 Analyse-L4	High-3 Medium-2 Medium-2
3				Analyze	L4	PO1 PO3 PO5 PO6	Apply-L3 Design-L6 Apply-L3 Analyse-L4	High-3 Low-1 High-3 High-3
4				Apply	L4	PO1 PO2 PO5 PO6	Apply-L3 Analyse-L4 Apply-L3 Analyse-L4	High-3 High-3 High-3 High-3
5				Evaluate	L5	PO1 PO2 PO3 PO5 PO6 PO7	Apply-L3 Analyse-L4 Design-L6 Apply-L3 Analyse-L4 Apply-L3	High-3 High-3 Medium-1 High-3 High-3 High-3

Justification:

CO1: Understanding the Fundamentals of Electrical Safety

Action Verb: L2

C01 Action Verb is Less than PO1 Action By1 Therefore The Correlation Is Medium-2
C01 Action Verb is Less than PO2 Action By2 Therefore The Correlation Is Low-1
C01 Action Verb is Less Than PO6 Action By2 Therefore The Correlation Is Low-1

C02: Identifying and Applying Safety Components

Action Verb: L3

C02 Action Verb Is Equal To PO1 Therefore The Correlation Is High-3

C02 Action Verb Is Less than PO2 Action by one Therefore The Correlation Is Medium-2

C02 Action Verb Is Less than PO6 action by one Therefore The Correlation Is Medium-2

C03: Analyzing Grounding Practices and Electrical Bonding

Action Verb: L4

C03 Action Verb Is greater than PO1 action by one Therefore The Correlation Is High-3

C03 Action Verb Is Less than PO3 Action by 2 Therefore The Correlation Is Low-1

C03 Action Verb Is greater than PO5 Action by 1 Therefore The Correlation Is High-3

C03 Action Verb Is Equal To PO6 Therefore The Correlation Is High-3

C04: Applying Safety Practices in Electrical Installations and Environments

Action Verb: L4

C04 Action Verb Is Greater Than PO1 Action By 1 Therefore The Correlation Is High-3

C04 Action Verb Is Equal To PO2 Therefore The Correlation Is High-3

C04 Action Verb Is Greater Than PO5 Action By 1 Therefore The Correlation Is High-3

C04 Action Verb Is Equal To PO6 Therefore The Correlation Is High-3

C05: Evaluating Electrical Safety Standards and Regulatory Compliance

Action Verb: L5

C05 Action Verb Is Greater Than PO1 Action By 2 Therefore The Correlation Is High-3

C05 Action Verb Is Greater Than PO2 Action By 1 Therefore The Correlation Is High-3

C05 Action Verb Is less Than PO3 Action By One Therefore The Correlation Is Medium-1

C05 Action Verb Is Greater Than PO5 Action By 2therefore The Correlation Is High-3

C05 Action Verb Is Greater Than PO6 Action By 1therefore The Correlation Is High-3

C05 Action Verb Is Greater Than PO7 Action By 2 Therefore The Correlation Is High-3



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Sustainable Energy Technologies (Open Elective-1)	L	T / CLC	P	C
23AOE0301	III-I		2	1	0	3

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

CO1	Analyze solar radiation data, PV module characteristics, and the environmental impact of solar power systems.
CO2	Evaluate the performance of various solar thermal collectors and select appropriate battery storage systems for PV applications.
CO3	Apply the principles of wind and biomass energy conversion to analyze the performance of renewable energy systems.
CO4	Analyze the operational principles and applications of geothermal, ocean energy, and fuel cell systems.
CO5	Design an off-grid solar PV power plant considering component selection, system integration, and economic aspects

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
CO1	Analyze	Solar radiation data, PV module characteristics, and the environmental impact of solar power systems.			L4
CO2	Evaluate	The performance of various solar thermal collectors and select appropriate battery storage systems.	for PV applications.		L5
CO3	Apply	The principles of wind and biomass energy conversion.	to analyze the performance of renewable energy systems.		L3
CO4	Analyze	The operational principles and applications of geothermal, ocean energy, and fuel cell systems.			L4
CO5	Design	An off-grid solar PV power plant.	considering component selection, system integration, and economic aspects.		L6

UNIT - I		9 Hrs
SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, structure of the sun, the solar constant, sun-earth relationships, coordinate systems and coordinates of the sun, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data, numerical problems		
UNIT - II		9Hrs
SOLAR PV MODULES AND PV SYSTEMS: PV Module Circuit Design, Module Structure, Packing Density, Interconnections, Mismatch and Temperature Effects, Electrical and Mechanical Insulation, Lifetime of PV Modules, Degradation and Failure, PV Module Parameters, Efficiency of PV Module, Solar PV Systems-Design of Off Grid Solar Power Plant. Installation and Maintenance		
UNIT - III		9 Hrs
STORAGE IN PV SYSTEMS: Battery Operation, Types of Batteries, Battery Parameters, Application and Selection of Batteries for Solar PV System, Battery Maintenance and Measurements, Battery Installation for PV System.		

							PO5)	
1				Analyze	L4	PO1, PO2, PO4	Apply(L3) Analyze(L4) Analyze(L4)	3
2				Evaluate	L5	PO1, PO2, PO3	Apply(L3) Analyze(L4) Design(L6)	3
3				Apply	L3	PO1, PO2	Apply(L3) Analyze(L4)	3
4				Analyze	L4	PO1, PO2, PO4	Apply(L3) Analyze(L4) Analyze(L4)	3
5				Design	L6	PO2, PO3, PO5, PO6	Analyze(L4) Design(L6) Usage(L3) Design(L6)	3

Justification Statements:

CO1: Analyze solar radiation data, PV module characteristics, and the environmental impact of solar power systems.

Action Verb: Analyze (L4)

PO1, PO2 & PO4 Verbs: Apply (L3), Analyze (L4), Sustainability (L3)

The CO1 Action Verb 'Analyze' (L4) is at a higher cognitive level than PO1 and PO7 verbs and is equal to PO2's 'Analyze' (L4). This outcome requires analyzing complex data in the context of sustainable engineering. Therefore, the correlation is high (3).

CO2: Evaluate the performance of various solar thermal collectors and select appropriate battery storage systems for PV applications.

Action Verb: Evaluate (L5)

PO2 & PO3 Verbs: Analyze (L4), Design (L6)

The CO2 Action Verb 'Evaluate' (L5) is a higher-order skill that requires analysis (PO2) and is a critical component of designing solutions (PO3). The ability to make judgments based on criteria is fundamental to these POs. Therefore, the correlation is high (3).

CO3: Apply the principles of wind and biomass energy conversion to analyze the performance of renewable energy systems.

Action Verb: Apply (L3)

PO1 & PO2 Verbs: Apply (L3), Analyze (L4)

The CO3 Action Verb 'Apply' (L3) is at the same cognitive level as PO1's verb and is a prerequisite for PO2's 'Analyze' (L4). It involves applying fundamental engineering knowledge to solve problems. Therefore, the correlation is high (3).

CO4: Analyze the operational principles and applications of geothermal, ocean energy, and fuel cell systems.

Action Verb: Analyze (L4)

PO1, PO2 & PO4 Verbs: Apply (L3), Analyze (L4)

The CO4 Action Verb 'Analyze' (L4) is at a higher level than PO1's 'Apply' (L3) and is equal to the verbs for PO2 and PO4. It requires a detailed investigation of complex energy systems. Therefore, the correlation is high (3).

CO5: Design an off-grid solar PV power plant considering component selection, system integration, and economic aspects.

Action Verb: Design (L6)

PO2, PO3 & PO5 Verbs: Analyze (L4), Design (L6), Usage (L3)

The CO5 Action Verb 'Design' (L6) is at the same cognitive level as PO3's verb.

This complex design task requires in-depth analysis of the problem (PO2) and the use of modern engineering tools (PO5). Therefore, the correlation is high (3).

AIITS TPT-CSE(DS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	ELECTRONIC CIRCUITS (Open Elective-1)	L	T / CLC	P	C
23AOE0401	III-I		2	1	0	3

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

CO1	Understand the operation of various semiconductor diodes and their applications.
CO2	Analyze the BJT characteristics, biasing methods and stabilization techniques.
CO3	Understand the single and multi-stage amplifiers using simplified hybrid model.
CO4	Evaluate the parameters of feedback amplifiers and frequency of various oscillators.
CO5	Analyze the characteristics, operation of Operational amplifier and it's applications

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	Operation of various semiconductor diodes and their applications.		Rectifiers, Clampers, Clippers, voltage regulators.	L2
CO2	Analyze	BJT characteristics, biasing methods and stabilization techniques.			L4
CO3	Understand	Single and multi-stage amplifiers using simplified hybrid model.		BJT, Coupled amplifiers	L2
CO4	Evaluate	Parameters of feedback amplifiers and frequency of various oscillators.			L5
CO5	Analyze	characteristics, operation of Operational amplifier and it's applications			L4

UNIT - I

16Hrs

Semiconductor Diode and Applications: Introduction, PN junction diode – structure, operation and VI characteristics, Half- wave, Full-wave and Bridge Rectifiers with and without Filters, Positive and Negative Clipping and Clamping circuits (Qualitative treatment only). Special Diodes: Zener and Avalanche Breakdowns, VI Characteristics of Zener diode, Zener diode as voltage regulator, Construction, operation and VI characteristics of Tunnel Diode, LED, Varactor Diode, Photo Diode .

UNIT - II

17Hrs

Bipolar Junction Transistor (BJT): Principle of Operation, Common Emitter, Common Base and Common Collector Configurations, Transistor as a switch and Amplifier, Transistor Biasing and

Stabilization - Operating point, DC & AC load lines, Biasing - Fixed Bias, Self Bias, Bias Stability, Bias Compensation using Diodes.	
UNIT - III	19 Hrs
Single stage amplifiers: Classification of Amplifiers - Distortion in amplifiers, Analysis of CE, CC and CB configurations with simplified hybrid model.	
Multistage amplifiers: Different Coupling Schemes used in Amplifiers - RC coupled amplifiers, Transformer Coupled Amplifier, Direct Coupled Amplifier; Multistage RC coupled BJT amplifier (Qualitative treatment only).	
UNIT - IV	20 Hrs
Feedback amplifiers: Concepts of feedback, Classification of feedback amplifiers, Effect of feedback on amplifier characteristics, Voltage Series, Voltage Shunt, Current Series and Current Shunt Feedback Configurations (Qualitative treatment only).	
Oscillators: Classification of oscillators, Condition for oscillations, RC Phase shift Oscillators, Generalized analysis of LC Oscillators-Hartley and Colpitts Oscillators, Wien Bridge Oscillator.	
UNIT - V	18 Hrs
Op-amp: Classification of IC'S, basic information of Op-amp, ideal and practical Op-amp, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential.	
Applications of op-amp : Summing, scaling and averaging amplifiers, Integrator, Differentiator, phase shift oscillator and comparator.	
Textbooks:	
1. Electronics Devices and Circuits, J.Millman and Christos. C. Halkias, 3rd edition, Tata McGraw Hill, 2006.	
2. Electronics Devices and Circuits Theory, David A. Bell, 5th Edition, Oxford University press. 2008.	
Reference Books:	
1. Electronics Devices and Circuits Theory, R.L.Boylestad, LouisNashelsky and K.Lal Kishore, 12th edition, 2006, Pearson, 2006.	
2. Electronic Devices and Circuits, N.Salivahanan, and N.Suresh Kumar, 3rd Edition, TMH, 2012	
3. Microelectronic Circuits, S.Sedra and K.C.Smith, 5th Edition, Oxford University Press.	
Online Learning Resources:	
nptel videos	

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

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	BT L			
1	16	18%	2	Understand	L2	PO1, PO2	PO1: Apply (L3) PO2: Review(L2)	2 3

2	17	19%	2	Analyze	L4	P O 1, P O 2, P O 3, PO4	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze(L4)	3 3 3 3
3	19	21%	3	Understand	L2	P O 1, P O 2, P O 4, PO5	PO1: Apply (L3) PO2: Review (L2) PO3: Analyze (L4) PO5: Select(L1)	2 3 1 3
4	20	22%	3	Evaluate	L5	P O 1, P O 2, P O 4, PO5	PO1: Apply (L3) PO2: Identify(L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3 3
5	18	20%	2	Analyze	L4	PO1, P O 2, P O 4	PO1: Apply (L3) PO2: Identify (L3) PO4: Analyze(L4)	3 3 3
	90	100%						

Correlation matrix Justification Statements:

CO1: Understand the operation of various semiconductor diodes and their applications.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3) CO1 Action Verb is less than PO1 verb by one level; Therefore, the correlation is moderate (2). PO2 Verbs: Review (L2) CO1 Action Verb is equal to PO2 verb; Therefore, the correlation is high (3).

CO2: Analyze the BJT characteristics, biasing methods and stabilization techniques.

Action Verb: Analyze(L4)

PO1 Verbs: Apply (L3) CO2 Action Verb is greater than PO1 verb; Therefore, the correlation is high (3). PO2 Verbs: Identify (L3) CO2 Action Verb is greater than PO2 verb; Therefore, the correlation is high (3). PO3 Verbs: Develop (L3) CO2 Action Verb is greater than PO3 verb; Therefore, the correlation is high (3). PO4 Verbs: Analyze (L4) CO2 Action Verb is equal to PO4 verb; Therefore, the correlation is high (3).

CO3: Understand the single and multi-stage amplifiers using simplified hybrid

model.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3),CO3 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2). PO2 Verbs: Review (L2),CO3 Action Verb is equal to PO2 verb by same levels; therefore, correlation is High (3). PO4 Verbs: Analyze-L4,CO3 Action Verb is less than PO4 verb by two levels; therefore, correlation is low (1).

PO5 Verbs: Select-L1,CO3 Action Verb is more than PO5 verb by one level; therefore, correlation is high (3).

CO4: Evaluate the parameters of feedback amplifiers and frequency of various oscillators.

Action Verb: Evaluate(L5)

PO1 Verbs: Apply (L3)CO4 Action Verb is high than PO1 verb by two levels ; Therefore, correlation is high (3). PO2 Verb: Identify (L3)CO4 Action Verb is high than PO2 verb by two levels ; Therefore, correlation is high (3). PO4 Verbs: Analyze(L4)CO4 Action Verb is higher than PO4 verb by one levels; therefore, correlation is high (3). PO5 Verbs: Apply (L3),CO4 Action Verb is higher than PO5 verb by two levels; Therefore, correlation is high (3).

CO5: Analyze the characteristics, operation of Operational amplifiers and it's applications

Action Verb: Analyze(L4)

PO1 Verbs: Apply (L3)CO5 Action Verb is PO1 verb by two levels ; Therefore, correlation is high (3).

PO2 Verb: Identify (L3)CO5 Action Verb is high than PO2 verb by two levels ; Therefore, correlation is high (3). PO4 Verbs: Analyze(L4)CO5 Action Verb is higher than PO4 verb by one levels; therefore, correlation is high (3).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Mathematical Foundations for Machine Learning and AI (Open Elective-1)	L	T / CLC	P	C
23AOE9901	III-I		2	1	0	3

Course Outcomes (CO): Student will be able to

1. Apply linear algebra concepts to ML techniques like PCA and regression.
2. Analyze probabilistic models and statistical methods for AI applications.
3. Apply optimization techniques for machine learning algorithms.
4. Apply vector calculus and transformations in AI-based models.
5. Evaluate graph-based AI models using mathematical representations.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	linear algebra concepts	to ML techniques like PCA and regression.		L3
2	Analyze	probabilistic models and statistical methods	for AI applications.		L4
3	Apply	optimization techniques	for machine learning algorithms.		L3
4	Apply	vector calculus and transformations	in AI-based models.		L3
5	Evaluate	graph-based AI models	using mathematical representations.		L5

UNIT I: Linear Algebra for Machine Learning

8 hours

Review of Vector spaces, basis, linear independence, Vector and matrix norms, Matrix factorization techniques, Eigen values, eigenvectors, diagonalization, Singular Value Decomposition (SVD) and Principal Component Analysis (PCA).

UNIT II: Probability and Statistics for AI

8 hours

Probability distributions: Gaussian, Binomial, Poisson. Bayes' Theorem, Maximum Likelihood Estimation (MLE), and Maximum a Posteriori (MAP). Entropy and Kullback-Leibler (KL) Divergence in AI, Cross entropy loss, Markov chains.

UNIT III: Optimization Techniques for ML

8 hours

Multivariable calculus: Gradients, Hessians, Jacobians. Constrained optimization: Lagrange multipliers and KKT conditions. Gradient Descent and its variants (Momentum, Adam) Newton's method, BFGS method.

UNIT IV: Vector Calculus & Transformations

8 hours

Vector calculus: Gradient, divergence, curl. Fourier Transform & Laplace Transform in ML applications.

UNIT V: Graph Theory for AI

8 hours

Graph representations: Adjacency matrices, Laplacian matrices. Bayesian Networks & Probabilistic Graphical Models. Introduction to Graph Neural Networks (GNNs).

Textbooks:

1. Mathematics for Machine Learning by Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press, 2020.
2. Pattern Recognition and Machine Learning by Christopher Bishop, Springer.

Reference Books:

1. Gilbert Strang, Linear Algebra and Its Applications, Cengage Learning, 2016.
2. Jonathan Gross, Jay Yellen, Graph Theory and Its Applications, CRC Press, 2018.

Web References:

- MIT– Mathematics for Machine Learning <https://ocw.mit.edu>
- Stanford CS229 – Machine Learning Course <https://cs229.stanford.edu/>
- Deep AI – Mathematical Foundations for AI <https://deepai.org>

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								

(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 correlation	CO		Program Outcome (PO)	PO(s): Action verb and BTL	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%		Verb	BTL			
1				Apply	L3	PO1	Apply	3
2				Analyze	L4	PO2	Analyze	3
3				Apply	L3	PO1	Apply	3
4				Apply	L3	PO1	Apply	3
5				Evaluate	L5	PO3	Evaluate	3

CO1: Apply linear algebra concepts to ML techniques like PCA and regression.

Action Verb: Apply(L3)

PO1 Verbs: Apply (L3)

CO1 Action Verb is equal to PO1 verb ; Therefore correlation is high (3).

CO2: Analyze probabilistic models and statistical methods for AI applications.

Action Verb: Analyze (L4)

PO2 Verbs: Analyze (L4)

CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO3: Apply optimization techniques for machine learning algorithms.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO3 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).

CO4: Apply vector calculus and transformations in AI-based models.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO4 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).

CO5: Evaluate graph-based AI models using mathematical representations.

Action Verb: Evaluate(L5)

PO3 Verb: Evaluate (L6)

CO5 Action verb is equal to PO3 verb; therefore the correlation is high (3).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

DEPARTMENT OF CSE(DATA SCIENCE)

Course Code	Year & Sem	MATERIALS CHARACTERIZATION TECHNIQUES (Open Elective-1)	L	T / CLC	P	C
23AOE9906	III-I		2	1	0	3

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

CO1	Understand the crystal structure and crystal size by using X-ray Diffraction (XRD) technique.
CO2	Analyze the basic principles of Scanning Electron Microscopy (SEM).
CO3	Analyze the fundamentals of Transmission Electron Microscope (TEM).
CO4	Apply the various spectroscopic techniques for engineering applications.
CO5	Analyze the electric and magnetic properties of a specimen using various characterization techniques.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
CO1	Understand	The crystal structure and crystal size by using X-ray Diffraction (XRD) technique.			L2
CO2	Analyze	The various spectroscopic techniques for engineering applications.			L4
CO3	Analyze	The fundamentals of Transmission Electron Microscope (TEM).			L4
CO4	Apply	The various spectroscopic techniques for engineering applications.			L3
CO5	Analyze	The electric and magnetic properties of a specimen using various characterization techniques.			L4

UNIT - I	Structure analysis by Powder X-Ray Diffraction	9 Hrs
Introduction, Bragg's law of diffraction, Intensity of Diffracted beams, Factors affecting Diffraction, Intensities, Structure of polycrystalline Aggregates, Determination of crystal structure, Crystallite size by Scherer and Williamson-Hall (W-H) Methods, Small angle X-ray scattering (SAXS) (in brief).		
UNIT - II	Microscopy technique -1 -Scanning Electron Microscopy (SEM)	9Hrs
Introduction, Principle, Construction and working principle of Scanning Electron Microscopy, Specimen preparation, Different types of modes used (Secondary Electron and Backscatter Electron), Advantages, limitations and applications of SEM.		
UNIT - III	Microscopy Technique -2 - Transmission Electron Microscopy (TEM)	9 Hrs
Construction and Working principle, Resolving power and Magnification, Bright and dark fields, Diffraction and image formation, Specimen preparation, Selected Area Diffraction, Applications of Transmission Electron Microscopy, Difference between SEM and TEM, Advantage and Limitations of Transmission Electron Microscopy.		
UNIT - IV	Spectroscopy techniques	9 Hrs

Principle, Experimental arrangement, Analysis and advantages of the spectroscopic techniques – (i) UV-Visible spectroscopy (ii) Raman Spectroscopy, (iii) Fourier Transform infrared (FTIR) spectroscopy, (iv) X-ray photoelectron spectroscopy (XPS).

UNIT - V **Electrical & Magnetic Characterization techniques** **9 Hrs**

Electrical Properties analysis techniques (DC conductivity, AC conductivity) Activation Energy, Effect of Magnetic field on the electrical properties (Hall Effect). Magnetization measurement by induction method, Vibrating sample Magnetometer (VSM) and SQUID.

Textbooks:

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods – Yang Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2013.
2. Microstructural Characterization of Materials - David Brandon, Wayne D Kalpan, John Wiley & Sons Ltd., 2008.

Reference Books:

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville Banwell and Elaine M. McCash, Tata McGraw-Hill, 2008.
2. Elements of X-ray diffraction – Bernard Dennis Cullity & Stuart R Stocks, Prentice Hall, 2001 – Science.
3. Practical Guide to Materials Characterization: Techniques and Applications - Khalid Sultan – Wiley – 2021.
4. Materials Characterization Techniques - Sam Zhang, Lin Li, Ashok Kumar - CRC Press - 2008

Online Learning Resources:

1. <https://nptel.ac.in/courses/115/103/115103030/>
2. https://nptel.ac.in/content/syllabus_pdf/113106034.pdf
3. <https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mm08/>

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												
CO2	3												
CO3	3				3								
CO4	3												
CO5	3	3											

Mapping of Course outcomes with Program outcomes Justification Table

CO No.	Lesson Plan (Hrs.)	%	C O			Program Outcomes (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of correlation (1-3)
			correlation	Verb	BTL			
1				Understand	L2	PO1	PO1: Apply (L3)	2
2				Analyze	L4	PO1	PO1: Apply (L3)	3

3				Analyze	L4	PO1, PO5	PO1, PO5: Apply (L3)	3
4				Apply	L3	PO1	PO1: Apply (L3)	3
5				Analyze	L4	PO1, PO2	PO1, PO2: Apply (L3)	3

Justification:

CO1: Understand the crystal structure and crystal size by using X-ray Diffraction (XRD) technique.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

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

CO2: Analyze the basic principles of Scanning Electron Microscopy (SEM).

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO2 Action Verb level is greater than PO1 verb by one level; Therefore, correlation is high (3).

CO3: Analyze the fundamentals of Transmission Electron Microscope (TEM).

Action Verb: Analyze (L4)

PO1 and PO5 Verbs: Apply (L3)

CO3 Action Verb level is greater than PO1 and PO5 verbs by one level; Therefore correlation is high (3).

CO4: Apply the various spectroscopic techniques for engineering applications.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO4 Action Verb is equal to PO1 verb; Therefore, correlation is high (3).

CO5: Analyze the electric and magnetic properties of a specimen using various characterization techniques.

Action Verb: Analyze (L4)

PO1 and PO2 Verb: Apply (L3)

CO5 Action verb is greater than PO1 and PO2 verbs by one level; therefore, the correlation is high (3).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

DEPARTMENT OF CSE(DATA SCIENCE)

Course Code	Year & Sem	Chemistry of Energy Systems (Open Elective-1)	L	T / CLC	P	C
23AOE9911	III-I		2	1	0	3

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

CO1	Understand the problems based on electrode potential and concept of batteries.
CO2	Apply fuel technology in various energy and engineering contexts.
CO3	Analyze the advantages of photoelectric catalytic process such as high efficiency, low environmental impact and renewable energy applications.
CO4	Apply the electrochemical principles to photo voltaic cell, solar power and solar cells.
CO5	Analyze various methods for storage of hydrogen fuel.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
CO1	Understand	the problems based on electrode potential and concept of batteries.			L2
CO2	Apply	fuel technology in various energy and engineering contexts.			L3
CO3	Analyze	the advantages of photoelectric catalytic process such as high efficiency, low environmental impact and renewable energy applications.			L4
CO4	Apply	the electrochemical principles to photo voltaic cell, solar power and solar cells.			L3
CO5	Analyze	various methods for storage of hydrogen fuel.			L4

UNIT - I	Electrochemical Systems	9 Hrs
Galvanic cell, Nernst equation, standard electrode potential, application of EMF, electrical double layer, polarization, Batteries- Introduction ,Lead-acid ,Nickel- cadmium, Lithium ion batteries and their applications.		
UNIT - II	Fuel Cells	9Hrs
Fuel cell- Introduction, Basic design of fuel cell, working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency and applications		
UNIT - III	Photo and Photo electrochemical Conversions)	9 Hrs
Photochemical cells Introduction and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions and their applications.		
UNIT - IV	Solar Energy	9 Hrs
Introduction and prospects, photovoltaic (PV) technology, concentrated solar power (CSP), Solar cells and applications		
UNIT - V	Hydrogen Storage	9 Hrs
Hydrogen storage and delivery: State-of-the art, Established technologies, Chemical and Physical methods of hydrogen storage, Compressed gas storage, Liquid hydrogen storage, Other storage		

methods, Hydrogen storage in metal hydrides, metal organic frameworks (MOF), Metal oxide porous structures, hydrogel, and Organic hydrogen carriers.

Textbooks:

1. Physical chemistry by Ira N. Levine
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins

Reference Books:

1. Fuel Cell Hand Book 7th Edition, by US Department of Energy (EG&G technical services And corporation)
2. Hand book of solar energy and applications by Arvind Tiwari and Shyam
3. Solar energy fundamental, technology and systems by Klaus Jagar et.al.
4. Hydrogen storage by Levine Klebonoff

Online Learning Resources:

2. <https://nptel.ac.in/courses/115/103/115103030/>
2. https://nptel.ac.in/content/syllabus_pdf/113106034.pdf
3. <https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-mm08/>

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	3												
CO2	3												
CO3	3												
CO4	3												
CO5	3												

Mapping of Course outcomes with Program outcomes Justification Table

CO No.	C O					Program Outcome s(PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of correlation(1-3)
	Lesson Plan (Hrs.)	%	correlation	Verb	BTL			
1				Understand	L2	PO1	PO1: Apply (L3)	2
2				Apply	L3	PO1	PO1: Apply (L3)	3
3				Analyze	L3	PO1	PO1: Apply (L3)	3
4				Apply	L4	PO1	PO1: Apply (L3)	3
5				Analyze	L4	PO1	PO1: Apply (L3)	3

Justification:

CO1: Understand the problems based on electrode potential and concept of batteries

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 fuel technology in various energy and engineering contexts

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3)

CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

CO3: Analyze the advantages of photoelectric catalytic process such as high efficiency, low environmental impact and renewable energy applications

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

CO3 Action Verb is less than PO1 verb; Therefore correlation is high (2).

CO4: Apply the electrochemical principles to photo voltaic cell, solar power and solar cells

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO3 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).

CO5 Analyze various methods for storage of hydrogen fuel

Action Verb: Analyze (L4)

PO1 Verb: Analyze (L4)

CO5 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).

AIATS TPT-CSE(DS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	English For Competitive Examinations (Open Elective-I)	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

C O	Action Verb	Knowledge Statement	Condition	Criteria	Bloom s 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).

AIATS TPT - CSUOS



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES::TIRUPATI
(AUTONOMOUS)**

Year: III

Semester: I

Branch of Study: All

Branches

Subject Code: 23AOEMB01	Subject Name: Entrepreneurship and New Venture Creation (Open Elective-I)	L 2	T 1	P 0	Credits 03
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Course Outcomes

CO1: Understand the entrepreneurial mind – set for venture creation and Intrapreneurial Leadership.

CO2: Analyze the process of problem-opportunity identification through design thinking, and validating with the potential customer.

CO3: Understand Prototype Development and validate MVP of their venture idea.

CO4: Evaluate the financial and market viability of a venture by conducting financial and marketing feasibility.

CO5: Understand an investible pitch deck of their practice venture to attract stakeholders.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	an entrepreneurial mind – set		for venture creation and Entrepreneurial Leadership	L2
CO2	Analyze	the process of problem-opportunity identification	Through design thinking, and validating with the potential customer.		L4
CO3	Understand	Proto type Development and validate MVP of their venture idea			L2
CO4	Evaluate	the financial and market viability of a venture	by conducting financial and marketing feasibility.		L5
CO5	Understand	an investible pitch deck of their practice venture		to attract stakeholders	L2

UNIT-I: Entrepreneurship Fundamentals and context

Meaning and concept, attributes and mindset of entrepreneurial and intrapreneurial leadership, role models in each and their role in economic development. An understanding of how to build entrepreneurial mindset, skill sets, attributes and networks while on campus.

Unit II: Problem & Customer Identification

Understanding and analyzing the macro-Problem and Industry perspective - technological, socioeconomic and urbanization trends and their implication on new opportunities - Identifying passion - identifying and defining problem using Design thinking principles - Analyzing problem and validating with the potential customer - Understanding customer segmentation, creating and validating customer personas.

Unit III: Solution design, Prototyping & Opportunity Assessment and Sizing

Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer's needs and create a strong value proposition - Understanding prototyping and Minimum Viable product (MVP) - Developing a feasibility prototype with differentiating value, features and benefits - Assess relative market position via competition analysis - Sizing the market and assess scope and potential scale of the opportunity.

UNIT-IV: Business & Financial Model, Go-to-Market Plan

Introduction to Business model and types, Lean approach, 9 block lean canvas

model, riskiest assumptions to Business models. Importance of Build - Measure - Lean approach. Business planning: components of Business plan- Sales plan, People plan and financial plan. Financial Planning: Types of costs, preparing a financial plan for profitability using financial template, understanding basics of Unit economics and analyzing financial performance.

Introduction to Marketing and Sales, Selecting the Right Channel, creating digital presence, building customer acquisition strategy. Choosing a form of business organization specific to your venture, identifying sources of funds: Debt & Equity Map the Start-up Life-cycle to Funding Options.

UNIT-V: Scale Outlook and Venture Pitch readiness Understand and identify potential and aspiration for scale vis-à-vis your venture idea. Persuasive Storytelling and its key components. Build an Investor ready pitch deck.

Textbooks:

- Robert D.Hisrich, Michael P.Peters, Dean A. Shepherd, Sabyasachi Sinha. Entrepreneurship,McGrawHill,11thEdition(2020)
- Ries E, The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses.CrownBusiness,(2011).
- Osterwalder, A., & Pigneur, Y. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons.(2010).

References:

- Simon Sinek, *Start with Why*, Penguin Books limited.(2011)
- BrownTim,*Change by Design Revised &Updated: HowDesign Thinking Transforms Organizations and Inspires Innovation*,HarperBusiness.(2019)
- NamitaThapar(2022)*The Dolphin and the Shark:Stories on Entrepreneurship* , Penguin Books Limited
- Saras D.Sarasvathy, (2008) *Effectuation:Elements of Entrepreneurial Expertise*, Elgar Publishing Ltd.

Mapping of course outcomes with program outcomes

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)													
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PSO 1	PSO 2	
Entrepreneurship and new venture creation	CO 1	2													
	CO 2			3											
	CO 3				3										
	CO 4	3													
	CO 5									2					

Correlation matrix

Unit No.	Lesson plan(Hrs)	%	CO			Program Outcome (PO)	PO(s):Action Verb and BTL	Level of Correlation (0-3)
			Correlation	Co's Action verb	BTL			
	10	14.93	2	Understand	L2	PO1	Apply (L3)	2
2	12	17.91	2	Analyze	L4	PO3	Apply (L3)	3
3	12	17.91	2	Create	L6	PO4	Apply (L3)	3
4	18	26.86	3	Evaluate	L5	PO1	Apply (L3)	3

5	15	22.38	3	Understand	L2	PO9	Thumb Rule	2
Total	67	100						

Justification Statements:

CO1: Understand an entrepreneurial mind – set for venture creation and Intrapreneurial Leadership.

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)

CO2: Analyze the process of problem-opportunity identification through design thinking, and validating with the potential customer.

Action Verb: Analyze (L4)

PO3: Apply (L3)

CO2 Action verb is more than PO3 verb. Therefore the correlation is High (3)

CO3: Understand Prototype Development and validate MVP of their venture idea.

Action Verb: Understand (L2)

PO4: Apply (L3)

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

CO4: Evaluate the financial and market viability of a venture by conducting financial and marketing feasibility.

Action Verb: Evaluate (L5)

PO1: Apply (L3)

CO4 Action verb is more than PO1 verb by two levels. Therefore the correlation is High (3)

CO5: Understand an investible pitch deck of their practice venture to attract stakeholders.

Action Verb: Understand (L2)

PO9: Thumb Rule

As using thumb rule, correlates with PO9. Therefore the correlation is medium (2)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Machine Learning Lab	L	T / CLC	P	C
23APC3208	III-I		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1:**Understand** the mathematical perspectives of machine learning algorithms through programming.

CO2:**Apply** the supervised and unsupervised learning techniques to train the models.

CO3:**Design** a Artificial Neural Network to automate learning process using back propagation

CO4:**Apply** the decision trees and Bayesian classifiers to categorize data.

CO5:**Analyze** datasets to identify predictions using K-nearest neighbor algorithm

List of Experiments

Note:

- The programs can be implemented in either JAVA or Python.
- For Problems 1 to 6 and 10, programs are to be developed without using the built-in classes or APIs of Java/Python.
- Data sets can be taken from standard repositories (<https://archive.ics.uci.edu/ml/datasets.html>) or constructed by the students

- Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file. [CO1]
- For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples. [CO2]
- Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. [CO3]
- Build an Artificial Neural Network by implementing the Back-propagation algorithm and test the same using appropriate data sets. [CO3]
- Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets. [CO4]
- Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set. [CO4]
- Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API. [CO4]
- Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program. [CO4]
- Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem. [CO5]
- Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs. [CO5]

Projects

- Predicting the Sale price of a house using Linear regression [CO1]
- Spam classification using Naïve Bayes algorithm [CO2]
- Predict car sale prices using Artificial Neural Networks [CO3]
- Predict Stock market trends using LSTM [CO4]
- Detecting faces from image [CO5]

References:

- Python Machine Learning Workbook for beginners, AI Publishing, 2020.

Online Learning Resources/Virtual Labs:

- Machine Learning A-Z (Python & R in Data Science

Course) Udey
2) Machine Learning | Coursera

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		3						2	2	
CO3	3	3	3		3								2
CO4	3	3		3	3							3	
CO5	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 PO5	PO1: Apply(L3) PO5: Apply (L3)	2 2
2	CO2: Apply	L3	PO1 PO2 PO3 PO5 PO11	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO5: Apply (L3) PO11: Thumb Rule	3 3 3 3 2
3	CO3: Apply	L3	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO5: Apply (L3)	3 3 3 3
4	CO4: Analyze	L4	PO1 PO2 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 3
5	CO5: Analyze	L4	PO1 PO5	PO1: Apply(L3) PO5: Apply (L3)	3 3

Justification Statements :

CO1: Understand the mathematical perspectives of machine learning algorithms through programming.

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)

PO5 Verb: Create (L3)

CO1 Action verb is greater than as PO5 verb one level. Therefore, the correlation is moderate (2)

CO2: Apply the supervised and unsupervised learning techniques to train the models

Action Verb: Apply (L3)

PO1 Verb: 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 as PO2 verb by one level. Therefore, the correlation is high (3)

PO3 Verb: Develop (L3)

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

PO5 Verb: Apply (L3)

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

PO11 Verb: Thumb rule

New concepts are evolving supervised and unsupervised learning, which is always a life long learning. Hence the correlation is moderate (2)

CO3: Design a Artificial Neural Network to automate learning process using back propagation

Action Verb: Design(L6)

PO1 Verb: Apply (L3)

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

PO2 Verb: Formulate(L6)

CO3 Action verb is same as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: Develop (L6)

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

PO5 Verb: Create (L6)

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

CO4: Apply the decision trees and Bayesian classifiers to categorize data.

Action Verb: Apply(L3)

PO1 Verb: Apply (L3)

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

PO2 Verb: Identify(L3)

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

PO4 Verb: Apply (L3)

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

PO5 Verb: Apply (L3)

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

CO5: Analyze datasets to identify predictions using K-nearest neighbor algorithm

Action Verb: Analyse (L4)

PO1 Verb: Apply (L3)

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

PO5 Verb: Apply (L3)

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



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Operating Systems lab	L	T / CLC	P	C
23APC3209	III-I		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the basic commands in UNIX operating systems.

CO2: Apply the concepts of CPU scheduling algorithms to solve real time problems.

CO3: Apply the concepts of process synchronization methods.

CO4: Analyze the various solutions for Memory management and deadlocks.

CO5: Analyze various file system interfaces.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the basic commands in UNIX operating system			L2
CO2	Apply	the concepts of CPU scheduling algorithms		to solve real time problems	L3
CO3	Apply	the concepts of process synchronization methods			L3
CO4	Analyze	the various solutions		for Memory management and Deadlocks	L4
CO5	Analyze	various file system interfaces			L4

List of Experiments

1. Practicing of Basic UNIX Commands. **(CO1)**
2. Write programs using the following UNIX operating system calls Fork, exec, getpid, exit, wait, close, stat, opendir and readdir **(CO1)**
3. Simulate UNIX commands like cp, ls, grep, etc., **(CO1)**
4. Simulate the following CPU scheduling algorithms a) Round Robin b) SJF c) FCFS d) Priority **(CO2)**
5. Implement a dynamic priority scheduling algorithm. **(CO2)**
6. Assume that there are five jobs with different weights ranging from 1 to 5. Implement round robin algorithm with time slice equivalent to weight. **(CO2)**
7. Implement priority scheduling algorithm. While executing, no process should wait for more than 10 seconds. If the waiting time is more than 10 seconds that process has to be executed for at least 1 second before waiting again. **(CO2)**
8. Control the number of ports opened by the operating system with a) Semaphore b)

Monitors. **(CO3)**

9. Simulate how parent and child processes use shared memory and address space. **(CO3)**

10. Simulate sleeping barber problem. **(CO3)**

11. Simulate dining philosopher 's problem. **(CO3)**

12. Simulate producer-consumer problem using threads. **(CO3)**

13. Implement the following memory allocation methods for fixed partition a) First fit b) Worst fit c)

Best fit **(CO4)**

14. Simulate the following page replacement algorithms a) FIFO b) LRU c) LFU etc., **(CO4)**

15. Simulate Paging Technique of memory management **(CO4)**

16. Simulate Bankers Algorithm for Dead Lock avoidance and prevention **(CO4)**

17. Simulate the following file allocation strategies a) Sequential b) Indexed c) Linked **(CO5)**

18. Simulate all File Organization Techniques a) Single level directory b) Two level c) Hierarchical d)

DAG **(CO5)**

References:

1. –Operating System Concepts, Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Eighth Edition, John Wiley.

2. –Operating Systems: Internals and Design Principles, Stallings, Sixth Edition–2009, Pearson Education

3. –Modern Operating Systems, Andrew S Tanenbaum, Second Edition, PHI.

4. –Operating Systems, S.Haldar, A.A.Aravind, Pearson Education.

5. –Principles of Operating Systems, B.L.Stuart, Cengage learning, India Edition.2013-2014

6. –Operating Systems, A.S.Godbole, Second Edition, TMH.

7. –An Introduction to Operating Systems, P.C.P. Bhatt, PHI.

Online Learning Resources/Virtual Labs:

<https://www.cse.iitb.ac.in/~mythili/os/> <http://peterindia.net/OperatingSystems.html>

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		3						2		2
CO3	3	3	3		3							2	
CO4	3	3		3	3								2
CO5	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 PO5	PO1: Apply(L3) PO5: Apply (L3)	2 2
2	CO2: Apply	L3	PO1 PO2 PO3 PO5 PO11	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO5: Apply (L3) PO11:Thumb Rule	3 3 3 3 2
3	CO3: Apply	L3	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO5: Apply(L3)	3 3 3 3

4	CO4: Analyze	L4	PO1 PO2 PO4 PO5	PO1:Apply(L3) PO2:Identify (L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 3
5	CO5: Analyze	L4	PO1 PO5	PO1: Apply(L3) PO5: Apply (L3)	3 3

Justification Statements :

CO1: Understand the basic commands in UNIX operating systems.

Action Verb: Understand (L2)

PO1 Verb: Apply (L3)

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

PO5 Verb: Apply (L3)

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

CO2: Apply the concepts of CPU scheduling algorithms to solve real time problems.

Action Verb: Apply (L3)

PO1 Verb: 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 as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: Develop (L6)

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

PO5 Verb: Apply (L3)

CO2 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)

PO11 Verb: Thumb rule

Algorithms analysis is learning process to find the solution better manner the correlation is moderate (2)

CO3: Apply the concepts of process synchronization methods.

Action Verb:Apply(L3)

PO1 Verb: 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 as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: Develop (L3)

CO3 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)

PO5 Verb: Apply(L3)

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

CO4: Analyze the various solutions for Memory management and Deadlocks.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

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

PO2 Verb: Idetify(L3)

CO4 Action verb is greater than as PO2 verb by one level. Therefore, the correlation is high (3)

PO4 Verb: Analyze (L4)

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

PO5 Verb: Apply (L3)

CO4 Action verb is greater than as PO5 verb by one level. Therefore, the correlation is high (3)

CO5: Analyze various file system interfaces.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

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

PO5 Verb: Apply (L3)

CO5 Action verb is greater than PO5 verb by one level. Therefore, the correlation is high (3)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Soft Skills Lab	L	T	P	C
23ASC9901	III-I		0	1	2	2

Course Outcomes:

Pre-Requisites	SOFT SKILLS	Semester	II
Course Outcomes (CO): Student will be able to			
<p>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.</p>			

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 professional 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_2iUCG87CQhELCyvXh0E_y-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHIsQFwJZel_j2PUy0pwjVUgj7KlJ

3. <https://youtu.be/-Y-R9hD17IU>
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 professional 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).

AIITS TPT-CSE(DS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Tinkering Lab			
23AES0404	III-I	L	T	P	C
		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)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)**

COMPUTER SCIENCE AND ENGINEERING

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, Vision vs 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:		
<ol style="list-style-type: none"> 1. Michael A. Nielsen, Isaac L. Chuang, <i>Quantum Computation and Quantum Information</i>, Cambridge University Press, 10th Anniversary Edition, 2010. 2. Eleanor Rieffel and Wolfgang Polak, <i>Quantum Computing: A Gentle Introduction</i>, MIT Press, 2011. 3. Chris Bernhardt, <i>Quantum Computing for Everyone</i>, MIT Press, 2019. 		
Reference Books:		
<ol style="list-style-type: none"> 1. David McMahon, <i>Quantum Computing Explained</i>, Wiley, 2008. 2. Phillip Kaye, Raymond Laflamme, Michele Mosca, <i>An Introduction to Quantum Computing</i>, Oxford University Press, 2007. 3. Scott Aaronson, <i>Quantum Computing Since Democritus</i>, Cambridge University Press, 2013. 4. Alastair I.M. Rae, <i>Quantum Physics: A Beginner's Guide</i>, Oneworld Publications, Revised Edition, 2005. 5. Eleanor G. Rieffel, Wolfgang H. Polak, <i>Quantum Computing: A Gentle Introduction</i>, MIT Press, 2011. 6. Leonard Susskind, Art Friedman, <i>Quantum Mechanics: The Theoretical Minimum</i>, Basic Books, 2014. 7. Bruce Rosenblum, Fred Kuttner, <i>Quantum Enigma: Physics Encounters Consciousness</i>, Oxford University Press, 2nd Edition, 2011. 8. Giuliano Benenti, Giulio Casati, Giuliano Strini, <i>Principles of Quantum Computation and Information, Volume I: Basic Concepts</i>, World Scientific Publishing, 2004. 9. K.B. Whaley et al., <i>Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document</i>, Quantum Flagship, European Commission, 2020. 10. Department of Science & Technology (DST), Government of India, <i>National Mission on Quantum Technologies & Applications – Official Reports and Whitepapers</i>, MeitY/DST Publications, 2020 onward. 		
Online Learning Resources:		
<ul style="list-style-type: none"> • 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
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(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 Rule	2 1 3
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)

**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)
(Effective for the batches admitted in 2023-24)
Semester VI (Third year II Semester)**

Sl. No.	Category	Course Code (Actual)	Course Title	Hours per week			Credits C	CIE	SEE	Total
				L	T / CLC	P				
1	PC	23APC3210	Natural Language Processing	2	1	0	3	30	70	100
2	PC	23APC3211	Predictive Analytics	2	1	0	3	30	70	100
3	PC	23APC3212	Data Visualization	2	1	0	3	30	70	100
4	PE-II	23APE3205	Social Network Analysis	2	1	0	3	30	70	100
		23APE3206	Cryptography & NS							
		23APE3207	Computer Networks							
		23APE3208	Recommender Systems							
		23APE3209	Deep Learning							
5	PE-III (NPTEL)	23APE3210	Software Project Management	2	1	0	3	30	70	100
		23APE3211	Quantum Computing							
		23APE3212	Computer Vision							
		23MOC3201	Cloud Computing							
6	OE-II		*Open Elective-II	2	1	0	3	25	75	100
7	PC	23APC3213	Predictive Analytics Lab	0	0	3	1.5	30	70	100
8	PC	23APC3214	NLP and Data Visualization Lab (Using Power BI / Tableau etc.,)	0	0	3	1.5	30	70	100
9	SC	23ASC3202	Full Stack development -I	0	1	2	2	30	70	100
10	AC	23AMC9902	Technical Paper Writing & IPR	2	0	0	-	30	-	30
11	SC	23ASC3203	Technical Workshop	0	0	0	0	0	0	0
Total				14	07	08	23	295	635	930

Note:

Workshop can be conducted either in 3-1 or 3-2 and participation certificate with 90% and above attendance on it should be submitted to department and exam section before 3-2 regular exam notification issued.

***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.	23APE0322	Automation and Robotics	ME
5.	23AOE0402	Digital Electronics	ECE
6.	23AOE9902	Optimization Techniques	Mathematics
7.	23AOE9903	Mathematical Foundation of Quantum Technologies	
8.	23AOE9907	Physics Of Electronic Materials and Devices	Physics
9.	23AOE9912	Chemistry Of Polymers and Applications	Chemistry
10	23AOE9916	Academic Writing and Public Speaking	Humanities



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (CSE)**

Course Code	Year & Sem	Natural Language Processing	L	T / CLC	P	C
23APC3210	III-II		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the basic concepts of NLP to build language models

CO2: Apply parsing techniques to study syntactic structure of sentences in natural language

CO3: Analyze grammars and mechanisms of augmented transition network for NLP

CO4: Apply language models and semantic interpretation to NLP

CO5: Analyze machine translation and multi lingual information retrieval approaches to improve system performance

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the basic concepts of NLP		to build language models	L2
CO2	Apply	parsing techniques		to study syntactic structure of sentences in natural language	L3
CO3	Analyze	grammars and mechanisms of		augmented transition network for NLP	L4
CO4	Apply	language models and semantic interpretation		to generate compelling 2D transitions between images	L3
CO5	Analyze	machine translation and multi lingual information retrieval approaches		To improve system performance	L4

UNIT - I	Introduction to Natural language	8 Hrs
Introduction to Natural language: The Study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different Levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English Syntax		
UNIT - II	Grammars and Parsing	9 Hrs
Grammars and Parsing: Grammars and Parsing- Top- Down and Bottom-Up Parsers, Transition Network Grammars, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks, Bayees Rule, Shannon game, Entropy and Cross Entropy.		
UNIT - III	Grammars for Natural Language	8 Hrs
Grammars for Natural Language: Grammars for Natural Language, Movement Phenomenon in Language, Handling questions in Context Free Grammars, Hold Mechanisms in ATNs, Gap Threading, Human Preferences in Parsing, Shift Reduce Parsers, Deterministic Parsers.		
UNIT - IV	Semantic Interpretation	8 Hrs
Semantic Interpretation: Semantic & Logical form, Word senses & ambiguity, The basic logical form language, Encoding ambiguity in the logical Form, Verbs & States in logical form, Thematic roles, Speech acts & embedded sentences, Defining semantics structure model theory. Language Modeling: Introduction, n-Gram Models, Language model Evaluation, Parameter Estimation, Language Model Adaption, Types of Language Models, Language-Specific Modeling Problems, Multilingual and cross lingual language modeling.		
UNIT - V	Machine Translation Survey	9 Hrs
Machine Translation Survey: Introduction, Problems of Machine Translation, Is Machine Translation Possible, Brief History, Possible Approaches, Current Status. Anusaraka or Language Accessor: Background, Cutting the Gordian Knot, The Problem, Structure of Anusaraka System, User Interface, Linguistic Area, Giving up Agreement in Anusarsaka Output, Language Bridges. Multilingual Information Retrieval: Introduction, Document Preprocessing, Monolingual Information Retrieval, CLIR, MLIR, Evaluation in Information Retrieval, Tools, Software and Resources. Multilingual Automatic Summarization: Introduction, Approaches to Summarization, Evaluation,		

How to Build a Summarizer, Competitions and Datasets.

Textbooks:

1. James Allen, Natural Language Understanding, 2nd Edition, 2003, Pearson Education.
2. Multilingual Natural Language Processing Applications : From Theory To Practice Daniel M. Bikel and Imed Zitouni, Pearson Publications.
3. Natural Language Processing, A paninian perspective, Akshar Bharathi, Vineet chaitanya, Prentice – Hall of India.

Reference Books:

1. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
2. Jurafsky, Dan and Martin, James, Speech and Language Processing, 2nd Edition, Prentice Hall, 2008.
3. Manning, Christopher and Henrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999

Online Learning Resources

1. <https://nptel.ac.in/courses/106/105/106105158/>
2. <http://www.nptelvideos.in/2012/11/natural-language-processing.html>

Mapping of course outcomes with program outcomes

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

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

Correlation matrix

Unit No.	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BT L	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
1	8	19%	2	CO1:Understand	L2	PO1 PO2 PO4	PO1: Apply(L3) PO2: Review(L2) PO4: Interpret(L2)	2 3 3
2	9	21%	3	CO2 : Apply	L3	PO1 PO2 PO4 PO5 PO11	PO1: Apply(L3) PO2: Identify(L3) PO4: Analyze(L4) PO5: Apply(L3) PO11: Thumb rule	3 3 2 3 2
3	8	19%	2	CO3 : Analyze	L4	PO1 PO2 PO4 PO5 PO11	PO1: Apply(L3) PO2: Identify(L3) PO4: Analyze(L4) PO5: Apply(L3) PO11: Thumb rule	3 3 3 3 3
4	8	19%	2	CO4 : Apply	L3	PO1	PO1:	3

						PO2 PO3 PO11	Apply(L3) PO2: Identify(L3) PO3: Develop(L3) PO11: Thumb rule	3 3 2
5	9	21%	3	CO5 :Analyze	L4	PO1 PO2 PO4 PO6 PO11	PO1: Apply(L3) PO2: Identify(L3) PO4: Analyze(L4) PO6: Thumb rule PO11: Thumb rule	3 3 3 3 3
	42	100%						

Justification Statements :

CO1: Understand the basic concepts of NLP concepts to build language models

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 : Review(L2)

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

PO4: Interpret(L2)

CO1 Action verb is same as PO4 verb. Therefore the correlation is high(3)

CO2: Apply parsing techniques to study syntactic structure of sentences in natural language

Action Verb : Apply(L3)

PO1: Apply(L3)

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

PO2: Identify(L3)

CO2 Action verb is same 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 medium(2)

PO5: Apply(L3)

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

PO11: Thumb rule

For developing natural language applications, one needs to learn continuously. Therefore the correlation is medium(2)

CO3: Analyze grammars and mechanisms of augmented transistion network for NLP

Action Verb : Analyze (L4)

PO1: Apply(L3)

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

PO2: Identify(L3)

CO3 Action verb is greater than PO2 verb. Therefore the correlation is high (3)

PO4: Analyze (L4)

CO3 Action verb is same as PO4 verb. Therefore the correlation is high(3)

PO5: Apply(L3)

CO3 Action verb is greater than PO5 verb. Therefore the correlation is high (3)

PO11: Thumb rule

For developing natural language applications, one needs to learn continuously. Therefore the correlation is high(3)

CO4: Apply language models and semantic interpretation to NLP

Action Verb : Apply(L3)

PO1: Apply(L3)

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

PO2: Identify(L3)

CO4 Action verb is same level 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)

PO11: Thumb rule

For developing natural language applications, one needs to learn continuously. Therefore the correlation is medium(2)

CO5: Analyze machine translation and multi lingual information retrieval approaches to improve system performance

Action Verb : Analyze (L4)

PO1: Apply(L3)

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

PO2: Identify(L3)

CO5 Action verb is greater than 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)

PO6: Thumb rule

Information retrieval methods are used in many real time applications. Therefore the correlation is high(3)

PO11: Thumb rule

In language translation retrieval approaches to improve performance gets updated regularly. Therefore the correlation is high(3)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	PREDICTIVE ANALYTICS	L	T / CLC	P	C
23APC3211	III-II		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the key concepts of predictive analytics

CO2: Apply the knowledge to explore, visualize, and clean data for predictive modeling and analysis.

CO3: Apply association rules to perform clustering and interpret descriptive models to uncover patterns and insights in the data.

CO4: Analyze predictive models to generate predictions for new data

CO5: Understand advanced techniques like model ensembles and text mining to deploy predictive models effectively in real-world applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the key concepts of predictive analytics			L2
CO2	Apply	the knowledge to explore, visualize, and clean data		for predictive modeling and analysis	L3
CO3	Apply	association rules		to perform clustering and interpret descriptive models to uncover patterns and insights in the data.	L3
CO4	Analyze	predictive models		to generate predictions for new data	L4
CO5	Understand	advanced techniques like model ensembles and text mining		to deploy predictive models effectively in real-world applications.	L2

UNIT – I	10 Hrs
<p>Overview of Predictive Analytics: What Is Analytics? What Is Predictive Analytics? Business Intelligence Predictive Analytics vs. Business Intelligence, Predictive Analytics vs. Statistics, Predictive Analytics vs. Data Mining, Who Uses Predictive Analytics? , Challenges in Using Predictive Analytics, What Educational Background Is Needed to Become a Predictive Modeler? Setting Up the Problem: Predictive Analytics Processing Steps: CRISP-DM, Business Understanding, Defining Data for Predictive Modelling, Defining the Target Variable, Defining Measures of Success for Predictive Models, Doing Predictive Modelling Out of Order, Case study- Recovering Lapsed Donors, Fraud Detection.</p>	

UNIT – II		8 Hrs
Data Understanding: What the Data Looks Like, Single Variable Summaries, Data Visualization in One Dimension, Histograms, Multiple Variable Summaries, Data Visualization, Two or Higher Dimensions, The Value of Statistical Significance, Pulling It All Together into a Data Audit. Data Preparation: Variable Cleaning, Feature Creation.		
UNIT – III		9 Hrs
Item sets and Association Rules: Terminology, Parameter Settings, How the Data Is Organized, Measures of Interesting Rules, Deploying Association Rules, Problems with Association Rules, Building Classification Rules from Association Rules. Descriptive Modelling: Data Preparation Issues with Descriptive Modelling, Principal Component Analysis, Clustering Algorithms. Interpreting Descriptive Models: Standard Cluster Model Interpretation.		
UNIT – IV		9 Hrs
Predictive Modelling: Decision Trees, Logistic Regression, Neural Networks, K-Nearest Neighbour, Naïve Bayes, Regression Models, Linear Regression, Other Regression Algorithms. Assessing Predictive Models: Batch Approach to Model Assessment, Assessing Regression Models.		
UNIT – V		10 Hrs
Model Ensembles: Motivation for Ensembles, Bagging, Boosting, Improvements to Bagging and Boosting, Model Ensembles and Occam’s Razor, Interpreting Model Ensembles. Text Mining: Motivation for Text Mining, A Predictive Modelling Approach to Text Mining, structured vs. Unstructured Data, Why Text Mining Is Hard, Data Preparation Steps, Text Mining Features, Modelling with Text Mining Features, Regular Expressions. Model Deployment: General Deployment Considerations. Case Studies: Survey Analysis Case Study, Help Desk Case Study		
Textbooks:		
1. Dean Abbott, Applied Predictive Analytics, Published by Jhon Wiley & Sons, Inc, 2014.		
Reference Books:		
1. Eric Siegel, Predictive Analytics, Published by Jhon Wiley & Sons, inc, 2013.		
2. Data Analytics using Python Kindle Edition by Bharti Motwani, 2020		
Online Learning Resources:		
1. Predictive Analytics: Introduction to Business Forecasting Udemy		

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
CO2	3	3			3							2	2
CO3	3	3	3		3							2	2
CO4	3	1		3	3							2	2
CO5	2		2		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) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
1	10	21%	3	CO1 :Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3	
2	8	17%	2	CO2 :Apply	L3	PO1 PO2 PO5	PO1: Apply(L3) PO2: Review(L2) PO5: Apply(L3)	3 3 3	
3	9	20%	2	CO3 :Apply	L3	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO5: Apply(L3)	3 3 3 3	
						PO2	PO1: Apply(L3)	3	

4	9	20%	2	CO4 :Analyze	L4	PO3 PO4 PO5	PO2: Review(L2) PO4: Analyze (L4) PO5: Apply(L3)	3 3 3
5	10	21%	3	CO5 :Understand	L2	PO1 PO3 PO5 PO11	PO1: Apply(L3) PO3: Develop (L3) PO5: Apply(L3) PO11:Thumb Rule	2 2 2 2
	46	100 %						

Justification Statements :

CO1: Understand the key concepts 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 medium (2)

PO2 Verb : Review(L2)

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

CO2: Apply the knowledge to explore, visualize, and clean data for predictive modeling and analysis.

Action Verb : Apply (L3)

PO1: Apply(L3)

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

PO2 Verb : Review(L2)

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

PO5: Apply(L3)

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

CO3: Apply association rules to perform clustering and interpret descriptive models to uncover patterns and insights in the data.

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 greater than 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)

PO5: Apply(L3)

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

CO4:Analyze predictive models to generate predictions for new data **Action Verb : Analyze (L4)**

PO1: Apply(L3)

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

PO2: Review (L2)

CO4 Action verb is greater level as PO2 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)

CO5:Understand advanced techniques like model ensembles and text mining to deploy predictive models effectively in real-world applications.

Action Verb : Understand (L2)

PO1: Apply(L3)

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

PO3: Develop (L3)

CO5 Action verb is less than PO3 verb by one level. Therefore, the correlation is medium (2)

PO5: Apply(L3)

CO5 Action verb is less than PO5 verb by one level. Therefore, the correlation is medium (2)

PO11: Thumb rule

Recognizes real-world implications and deployment strategies for ML models. Therefore, the correlation is medium (2)

AIATS TPT-CSE(ODS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Data Visualization	L	T / CLC	P	C
23APC3212	III-II		2	1	0	3

After studying the course, student will be able to

CO1: Understand the Context to design effective visual representations of data,

CO2: Analyze the visual communications to eliminate clutter to convey information.

CO3: Understand the Tableau Software to make the environment and datasets for visualization tasks.

CO4: Analyze the data using proportions and means to predict hidden patterns.

CO5: Design the dashboards and Tableau Stories to communicate analytic insights to intended audience.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the Context to design effective visual representations of data,			L2
CO2	Analyze	the visual communications to eliminate clutter to convey information			L4
CO3	Understand	the Tableau Software		to make the environment and datasets for visualization tasks.	L2
CO4	Analyze	the data using proportions and means		to predict hidden patterns.	L4
CO5	Design	the dashboards and Tableau Stories		to communicate analytic insights to intended audience.	L6

UNIT - I		9 Hours
Introduction, the importance of Context, Choosing and effective visual		
UNIT - II		9 Hours
Clutter is your enemy, Focus your audience's attention, Lessons in Storytelling		
UNIT - III		10 Hours
Communicating data: A step in the process, a model of communication, Three types of communication problems, six principles of communicating data. Introduction to Tableau: Using Tableau, Tableau products, connecting to data. How much and How many: Communicating how much, communicating how many Ratios and Rates: Ratios, Rates		
UNIT - IV		10 Hours
Proportions and Percentages: Part to whole, current to historical, actual to target. Mean and Median Variation and Uncertainty: Respecting variation, Variation over time-Control charts, Understanding uncertainty		
UNIT - V		8 Hours

Multiple Quantities: Scatter plots, Stacked Bars, Regression and Trend Lines, The Quadrant Chart
 Changes over time: The origin of time charts, the line chart, the dual axis line chart, the connected scatter plot, the date filed type and seasonality, the timeline, the slopegraph
 Maps and Location: One special map, circle maps, filled maps, dual encoded maps.

Textbooks:
 1. Cole Nussbaumer Knaflic, Storytelling with data, Wiley
 2. Ben Jones, Communicating Data with Tableau, O'Reilly

Reference Books:
 1. A Julie Steele and Noah Iliinsky, Designing Data Visualizations: Representing Informational Relationships, O'Reilly.
 2. Andy Kirk, Data Visualization: A Successful Design Process, PAKT.
 3. Scott Murray, Interactive Data Visualization for Web, O'Reilly.

Online Learning Resources:
 1. Data Analysis and Visualization Foundations | Coursera
 2. Data Visualization | Coursera

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	3			3								
CO3	3	3		2	3			2	2				
CO4	3	3									2		
CO5	2	3	2	3	2						2		

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

Correlation matrix

Unit No.	Lesson Plan Hrs	%	Coorelation	Co's Action verb	B TL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
1	9	19%	2	CO1: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2:Review(L2)	2 3
2	9	19%	2	CO2: Analyze	L4	PO1 PO2 PO6	PO1: Apply(L3) PO2: Review(L2) PO5: Apply(L3)	3 3 3
3	10	21%	3	CO3: Understand	L2	PO1 PO2 PO4 PO5 PO8 PO9	PO1: Apply(L3) PO2:Review(L2) PO4:Interpret(L2) PO5: Apply(L3) PO8: Thumbrule PO9: Thumbrule	2 3 3 2 2 2
4	10	21%	3	CO4: Analyze	L4	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review(L2) PO11:Thumbrule	3 3 3
5	8	17%	2	CO5: Design	L6	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review(L2) PO3:Develop(L3) PO4:Interpret(L2) PO5: Apply(L3) PO11: Thumbrule	3 3 3 3 3 3
	46							

Justification Statements :

CO1: : Understand the Context to design effective visual representations of 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 as PO2 verb. Therefore the correlation is high (3)

CO2: Analyze the visual communications to eliminate clutter to convey information.

Action Verb : Analyze(L4)

PO1: Apply(L3)

CO2 Action verb is greater than 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)

PO5: Apply(L3)

CO2 Action verb is greater than PO5 verb. Therefore the correlation is high (3)

CO3: Understand the Tableau Software to make the environment and datasets for visualization tasks

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)

PO4: Interpret (L2)

CO3 Action verb is same level as PO4 verb. Therefore the correlation is high (3)

PO5: Apply(L3)

CO3 Action verb is less than PO5 verb by two levels. Therefore the correlation is moderate(2)

PO8: Thumb rule

Team work is required to promote the brands and trending topics. Hence the correlation is moderate (2)

PO9: Thumb rule

Effective communication is required to prevent conflicts from escalating. Therefore the correlation is moderate (2)

CO4: Analyze the data using proportions and means to predict hidden patterns

Action Verb:Analyze(L4)

PO1: Apply (L3)

CO4 Action verb is greater than 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)

PO11: Thumb rule

Advanced techniques are inevitable in data visualization especially in PowerBI to improve dashboards. Therefore the correlation is high(3)

CO5: Design the dashboards and Tableau Stories to communicate analytic insights to intended audience.

Action Verb : Design (L6)

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: Interpret (L2)

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

Advanced techniques are inevitable in Data Visualization especially in Power BI to improve user interface. Therefore the correlation is high(3)

AIATS TPT-CSE(ODS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Social Network Analysis (Professional Elective-II)	L	T / CLC	P	C
23APE3205	III-II		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1:Understand the social network data using microformats and semantic markup.

CO2:Analyze the social network relationships, including friends and followers using set operations.

CO3: Apply the techniques to extract and utilize tweet content for effective social media analysis.

CO4: Apply the clustering techniques to organize and leverage networking on LinkedIn

CO5:Understand the facebook features and tools for marketing and networking the brands.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The social network data	using microformats and semantic markup.		L2
CO2	Analyze	the social network relationships, including friends and followers	using set operations		L4
CO3	Apply	the techniques to extract and utilize tweet content		for effective social media analysis	L3
CO4	Apply	the clustering techniques to organize and leverage network on LinkedIn		for career advancement and networking opportunities.	L3
CO5	Understand	the facebook features and tools		for marketing and networking the brands.	L2

UNIT - I		8 Hours
Hacking on Twitter data, Micro formats: Semantic Markup and common sense collide		
UNIT - II		9 Hours
Mailboxes: Oldies but Goodies, Titter: Friends, Followers and Set wise operations		
UNIT - III		8 Hours
Twitter: The Tweet, the Whole Tweet, and Nothing but the Tweet		
UNIT - IV		8 Hours
LinkedIn: Clustering your professional network for Fun (and profit)		
UNIT - V		9 Hours
Face book: The All-in-one Wonder		
Textbooks:		

1. Matthew A. Russel, Mining the Social Web, O'Reilly, 2013
Reference Books:
1. Social Network Analysis: A Introduction with an Extensive Implementation to a Large Scale Online Network using Pajek, SeifedineKadry, Mohammed Taie, 2014.
2. An Introduction to Social Network Data Analytics, Charu C. Aggarwal, IBM T. J. Watson Research Center.
Online Learning Resources:
1. Social Network Analysis Coursera

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	3			3								
CO3	3	3		2	3			2	2				
CO4	3	3									2		
CO5	2	3	2	3	2						2		

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

Correlation matrix

Unit No.	Lesson Plan Hrs	%	Coorelation	Co's Action verb	B TL	Progr am Outc ome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlatio n (0-3)
1	8	19%	2	CO1: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2:Review(L2)	2 3
2	9	21%	3	CO2: Analyze	L4	PO1 PO2 PO6	PO1: Apply(L3) PO2: Identify(L3) PO5: Apply(L3)	3 3 3
3	8	19%	2	CO3: Apply	L3	PO1 PO2 PO4 PO5 PO8 PO9	PO1: Apply(L3) PO2:Review(L2) PO4:Analyze(L4) PO5: Apply(L3) PO8: Thumbrule PO9: Thumbrule	3 3 2 3 2 2
4	8	19%	2	CO4: Apply	L3	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review(L2) PO11:Thumbrule	3 3 2
5	9	21%	3	CO5: Understand	L2	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review(L2) PO3:Develop(L3) PO4:Interpret(L2) PO5: Apply(L3) PO11: Thumbrule	2 3 2 3 2 2
	42							

Justification Statements :

CO1: Understand how to extract and analyze social network data using microformats and semantic markup.

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 social network relationships, including friends and followers, using set operations.

Action Verb : Analyze(L4)

PO1: Apply(L3)

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

PO2: Identify(L3)

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

PO5: Apply(L3)

CO2 Action verb is greater than PO5 verb. Therefore the correlation is high (3)

CO3: Apply the techniques to extract and utilize tweet content for effective social media analysis

Action Verb : Apply (L3)

PO1: Apply(L3)

CO3 Action verb is same as 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)

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)

PO8: Thumb rule

Team work is required to promote the brands and trending topics. Hence the correlation is moderate (2)

PO9: Thumb rule

Effective communication is required to prevent conflicts from escalating. Therefore the correlation is moderate (2)

CO4: Apply the clustering techniques to organize and leverage networking on LinkedIn

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)

PO11: Thumb rule

Advanced techniques are inevitable in social networking especially in LinkedIn to improve user network time to time. Therefore the correlation is moderate(2)

CO5: Understand the facebook features and tools for marketing and networking the brands.

Action Verb : Understand (L2)

PO1: Apply(L3)

CO5 Action verb is less than PO1 verb. Therefore the correlation is moderate(2)

PO2: 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 PO3 verb. Therefore the correlation is moderate(2)

PO4: Interpret (L2)

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

PO5: Apply(L3)

CO5 Action verb is less than PO5 verb by one level. Therefore the correlation is moderate (2)

PO11: Thumb rule

Advanced techniques are inevitable in social networking especially in Facebook to improve user network time to time. Therefore the correlation is moderate(2)

AIITS TPT-CSE(ODS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Cryptography & NS (Professional Elective-II)	L	T / CLC	P	C
23APE3206	III-II		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

- CO1: **Understand** the basic Security and Cryptography concepts and techniques
- CO2: **Analyze** the various cryptography algorithms for data encryption
- CO3: **Analyze** the different MAC and HASH algorithms to authenticate a message
- CO4: **Apply** the various security mechanisms for E-mail and IP security
- CO5: **Analyze** the various security breaches in real world applications

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The basic Security and Cryptography concepts and techniques			L2
CO2	Analyze	The various cryptographic algorithms		for data encryption	L4
CO3	Analyze	The different MAC and HASH algorithms		to authenticate a message	L4
CO4	Apply	The security mechanism		E-mail and IP security	L3
CO5	Analyze	The various security breaches		real world applications	L4

UNIT - I		14 Hrs
<p>Computer and Network Security Concepts: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security</p> <p>Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography</p> <p>Block Ciphers: Traditional Block Cipher Structure, The Data Encryption Standard, Advanced Encryption Standard: AES Structure, AES Transformation Functions</p>		
UNIT - II		10 Hrs
<p>Number Theory: The Euclidean Algorithm, Modular Arithmetic, Fermat's and Euler's Theorems, The Chinese Remainder Theorem, Discrete Logarithms,</p> <p>Finite Fields: Finite Fields of the Form GF(p), Finite Fields of the Form GF(2ⁿ)</p> <p>Public Key Cryptography: Principles, Public Key Cryptography Algorithms, RSA Algorithm, Diffie Hellman Key Exchange, Elliptic Curve Cryptography.</p>		
UNIT - III		9 Hrs
<p>Cryptographic Hash Functions: Application of Cryptographic Hash Functions, Requirements & Security, Secure Hash Algorithm, Message Authentication Functions, Requirements & Security, HMAC & CMAC.</p> <p>Digital Signatures: NIST Digital Signature Algorithm, Distribution of Public Keys, X.509 Certificates, Public- Key Infrastructure</p>		
UNIT - IV		9 Hrs
<p>User Authentication: Remote User Authentication Principles, Kerberos. Electronic Mail Security: Pretty Good Privacy (PGP) And S/MIME.</p> <p>IP Security: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange.</p>		
UNIT - V		9 Hrs
<p>Transport Level Security: Web Security Requirements, Transport Layer Security (TLS), HTTPS, Secure Shell (SSH)</p> <p>Fire walls: Fire wall Character is tics and Access Policy, Types of Fire walls, Fire wall Location and Configurations.</p> <p>Textbooks:</p>		

Cryptography and Network Security – William Stallings, Pearson Education, 8th Edition.
 Cryptography, Network Security and Cyber Laws–Bernard Menezes, Cengage Learning, 2010 edition.

Reference Books:

1. Cryptography and Network Security-BehrouzA Forouzan, Debdeep Mukhopadhyaya, McGraw Hill, 3rd Edition, 2015.
2. Network Security Illustrated, Jason Albanese and Wes Sonnenreich, MGH Publishers, 2003.

Online Learning Resources:

1. <https://nptel.ac.in/courses/106/105/106105031/lecture>
2. [https://nptel.ac.in/courses/106/105/106105162/lecturebyDr.SouravMukhopadhyayIITKharagpur\[VideoLecture\]](https://nptel.ac.in/courses/106/105/106105162/lecturebyDr.SouravMukhopadhyayIITKharagpur[VideoLecture])
3. <https://www.mitel.com/articles/web-communication-cryptography-and-network-security> web articles by Mitel Power Connections

Mapping of course outcomes with program outcomes

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

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

Correlation matrix

Unit No.	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)
	Lesson plan(Hrs)	%							
1	9	20%		2	CO1:Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	9	20%		2	CO2 : Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO6 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3) PO6: Thumb rule PO11: Thumb rule	3 3 3 3 3 3 3
3	9	20%		2	CO3 : Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO7 PO8 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO4: Analyze(L4) PO5:	3 3 3 3 3 3 3 3

							Apply(L3) PO7: Thumb rule PO8: Thumb rule PO11: Thumb rule	
4	9	20 %	2	CO4 : Apply	L3	PO1 PO2 PO7	PO1: Apply(L3) PO2: Review(L2) PO7: Thumb rule	3 3 2
5	9	20 %	2	CO5 :Analyze	L4	PO2 PO3 PO4 PO5 PO7 PO8 PO11	PO2: Review(L2) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3) PO7: Thumb rule PO8: Thumb rule PO11: Thumb rule	3 3 3 3 3 3
	45	100 %						

Justification Statements :

CO1: **Understand** the basic Security and Cryptography concepts and techniques

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 : Review(L2)

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

CO2: **Analyze** the various cryptography algorithms for data encryption

Action Verb : Analyze (L4)

PO1: Apply(L3)

CO2 Action verb is greater than 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)

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

PO5: Apply(L3)

CO2 Action verb is greater than PO5 verb .Therefore the correlation is high (3)

PO6: Thumb rule

For some of Security applications, Various Cryptographic algorithms were applied for societal needs. Therefore, the correlation is high(3)

PO11: Thumb rule

For some of Security applications, Various Cryptographic algorithms were analyzed. Therefore the correlation is high(3)

CO3: **Analyze** the different MAC and HASH algorithms to authenticate a message.

Action Verb : Analyze (L4)

PO1: Apply(L3)

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

PO2: Review(L2)

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

PO3: Develop(L3)

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

PO4: Analyze (L4)

CO3 Action verb is same as PO2 verb. Therefore the correlation is high(3)

PO5: Apply(L3)

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

PO7 : Thumb rule

Since ethical principles should be followed to while authenticating a message. Therefore the correlation is high(3)

PO8 : Thumb rule

Team work is required between client and server to perform authentication. Hence the correlation is high(3)

PO11 : Thumb rule

For some of Security applications, Various Cryptographic algorithms were analysed. Therefore the correlation is high(3)

CO4: Apply the various security mechanisms for Email and IP security.

Action Verb : Apply(L3)

PO1: Apply(L3)

CO4 Action verb is same level as 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)

PO7: Thumb rule

Since ethical principles shall be followed in maintaining IP Security. Therefore the correlation is medium(2)

CO5: Analyze the various security breaches in real world applications.

Action Verb : Analyze (L4)

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 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)

PO7 : Thumb rule

Since ethical principles should be followed to analyze the security breaches. Therefore the correlation is high(3)

PO8 : Thumb rule

Team work is required between client and server to secure the data. Hence the correlation is high(3)

PO11 : Thumb rule

For some of Security applications, Various Cryptographic algorithms were analysed. Therefore the correlation is high(3)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Computer Networks (Professional Elective-II)	L	T / CLC	P	C
23APE3207	III-II		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: **Understand** the fundamental concepts of computer networks and the Internet, including network edge/core, packet-switched networks, reference models, and transmission media.

CO2: **Analyze** the design issues and protocols of the data link layer, including error detection, correction, and multiple access techniques used in local area networks (LANs) and access networks.

CO3: **Evaluate** routing algorithms and the principles of internetworking within the network layer, with a focus on their implementation in the Internet.

CO4: **Apply** the principles of connectionless and connection-oriented transport protocols, including UDP, TCP, and congestion control mechanisms in network communication.

CO5: **Understand** the principles behind common network applications, including web services (HTTP), email, DNS, peer-to-peer applications, and content distribution networks.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The fundamental concepts of computer networks and the Internet, including network edge/core, packet-switched networks, reference models, and transmission media.			L2
CO2	Analyze	The design issues and protocols of the data link layer, including error detection, correction, and multiple access techniques.	By examining protocols and link layer models		L4
CO3	Evaluate	Routing algorithms and the principles of internetworking within the network layer, with focus on Internet implementation.		To explore the functioning of the network layer	L5
CO4	Apply	Principles of connectionless and connection-oriented transport protocols, including UDP, TCP, and congestion control mechanisms.			L3
CO5	Understand	Principles behind common network applications, including web services (HTTP), email, DNS, peer-to-peer applications, and content distribution networks.			L2

UNIT - I	Computer Networks and the Internet	8 Hrs
What Is the Internet? The Network Edge, The Network Core, Delay, Loss, and Throughput in Packet Switched Networks(Textbook 2) Reference Models, Example Networks, Guided Transmission Media, Wireless Transmission (Textbook 1)		
UNIT - II	The Data Link Layer, Access Networks, and LANs	10 Hrs

Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols (Textbook 1)		
Introduction to the Link Layer, Error-Detection and -Correction Techniques, Multiple Access Links and Protocols, Switched Local Area Networks Link Virtualization: A Network as a Link Layer, Data Center Networking, Retrospective: A Day in the Life of a Web Page Request (Textbook 2)		
UNIT - III	The Network Layer	8 Hrs
Routing Algorithms, Internetworking, The Network Layer in The Internet (Textbook 1)		
UNIT - IV	The Transport Layer	9 Hrs
Connectionless Transport: UDP (Textbook 2)		
The Internet Transport Protocols: TCP, Congestion Control (Textbook 1)		
UNIT - V	Principles of Network Applications	8 Hrs
Principles of Network Applications Lecture 8Hrs Principles of Network Applications, The Web and HTTP, Electronic Mail in the Internet, DNS—The Internet's Directory Service, Peer-to-Peer Applications Video Streaming and Content Distribution Networks (Textbook 2)		
Textbooks:		
1.Andrew S.Tanenbaum, David j.wetherall, Computer Networks, 6th Edition, PEARSON.		
2.James F. Kurose, Keith W. Ross, –Computer Networking: A Top-Down Approach , 6th edition, Pearson, 2019.		
3. Bruce S. Davie and Larry L. Peterson, Computer Networks: A Systems Approach,4 TH Edition,Elsevier 2007.		
Reference Books:		
1.Forouzan, Datacommunications and Networking, 5th Edition, McGraw Hill Publication.		
2.Youlu Zheng, Shakil Akthar, –Networks for Computer Scientists and Engineers , Oxford Publishers, 2016.		
Online Learning Resources:		
1. https://nptel.ac.in/courses/106105183/25		
2. http://www.nptelvideos.in/2012/11/computer-networks.html		
3. https://nptel.ac.in/courses/106105183/3		

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					2	2		
CO2	3	3	2	2	3			3		3	3	2	
CO3	3	3	3	3	3	3	3	3	3		3	3	2
CO4	3	3	2	2	3			2		2	2		
CO5	3	3	3	2	3	3	3	3	3	3	3	3	3

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

Correlation matrix

Unit No.	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)
	Lesson plan(Hrs)	%						
1	8	18%	2	Understand	L2	PO1 PO2 PO5 PO10	PO1: Apply (L3) PO2: Review (L2) PO5: Apply (L3) PO10: Thumb rule	3 2 2 2
2	10	24%	3	Analyse	L4	PO1 PO2 PO3 PO4 PO5 PO8 PO11	PO1: Apply (L3) PO2: Analyse (L4) PO3: Design (L3) PO4: Analyse (L4) PO5: Apply (L3) PO8: Thumb rule PO11: Thumb rule	3 3 2 2 3 3 3

3	8	18%	2	Evaluate	L5	PO1	PO1: Apply (L3)	3
						PO2	PO2: Analyse (L4)	3
						PO3	PO3: Design (L3)	3
						PO4	PO4: Analyse (L4)	3
						PO5	PO5: Apply (L3)	3
						PO6	PO6: Thumb rule	3
						PO7	PO7: Thumb rule	3
						PO8	PO8: Thumb rule	3
						PO9	PO9: Thumb rule	3
						PO11	PO11: Thumb rule	3
						4	9	22%
PO2	PO2: Analyse (L4)	3						
PO3	PO3: Design (L3)	2						
PO4	PO4: Analyse (L4)	2						
PO5	PO5: Apply (L3)	3						
PO8	PO8: Thumb rule	2						
PO11	PO11: Thumb rule	2						
5	8	18%	2	Analyse	L4	PO1	PO1: Apply (L3)	3
						PO2	PO2: Analyse (L4)	3
						PO3	PO3: Design (L3)	3
						PO4	PO4: Analyse (L4)	2
						PO5	PO5: Apply (L3)	3
						PO6	PO6: Thumb rule	3
						PO7	PO7: Thumb rule	3
						PO8	PO8: Thumb rule	3
						PO9	PO9: Thumb rule	3
						PO10	PO10: Thumb rule	3
						PO11	PO11: Thumb rule	3
	43	100 %						

Justification Statements :

CO1: Understand the fundamental concepts of computer networks and the Internet

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)

PO5: Apply (L3)

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

PO10: Thumb rule

CO1 supports effective communication in documentation and presentation. Therefore, the correlation is medium (2)

CO2: Analyze the design issues and protocols of the data link layer

Action Verb: Analyze (L4)

PO1: Apply (L3)

CO2 Action verb is greater than PO1 verb by one level. Therefore, the correlation is high (3)

PO2: Analyze (L4)

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

PO3: Design (L3)

CO2 Action verb is greater than PO3 verb by one level. Therefore, the correlation is medium (2)

PO4: Analyze (L4)

CO2 Action verb is same level as PO4 verb. Therefore, the correlation is medium (2)

PO5: Apply (L3)

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

PO8: Team Work (L3)

CO2 includes teamwork in LAN/protocol analysis. Therefore, the correlation is high (3)

PO11: Thumb rule

CO2 Action verb is greater than PO11 verb by one level. Therefore, the correlation is high (3)

CO3: Evaluate routing algorithms and internetworking principles

Action Verb: Evaluate (L5)

PO1: Apply (L3)

CO3 Action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3)

PO2: Analyze (L4)

CO3 Action verb is greater than PO2 verb by one level. Therefore, the correlation is high (3)

PO3: Design (L3)

CO3 Action verb is greater than PO3 verb by two levels. Therefore, the correlation is high (3)

PO4: Analyze (L4)

CO3 Action verb is greater than PO4 verb by one level. Therefore, the correlation is high (3)

PO5: Apply (L3)

CO3 Action verb is greater than PO5 verb by two levels. Therefore, the correlation is high (3)

PO6: Thumb rule

CO3 Action verb is greater than PO6 verb by one level. Therefore, the correlation is high (3)

PO7: Thumb rule

CO3 involves routing decisions with ethical implications. Therefore, the correlation is high (3)

PO8: Thumb rule

CO3 requires collaboration in simulations. Therefore, the correlation is high (3)

PO9: Thumb rule

CO3 supports communication through evaluation reports. Therefore, the correlation is high (3)

PO11: Thumb rule

CO3 supports life-long learning in evolving protocols. Therefore, the correlation is high (3)

CO4: Apply transport protocols including TCP and UDP

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 high (3)

PO3: Design (L3)

CO4 Action verb is same level as PO3 verb. Therefore, the correlation is medium (2)

PO4: Analyze (L4)

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

PO5: Apply (L3)

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

PO8: Thumb rule

CO4 involves simulation teamwork. Therefore, the correlation is medium (2)

PO11: Thumb rule

CO4 helps in adapting tools. Therefore, the correlation is medium (2)

CO5: Analyze the principles behind network applications

Action Verb: Analyze (L4)

PO1: Apply (L3)

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

PO2: Analyze (L4)

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

PO3: Design (L3)

CO5 Action verb is greater than PO3 verb by one level. Therefore, the correlation is high (3)

PO4: Analyze (L4)

CO5 Action verb is same level as PO4 verb. Therefore, the correlation is medium (2)

PO5: Apply (L3)

CO5 Action verb is greater than PO5 verb by one level. Therefore, the correlation is high (3)

PO6: Thumb rule

CO5 considers societal/ethical impact. Therefore, the correlation is high (3)

PO7: Thumb rule

CO5 involves ethical aspects in application use. Therefore, the correlation is high (3)

PO8: Thumb rule

CO5 requires teamwork for application development. Therefore, the correlation is high (3)

PO9: Thumb rule

CO5 involves communication in web/email protocols. Therefore, the correlation is high (3)

PO10: Thumb rule

CO5 requires planning and management. Therefore, the correlation is high (3)

PO11: Thumb rule

CO5 supports emerging applications and life-long learning. Therefore, the correlation is high (3)

AIITS TPT-CSE(CS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (CSE)**

Course Code	Year & Sem	Recommender systems (Professional Elective-II)	L	T / CLC	P	C
23APE3208	III-II			2	1	0

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the core concepts of recommender systems and neighborhood-based filtering methods.

CO2: Apply model-based and content-based recommendation techniques to solve domain-specific problems.

CO3: Analyze knowledge-based, hybrid, and ensemble models for effective recommendations.

CO4: Evaluate recommender systems using accuracy metrics and context-aware evaluation techniques.

CO5: Design time - and location-aware recommender systems for personalized user experiences.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's Level
CO1	Understand	The core concepts of recommender systems and neighborhood-based filtering methods			L2
CO2	Apply	Model-based and content-based recommendation techniques		to solve domain-specific problems	L3
CO3	Analyze	Knowledge-based, hybrid, and ensemble recommender models		for effective recommendations	L4
CO4	Evaluate	recommender systems using accuracy metrics and context-aware evaluation techniques			L5
CO5	Design	Time- and location-aware recommender systems		for personalized user experiences	L6

UNIT - I	8 Hrs
An Introduction to Recommender Systems, Neighborhood-Based Collaborative Filtering	
Introduction, Goals of Recommender Systems, Basic Models of Recommender Systems, Domain Specific Challenges in Recommender Systems. Advanced Topics and Applications. Introduction, Key Properties of Ratings Matrices, Predicting Ratings with Neighborhood- Neighborhood-Based Collaborative Filtering: Based Methods, Clustering and Neighborhood-Based Methods, Dimensionality Reduction and Neighborhood Methods, Graph Models for Neighborhood-Based Methods, A Regression Modelling View of Neighborhood Methods.	
UNIT - II	9 Hrs
Model-Based Collaborative Filtering, Content-Based Recommender Systems	
Introduction, Decision and Regression Trees, Rule-Based Collaborative Filtering, Naive Bayes Collaborative Filtering, Using an Arbitrary Classification Model as a Black-Box, Latent Factor Models, Integrating Factorization and Neighborhood Models. Content-Based Recommender Systems: Introduction, Basic	

Components of Content-Based Systems, Preprocessing and Feature Extraction, Learning User Profiles and Filtering, Content-Based Versus Collaborative Recommendations, Using Content-Based Models for Collaborative Filtering, Summary.

UNIT - III 9 Hrs

Knowledge-Based Recommender Systems, Ensemble Based and Hybrid Recommender Systems

Introduction, Constraint-Based Recommender Systems, Case-Based Recommenders, Persistent Personalization in Knowledge-Based Systems, Summary. Introduction, Ensemble Methods from the Classification Perspective, Weighted Hybrids, Switching Hybrids, Cascade Hybrids, Feature Augmentation Hybrids, Meta-Level Hybrids, Feature Combination Hybrids, Summary.

UNIT - IV 8 Hrs

Evaluating Recommender Systems, Context-Sensitive Recommender Systems

Introduction, Evaluation Paradigms, General Goals of Evaluation Design, Design Issues in Offline Recommender Evaluation, Accuracy Metrics in Offline Evaluation, Limitations of Evaluation Measures, Limitations of Evaluation Measures. Introduction, The Multidimensional Approach, Contextual Pre filtering: A Reduction-Based Approach, Contextual Pre-filtering: A Reduction-Based Approach, Contextual Modelling.

UNIT - V 8 Hrs

Time- and Location-Sensitive Recommender Systems

Introduction, Temporal Collaborative Filtering, Discrete Temporal Models, Location-Aware Recommender Systems, Location-Aware Recommender Systems Location-Aware Recommender Systems, Summary.

Textbooks:

1. Charu C. Aggarwal, "Recommender Systems", Springer, 2016..

Reference Books:

1. Francesco Ricci, Lior Rokach, "Recommender Systems Handbook", 2nd ed., Springer, 2015 Edition

Online Learning Resources:

1. Recommendation System -Understanding The Basic Concepts (analyticsvidhya.com)
2. Recommender Systems | Coursera

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								2
CO3	3	3		3	3			3				2	
CO4	3		3	3									2
CO5	3		3	3		3	3				3	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	8	19%	2	CO1 : Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Identify(L3)	2 2
2	9	22%	3	CO2 : Apply	L3	PO1 PO2 PO5	PO1: Apply(L3) PO2: Identify(L3) PO5: Apply(L3)	3 3 3
3	9	22%	3	CO3 : Analyze	L4	PO1 PO2 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO4: PO5:	3 3 3 3

						PO8	Analyze(L4) PO5:Apply(L3) PO8: Thumb rule	3
4	8	19%	2	CO4 : Evaluate	L5	PO1 PO3 PO4	PO1: Apply (L3) PO3: Develop (L3) PO4: Interpret(L5)	3 3 3
5	8	19%	2	CO5 : Design	L6	PO1 PO3 PO4 PO6 PO7 PO11	PO1: Formulate(L6) PO3: Design (L6) PO4: Analyze(L4) PO6: Thumb rule PO7: Thumb rule PO11: Thumb rule	3 3 3 3 3
	42	100%						

Justification Statements :

CO1: Understand the core concepts of recommender systems and neighborhood-based filtering methods.

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 model-based and content-based recommendation techniques to solve domain-specific problems.

Action Verb : Apply(L3)

PO1: Apply(L3)

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

PO2: Identify(L3)

CO2 Action verb is same as PO2 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: Analyze knowledge-based, hybrid, and ensemble models for effective recommendations.

Action Verb : Analyze (L4)

PO1: Apply(L3)

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

PO2: Identify (L3)

CO3 Action verb is greater than PO2 verb by one level. Therefore the correlation is high (3)

PO4: Analyze (L4)

CO3 Action verb is same level as PO4 verb. Therefore the correlation is high (3)

PO5: Apply(L3)

CO3 Action verb is greater than PO5 verb by one level. Therefore the correlation is high (3)

PO8: Thumb rule

Finding solution to real world problems. Hence the correlation is high (3)

CO4: Evaluate recommender systems using accuracy metrics and context-aware evaluation techniques. Action Verb: Evaluate(L5)

PO1 Verb : Apply(L3)

CO1 Action verb is greater than PO1 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: Interpret (L5)

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

CO5: Design time - and location-aware recommender systems for personalized user experiences.

Action Verb : Design (L6)

PO1: Formulate (L6)

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

PO3: Design (L6)

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

PO4: Analyze (L4)

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

PO6 : Thumb rule

Since ethical principles should be followed to create a recommender systems and services to users. Therefore the correlation is high (3)

PO7: Thumb rule

Team work is required between recommender system users and providers. Hence the correlation is high (3)

PO11: Thumb rule

For some of real world applications we use recommender systems to provide services. Therefore the correlation is high (3)

AIATS TPT-CSE(DS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Deep Learning (Professional Elective-II)	L	T / CLC	P	C
23APE3209	III-II		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: **Understand** the concepts of linear algebra and probability to structure the data

CO2: **Understand** the foundations of neural networks and deep learning to build learning models

CO3: **Analyze** the common architecture principles of deep networks to make intelligent model.

CO4: **Apply** the CNN models for image classification and object recognition tasks

CO5: **Analyze** the deep generating models to facilitate efficient model training.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the concepts of linear algebra and probability		to structure the data	L2
CO2	Understand	the foundations of neural networks and deep learning		to build learning models	L2
CO3	Analyze	the common architecture principles of deep networks		to make intelligent model	L4
CO4	Apply	the CNN models		for image classification and object recognition tasks	L3
CO5	Analyze	The deep generating models		to facilitate efficient model training	L4

UNIT - I	8 Hrs
<p>Linear Algebra: Scalars, Vectors, Matrices and Tensors, Matrix operations, types of matrices, Norms, Eigen decomposition, Singular Value Decomposition, Principal Components Analysis.</p> <p>Probability and Information Theory: Random Variables, Probability Distributions, Marginal Probability, Conditional Probability, Expectation, Variance and Covariance, Bayes' Rule, Information Theory.</p> <p>Numerical Computation: Overflow and Underflow, Gradient-Based Optimization, Constrained Optimization, Linear Least Squares.</p>	
UNIT - II	9 Hrs
<p>Machine Learning: Basics and Under fitting, Hyper parameters and Validation Sets, Estimators, Bias and Variance, Maximum Likelihood, Bayesian Statistics, Supervised and Unsupervised Learning, Stochastic Gradient Descent, Challenges Motivating Deep Learning.</p> <p>Deep Feed forward Networks: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and other Differentiation Algorithms.</p>	
UNIT - III	8 Hrs
<p>Regularization for Deep Learning: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training, Tangent Distance, Tangent Prop and Manifold Tangent Classifier.</p> <p>Optimization for Training Deep Models: Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms.</p>	
UNIT - IV	9 Hrs

Convolutional Networks: The Convolution Operation, Pooling, Convolution, Basic Convolution Functions, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, Basis for Convolutional Networks

UNIT - V **Deep Generating Models** **8 Hrs**

Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, Echo State Networks, LSTM, Gated RNNs, Optimization for Long-Term Dependencies, Auto encoders, Deep Generative Models.

Textbooks:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, –Deep Learning, MIT Press, 2016.
2. Josh Patterson and Adam Gibson, –Deep learning: A practitioner's approach, O'Reilly Media, First Edition, 2017.

Reference Books:

1. Fundamentals of Deep Learning, Designing next-generation machine intelligence algorithms, Nikhil Buduma, O'Reilly, Shroff Publishers, 2019.
2. Deep learning Cook Book, Practical recipes to get started Quickly, Douwe Osinga, O'Reilly, Shroff Publishers, 2019.

Online Learning Resources:

1. <https://keras.io/datasets/>
2. <http://deeplearning.net/tutorial/deeplearning.pdf>
3. <https://arxiv.org/pdf/1404.7828v4.pdf>
4. <https://www.cse.iitm.ac.in/~miteshk/CS7015.html>
5. <https://www.deeplearningbook.org>
6. <https://nptel.ac.in/courses/106105215>

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	2	3				2					2		2
CO3	3	3	3	3	3	3					3		
CO4	3	3									2	3	
CO5	3	3	3	3	3						3		2

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

Correlation matrix

Unit No.	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)
	Lesson plan(Hrs)	%							
1	8	19%		2	CO1: Understand	L2	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review(L2) PO11: Thumb rule	2 3 2
2	9	21%		3	CO2: Understand	L2	PO1 PO2 PO6 PO11	PO1: Apply(L3) PO2: Review(L2) PO6: Thumb rule PO11: Thumb rule	2 3 2 2

3	8	19 %	2	CO3:Analyse	L4	PO1 PO2 PO3 PO4 PO5 PO6 PO11	PO1: Apply(L3) PO2: Analyze(L 4) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule PO11: Thumb rule	3 3 3 3 3 3 3
4	9	21 %	3	CO4: Apply	L3	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review(L2) PO11: Thumb rule	3 3 2
5	8	19 %	2	CO5: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply(L3) PO2: Analyze(L 4) PO3: Develop(L 3) PO4: Analyze (L4) PO5: Apply(L3) PO11: Thumb rule	3 3 3 3 3
	42	100 %						

Justification Statements :

CO1: understand the concepts of linear algebra and probability to structure 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 as PO2 verb. Therefore the correlation is High (3)

PO11: Thumb rule

New statistical methods were derived and applied to solve various problems related to Deep Learning. Therefore the correlation is medium (2)

CO2: Understand the foundations of neural networks and deep learning to build learning models

Action Verb : Understand (L2)

PO1: Apply(L3)

CO2 Action verb is less than PO1 verb by one level. Therefore, the correlation is Moderate (2)

PO2: Review(L2)

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

PO6: Thumb rule

New innovations with more complex and layered neural networks are applied to address the various societal needs related to Deep Learning applications. Therefore the correlation is medium (2)

PO11: Thumb rule

New innovations with more complex and layered neural networks are derived to address the issues present in new trends of data. Therefore the correlation is medium (2)

CO3: Analyze the common architecture principles of deep networks to make intelligent model.

Action Verb : Analyze (L4)

PO1: Apply(L3)

CO3 Action verb is greater level of PO1 verb. Therefore, the correlation is High (3)

PO2: Analyze (L4)

CO3 Action verb is Same level as PO2 verb. Therefore, the correlation is High (3)

PO3: Develop (L3)

CO3 Action verb is greater level than PO3 verb by one level. Therefore the correlation is High(3)

PO4: Analyze (L4)

CO3 Action verb is same as PO4 verb. Therefore the correlation is High(3)

PO5: Apply(L3)

CO3 Action verb is less than PO5 verb by one level. Therefore the correlation is High(3)

PO6 : Thumb rule

New versions of architecture principles of deep networks were applied to address the societal needs. Therefore, the correlation is high(3)

PO11: Thumb rule

New innovations with more complex and layered deep networks are derived to address issues present in data set. Therefore the correlation is high(3)

CO4: Apply the CNN models for image classification and object recognition tasks

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 less than PO2 verb by one level. Therefore the correlation is High (3)

PO11: Thumb rule

New research models are derived to address issues present in data set. Therefore the correlation is medium (2)

CO5: Analyze the deep generating models to facilitate efficient model training.

Action Verb : Analyze(L4)

PO1: Apply(L3)

CO5 Action verb is greater than PO1 verb by one level. Therefore the correlation is High (3)

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 one level as PO3 verb. Therefore the correlation is High (3)

PO4: Analyze (L4)

CO5 Action verb is same as PO4 verb. Therefore the correlation is High(2)

PO5: Apply(L3)

CO5 Action verb is greater than PO5 verb by one level. Therefore the correlation is High(2)

PO11: Thumb rule

New sets of generative models are derived to address issues present in data set. Therefore the correlation is high(3)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Software Project Management (Professional Elective-III)	L	T / CLC	P	C
23APE3210	III-II		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the purpose and importance of project management

CO2: Analyze the phases and process of software project management life cycle

CO3: Analyze process workflows and responsibilities

CO4: Analyze automation tools, process metrics, and team management strategies to determine their impact on controlling and tailoring software project processes.

CO5: Apply process control and instrumentation for CCPDS-R

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the purpose and importance of project management			L2
CO2	Analyze	the phases and process of software management life cycle			L4
CO3	Analyze	process workflows and responsibilities			L4
CO4	Analyze	automation tools, process metrics, and team management strategies		to determine their impact on controlling and tailoring software project processes.	
CO5	Apply	process control and instrumentation		for CCPDS-R	L3

UNIT - I	9 Hrs
<p>Conventional Software Management: The water fall model, conventional software Management performance Evolution of Software Economics: software Economics. Pragmatic Software Cost Estimation Improving Software Economics: Reducing Software Product Size, Improving Software Processes, Improving Team Effectiveness, Improving Automation, Achieving Required Quality ,Peer Inspections.</p>	
UNIT - II	9Hrs
<p>The old way and the new: The principles of convention al software Engineering, principles of modern software management, transitioning to aniter ative process. Lifecycle phases: Engineering and production stages, inception, Elaboration, construction, transition phases. Artifacts of the process: The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts</p>	
UNIT - III	9 Hrs
<p>Work Flows of the process: Software process work flows, Inter Trans work flows.Check points of the Process: Major Mile Stones, Minor Milestones, Periodic status assessments. Iterative Process Planning: work break down structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning</p>	
UNIT - IV	9 Hrs
<p>Process Automation: Automation Building Blocks, The Project Environment. Project Control and Process instrumentation: The sevenscore Metrics, Management indicators, quality indicators Tailoring the Process: Process discriminants. Managing people and organizing teams.</p>	
UNIT - V	9 Hrs

Project Organizations and Responsibilities: Line - of-Business Organizations, Project Organizations, evolution of Organizations.
Future Software Project Management: modern Project Profiles, Next generation Software economics, modern process transitions.
Case Study: The Command Center Processing and Display System-Replacement(CCPDS-R)
Textbooks:
1. Software Project Management, Walker Royce,Pearson Education,2012
2. BobHughes, MikeCotterellandRajibMall—SoftwareProjectManagement ,6thEdition, Mc Graw Hill Edition, 2017
Reference Books:
1. PankajJalote,—SoftwareProjectManagementinpractice ,5thEdition,PearsonEducation, 2017.
2. Murali K.Chemuturi,Thomas M.Cagley Jr. Mastering Software Project Management: Best Practices, Tools and Techniques , J.Ross Publishing, 2010
3. SanjayMohapatra,—SoftwareProjectManagement ,CengageLearning,2011
Online Learning Resources:
1. http://nptel.ac.in/courses/106101061/29

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	2	2						3		3			
CO3	2	2		3				3		3			
CO4	2	2		3									
CO5	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	9	20%	2	CO1 :Understand	L2	PO1 PO10	PO1: Apply(L3) PO10: Thumb rule	2 2
2	9	20%	2	CO2 : Analyze	L4	PO1 PO2 PO8 PO10	PO1: Apply(L3) PO2: Identify (L3) PO8: Thumb rule PO10: Thumb rule	3 3 3 3
3	9	20%	2	CO3 : Analyze	L4	PO1 PO2 PO4 PO8 PO10	PO1: Apply(L3) PO2: Identify (L3) PO4: Analyze (L4) PO8: Thumb rule PO10: Thumb rule	3 3 3 3 3
4	9	20%	2	CO4 : Analyze	L4	PO1 PO2 PO4	PO1: Apply(L3) PO2: Identify (L3) PO4: Analyze (L4)	3 3 3

5	9	20%	2	CO5 : Apply	L3	PO1 PO2 PO4 PO10	PO1: Apply(L3) PO2: Identify (L3) PO4: Analyze (L4) PO10: Thumb rule	3 3 2 2
	45	100 %						

Justification Statements :

CO1: Understand the purpose and importance of project management

Action Verb: Understand (L2)

PO1: Apply(L3)

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

PO10: Thumb rule

To understand the purpose and importance of project management, knowledge on projects and management principles are required. Therefore the correlation is medium (2)

CO2: Analyze the phases and process of software project management life cycle

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)

PO8: Thumb rule

To analyze the phases and process of software project management life cycle, teamwork and individual performance is required. Therefore the correlation is high (3)

PO10: Thumb rule

To analyze the phases and process of software project management life cycle, knowledge on projects and management principles are required. Therefore the correlation is high (3)

CO3: Analyze process workflows and responsibilities

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 is more than PO2 verb. Therefore the correlation is high (3)

PO4: Analyze (L4)

CO3 Action verb is same as PO4 verb. Therefore the correlation is high (3)

PO8: Thumb rule

To analyze process workflows and responsibilities, teamwork and individual performance is required. Therefore the correlation is high(3).

PO10: Thumb rule

To analyze process workflows and responsibilities, knowledge on projects and management principles are required. Therefore the correlation is high(3).

CO4: Analyze automation tools, process metrics, and team management strategies to determine their impact on controlling and tailoring software project processes.

Action Verb : Analyze(L4)

PO1: Apply(L3)

CO4 Action verb is more than PO1 verb. Therefore the correlation is high (3)

PO2: Identify (L3)

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

PO4: Analyze (L4)

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

CO5: Apply process control and instrumentation for CCPDS-R

Action Verb : Apply (L3)

PO1: Apply(L3)

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

PO2: Identify (L3)

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

PO4: Analyze (L4)

CO5 Action verb is less than PO4 verb by one level. Therefore the correlation is medium (2)

PO10: Thumb rule

To apply process control and instrumentation for CCPDS-R, knowledge on projects and management principles are required. Therefore the correlation is medium (2).

AIITS TPT-CSE(ODS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Quantum Computing (Professional Elective-III)	L	T / CLC	P	C
23APE3211	III-II		2	1	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: **Understand** the basics of linear algebra and complex numbers to define complex quantum systems.

CO2: **Analyze** various physical implementations of qubits for designing quantum computing systems.

CO3: **Analyze** Quantum architecture and hardware to leverage quantum mechanics for computation

CO4: **Apply** the Quantum algorithms to perform parallel computations on all possible inputs

CO5: **Understand** quantum attacks on cryptosystems to secure computer system.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	basics of linear algebra and complex numbers		to define complex quantum systems	L2
CO2	Analyze	various physical implementations of qubits		for designing quantum computing systems	L4
CO3	Analyze	Quantum architecture and hardware		to leverage quantum mechanics for computation	L4
CO4	Apply	the Quantum algorithms to perform parallel computations on all possible inputs		to create interactive and dynamic dashboards.	L3
CO5	Understand	quantum attacks on cryptosystems		to secure computer system	L2

UNIT - I	8 Hrs
Introduction to Essential Linear Algebra: Some Basic Algebra, Matrix Math, Vectors and Vector Spaces, Set Theory.	
Complex Numbers: Definition of Complex Numbers, Algebra of Complex Numbers, Complex Numbers Graphically, Vector Representations of Complex Numbers, Pauli Matrices, Transcendental Numbers	
UNIT - II	9 Hrs
Basic Physics for Quantum Computing: The Journey to Quantum, Quantum Physics Essentials, Basic Atomic Structure, Hilbert Spaces, Uncertainty, Quantum States, Entanglement	
Basic Quantum Theory: Further with Quantum Mechanics, Quantum Decoherence, Quantum Electrodynamics, Quantum Chromodynamics, Feynman Diagram Quantum Entanglement and QKD, Quantum Entanglement, Interpretation, QKE.	
UNIT - III	8 Hrs
Quantum Architecture: Further with Qubits, Quantum Gates, More with Gates, Quantum Circuits, The Wave Quantum Architecture.	
Quantum Hardware: Qubits, How Many Qubits Are Needed? Addressing Decoherence, Topological Quantum Computing, Quantum Essentials.	
UNIT - IV	9 Hrs

Quantum Algorithms: What Is an Algorithm? Deutsch's Algorithm, Deutsch-Jozsa Algorithm, Bernstein-Vazirani Algorithm, Simon's Algorithm, Shor's Algorithm, Grover's Algorithm.

UNIT - V **8 Hrs**

Current Asymmetric Algorithms: RSA, Diffie-Hellman, Elliptic Curve The Impact of **Quantum Computing on Cryptography:** Asymmetric Cryptography, Specific Algorithms, Specific Applications

Textbooks:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press
2. Dr. Chuck Easttom, Quantum Computing Fundamentals, Pearson

Reference Books:

1. Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci
2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. Basic Concepts, Vol
3. Basic Tools and Special Topics, World Scientific. Pittenger A. O., An Introduction to Quantum Computing Algorithms

Online Learning Resources:

<https://www.coursera.org/learn/quantum-computing-for-everyone-an-introduction>

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	3	3	3							2	
CO3	3	3	3	3	3		3				3		3
CO4	3	3					2					3	
CO5		3	2	3	2			2					2

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

Correlation matrix

Unit No.	CO			Co's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation					
1	8	19%	2	CO1:Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	9	21%	3	CO2 : Analyze	L4	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
3	8	19%	2	CO3 : Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO7 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3) PO7: Thumb rule PO11: Thumb rule	3 3 3 3 3 3 3

4	9	21%	3	CO4 : Apply	L3	PO1 PO2 PO7	PO1: Apply(L3) PO2: Review(L2) PO7: Thumb rule	3 3 2
5	8	19%	2	CO5:Understand	L2	PO2 PO3 PO4 PO5 PO8	PO2: Review(L2) PO3: Develop(L3) PO4: Interpret(L2) PO5: Apply(L3) PO8: Thumb rule	3 2 3 2 2
	42	100%						

Justification Statements :

CO1: **Understand** basics of linear algebra and complex numbers to define complex quantum 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 : Review(L2)

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

CO2: **Analyze** various physical implementations of qubits for designing quantum computing systems.

Action Verb : Analyze (L4)

PO1: Apply(L3)

CO2 Action verb is greater than 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)

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

PO5: Apply(L3)

CO2 Action verb is greater than PO5 verb .Therefore the correlation is high (3)

CO3: **Analyze** Quantum architecture and hardware to leverage quantum mechanics for computation

Action Verb : Analyze (L4)

PO1: Apply(L3)

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

PO2: Review(L2)

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

PO3: Develop(L3)

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

PO4: Analyze (L4)

CO3 Action verb is same as PO2 verb. Therefore the correlation is high(3)

PO5: Apply(L3)

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

PO7 : Thumb rule

Since ethical principles should be followed to while authenticating a message. Therefore the correlation is high (3)

PO11: Thumb rule

For some of Security applications, Various Quantum algorithms were analyzed. Therefore the correlation is high (3)

CO4: Apply the Quantum algorithms to perform parallel computations on all possible inputs

Action Verb : Apply(L3)

PO1: Apply(L3)

CO4 Action verb is same level as 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)

PO7: Thumb rule

Since ethical principles shall be followed in maintaining IP Security. Therefore the correlation is moderate(2)

CO5: Understand quantum attacks on cryptosystems to secure computer system.

Action Verb : Understand (L2)

PO2: 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 PO3 verb by one level. Therefore the correlation is moderate (2)

PO4: Interpret (L2)

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

PO5: Apply(L3)

CO5 Action verb is less than PO5 verb by one level. Therefore the correlation is moderate (2)

PO8: Thumb rule

Team work is required between client and server to secure the data. Hence the correlation is moderate(2)

PO11: Thumb rule

For some of Security applications, Various new quantum algorithms were evolved. Therefore the correlation is high(3)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Computer Vision (Professional Elective-III)	L	T/CLC	P	C
23APE3212	III-II		2	1	0	3

Course Outcomes:

After studying the course, Student will able to

CO1: Understand the fundamental computer vision techniques to examine the visual data.

CO2: Understand the concepts of noise models, edge detection and multi-scale representation in Image Processing.

CO3: Analyze the texture representation and analysis techniques.

CO4: Analyze the images using various segmentation techniques, including graph-theoretic clustering methods

CO5: Apply the advanced computer vision techniques, to detect and recognize objects, and interpret complex patterns.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The fundamental computer vision techniques		to examine the visual data.	L2
CO2	Understand	the concepts of noise models, edge detection and multi-scale representation in Image Processing.			L2
CO3	Analyze	the texture representation and analysis techniques.			L4
CO4	Analyze	the images	using various segmentation techniques, including graph-theoretic clustering methods		L4
CO5	Apply	the advanced computer vision techniques		to detect and recognize objects, and interpret complex patterns	L3

Unit I	LINEAR FILTERS	8 Hrs
Introduction to Computer Vision, Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing Filters as Templates, Technique: Normalized Correlation and Finding Patterns, Technique: Scale and Image Pyramids.		
Unit II	EDGE DETECTION	9 Hrs
Noise- Additive Stationary Gaussian Noise, Why Finite Differences Respond to Noise, Estimating Derivatives - Derivative of Gaussian Filters, Why Smoothing Helps, Choosing a Smoothing Filter, Why Smooth with a Gaussian? Detecting Edges-Using the Laplacian to Detect Edges, Gradient-Based Edge Detectors, Technique: Orientation Representations and Corners.		
Unit III	TEXTURE	9 Hrs
Representing Texture -Extracting Image Structure with Filter Banks, Representing Texture using the Statistics of Filter Outputs, Analysis (and Synthesis) Using Oriented Pyramids -The Laplacian Pyramid, Filters in the Spatial Frequency Domain, Oriented Pyramids, Application: Synthesizing Textures for Rendering, Homogeneity, Synthesis		

by Sampling Local Models, Shape from Texture, Shape from Texture for Planes.
UNIT-IV SEGMENTATION BY CLUSTERING 8 Hrs
What is Segmentation, Human Vision: Grouping and Gestalt, Applications: Shot Boundary Detection and Background Subtraction. Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering. The Hough Transform, Fitting Lines, Fitting Curves
UNIT-V RECOGNIZATION BY RELATIONS BETWEEN TEMPLATES 8Hrs
Finding Objects by Voting on Relations between Templates, Relational Reasoning Using Probabilistic Models and Search, Using Classifiers to Prune Search, Hidden Markov Models, Application: HMM and Sign Language Understanding, Finding People with HMM.
Textbooks: 1. David A. Forsyth, Jean Ponce, Computer Vision – A modern Approach, PHI, 2003.
Reference Books: 1. Geometric Computing with Clifford Algebras: Theoretical Foundations and Applications in Computer Vision and Robotics, Springer;1 edition,2001 by Sommer. 2. Digital Image Processing and Computer Vision,1/e,by Sonka. 3. Computer Vision and Applications: Concise Edition (With CD) by Jack Academy Press, 2000.
Online Learning Resources: 1. https://nptel.ac.in/courses/106105216 2. https://nptel.ac.in/courses/108103174

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		2		3		2							3
CO3	3	3		3		3				3		2	
CO4				3	3	3					3		3
CO5	3	3				2					2	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	8	19%	2	CO1: Understand	L2	PO1 PO6	PO1: Apply(L3) PO6: Thumb rule	2 2
2	9	21%	3	CO2: Understand	L2	PO2 PO4 PO6	PO2: Identify(L3) PO4: Interpret(L2) PO6: Thumb rule	2 3 2
3	9	21%	3	CO3: Analyze	L4	PO1 PO2 PO4 PO6 PO10	PO1: Apply(L3) PO2: Identify(L3) PO4: Analyze(L4) PO6: Thumb rule PO10: Thumb rule	3 3 3 3 3
4	8	19%	2	CO4: Analyze	L4	PO4 PO5 PO6 PO11	PO4: Analyze(L4) PO5: Apply(L3) PO6: Thumb rule PO11: Thumb rule	3 3 3 3
5	8	19%	2	CO5: Apply	L3	PO1 PO2 PO6 PO11	PO1: Apply(L3) PO2: Review(L2) PO6: Thumb rule PO11: Thumb rule	3 3 2 2
	42	100%						

Justification Statements

CO1: Understand the fundamental computer vision techniques to examine the visual 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)

PO6:Thumb rule

To Use Linear filter or examples to simplify complex concepts like relational reasoning and probabilistic search. Therefore, the correlation is moderate (2)

CO2: Understand the concepts of noise models, edge detection and multi-scale representation in Image Processing.

Action Verb: Understand (L2)

PO2: Identify (L3)

CO2 Action verb is less than PO2 verb. Therefore, the correlation is moderate (2)

PO4: Interpret (L2)

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

PO6: Thumb rule

To Use Edge detection or examples to simplify complex concepts like relational reasoning and probabilistic search. Therefore, the correlation is moderate (2)

CO3: Analyze the texture representation and analysis techniques.

Action Verb: Analyze (L4)

PO1: Apply (L3)

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

PO2: Identify (L3)

CO3 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)

PO4: Analyze (L4)

CO3 Action verb is same level as PO4 verb. Therefore, the correlation is high (3)

PO6: Thumb rule

Texture analysis and synthesis inspire new artistic and design possibilities. Therefore, the correlation is high (3)

PO10: Thumb rule

For use techniques like synthesizing textures for rendering, homogeneity, and sampling local models for texture generation. Therefore, the correlation is high (3)

CO4: Analyze the images using various segmentation techniques, including graph-theoretic clustering methods

Action Verb: Analyze (L4)

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)

PO6: Thumb rule

To Illustrate applications like shot boundary detection and background subtraction. Therefore, the correlation is high (3)

PO11: Thumb rule

To select suitable techniques like clustering, graph-theoretic clustering, or Hough transform based on project requirements. Therefore, the correlation is high (3)

CO5: Apply the advanced computer vision techniques, to detect and recognize objects, and interpret complex patterns.

Action Verb: Apply (L3)

PO1: Apply (L3)

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

PO2: Review (L2)

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

PO6: Thumb rule

To Use analogies or examples to simplify complex concepts like relational reasoning and probabilistic search. Therefore, the correlation is moderate (2)

PO11: Thumb rule (3)

To explore new applications of HMMs, such as gesture recognition or human-computer interaction. Therefore, the correlation is moderate (2)

AIITS TPT-CSE(ODS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Cloud Computing (Professional Elective-III)	L	T/CLC	P	C
23MOC3201	III-II		2	1	0	3

Course Outcomes (CO): Student will be able to	
CO1	Understand the cloud computing basic concepts, technologies and services
CO2	Understand the Hadoop,python basics on application design
CO3	Apply python on cloud applications
CO4	Apply big data analytics,multimedia cloud on cloud applications.
CO5	Analyze cloud security on industry,healthcare and education

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	Cloud concepts, technologies and services			L2
CO2	Understand	Hadoop, python basics	On Application design		L2
CO3	Apply	Python	On cloud applications		L3
CO4	Apply	Big data analytics,multimedia cloud	On Cloud applications		L3
CO5	Analyze	Cloud security	On Industry,Healthcare and Education		L4

UNIT - I	Basics of Cloud computing	9 Hrs
<p>Introduction to cloud computing: Introduction, Characteristics of cloud computing, Cloud Models, Cloud Services Examples, Cloud Based services and applications</p> <p>Cloud concepts and Technologies: Virtualization, Load balancing, Scalability and Elasticity, Deployment, Replication, Monitoring, Software defined, Network function virtualization, Map Reduce, Identity and Access Management, services level Agreements, Billing.</p> <p>Cloud Services and Platforms: Compute Services, Storage Services, Database Services, Application services, Content delivery services, Analytics Services, Deployment and Management Services, Identity and Access Management services, Open Source Private Cloud software</p>		
UNIT - II	Hadoop and Python	9 Hrs
<p>Hadoop Map Reduce: Apache Hadoop, Hadoop Map Reduce Job Execution, Hadoop Schedulers, Hadoop Cluster setup.</p> <p>Cloud Application Design: Reference Architecture for Cloud Applications, Cloud Application Design Methodologies, Data Storage Approaches.</p> <p>Python Basics: Introduction, Installing Python, Python data Types & Data Structures, Control flow, Function, Modules, Packages, File handling, Date/Time Operations, Classes</p>		
UNIT - III	Python for Cloud Computing	9 Hrs
<p>Python for Cloud: Python for Amazon web services, Python for Google Cloud Platform, Python for windows Azure, Python for Map Reduce, Python packages of Interest, Python web Application Framework, Designing a REST ful web API.</p> <p>Cloud Application Development in Python: Design Approaches, Image Processing APP, Document Storage App, Map Reduce App, Social Media Analytics App.</p>		
UNIT - IV	Big data, Multimedia and Tuning	9 Hrs

Big Data Analytics: Introduction, Clustering Big Data, Classification of Big data Recommendation of Systems.

Multimedia Cloud: Introduction, Case Study: Live video Streaming App, Streaming Protocols, case

Cloud Application Bench marking and Tuning: Introduction, Workload Characteristics, Application Performance Metrics, Design Considerations for a Benchmarking Methodology, Benchmarking Tools, Deployment Prototyping, Load Testing & Bottleneck Detection case Study, Hadoop benchmarking case Study.

UNIT - V	Applications and Issues in Cloud	9 Hrs
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Cloud Security: Introduction, CSA Cloud Security Architecture, Authentication, Authorization, Identity Access Management, Data Security, Key Management, Auditing.

Cloud for Industry, Health care & Education: Cloud Computing for Health care, Cloud computing for Energy Systems, Cloud Computing for Transportation Systems, Cloud Computing for Manufacturing Industry, Cloud computing for Education.

Migrating into a Cloud: Introduction, Broad Approaches to migrating into the cloud, the seven- step model of migration into a cloud.

Organizational readiness and Change Management in The Cloud Age: Introduction, Basic concepts of Organizational Readiness, Drivers for changes: A frame work to comprehend the competitive environment, common change management models, change management maturity models, Organizational readiness self – assessment.

Legal Issues in Cloud Computing: Introduction, Data Privacy and security Issues, cloud contracting models, Jurisdictional issue raised by virtualization and data location, commercial and business considerations, Special Topics.

Textbooks:

1. CloudcomputingAhands-onApproach|By ArshdeepBahga,Vijay Madiseti,Universities Press, 2016
2. CloudComputingPrinciplesandParadigms:ByRajKumarBuyya,JamesBroberg,Andrzej, Goscinski,Wiley,2016

Reference Books:

1. MasteringCloudComputingbyRajkumarBuyya,ChristianVecchiola,SThamaraiSelvi,TMH
2. Cloud computing A Hands-On Approach by Arshdeep Bahga and Vijay Madiseti.
3. Cloud Computing: A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Tata McGraw Hill, rp2011.
4. Enterprise Cloud Computing, Gautam Shroff, Cambridge University Press, 2010.
5. CloudApplicationArchitectures:BuildingApplicationsandInfrastructureintheCloud,George Reese, O_Reilly, SPD, rp2011.
6. Essentials of Cloud Computing by K.Chandrasekaran. CRC Press.

Online Learning Resources:

1. Cloud computing – Course (nptel.ac.in)

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

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

CO-PO mapping justification:

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 PO9 PO11	PO1:Apply(L3) PO2:Review(L2) PO3:Develop(L3) PO9:Thumb Rule PO11:Thumb Rule	2 3 2 3 3
2	9	20%	2	CO2:Understand	L2	PO1 PO2 PO3 PO5 PO8 PO9	PO1:Apply(L3) PO2:Review(L2) PO3:Develop(L3) PO5:Apply(L3) PO8:Thumb Rule PO9:Thumb Rule	2 3 2 2 3 3
3	9	20%	2	CO3:Apply	L3	PO1 PO2 PO3 PO4 PO8	PO1:Apply(L3) PO2:Review(L2) PO3:Develop(L3) PO4:Analyze(L4) PO8:Thumb Rule	3 3 3 2 3
4	9	20%	2	CO4:Apply	L3	PO1 PO2 PO3 PO5 PO9 PO11	PO1:Apply(L3) PO2:Review(L2) PO3:Develop(L3) PO5:Apply(L3) PO9:Thumb Rule PO11:Thumb Rule	3 3 3 3 3 3
5	9	20%	2	CO5:Analyze	L4	PO1 PO2 PO4 PO8	PO1:Apply(L3) PO2:Review(L2) PO4:Analyze(L4) PO8:Thumb Rule	2 1 3 3
	45	100						

Justification Statements:

CO1: Understanding the cloud computing concepts, technologies and services

Action Verb: Understand (L2)

PO1 verb:Apply(L3)

CO1 Action Verb Less then PO1 verb.Therefore,the correlation is moderate(2).

PO2 Verb: Review(L2)

CO1 Action verb is grater than PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: Develop(L3)

CO1 Action verb is greater than PO3 verb. Therefore the correlation is moderate(2)

PO9 Verb:Thumb Rule

Cloud computing concepts are Communicate effectively within the engineering community and society as large.Then the correlation is high(3)

PO11verb:Thumb Rule

Recognize the need of basic concepts ,technologies and services as independent and lifelong learning.Then the correlation is high(3)

CO2: Understand Hadoop,python basics on application design

Action Verb: Understand (L2)

PO1 verb Apply(L3)

CO2 action verb is one level greater then PO1.Then the correlation is moderate(2)

PO2 verb:Review(L2)

CO2 action verb is grater then PO2. Then the correlation is high(3)

PO3 verb:Develop(L3)

CO2 action verb is less than PO2.Then the correlation is moderate(2)

PO5 verb: Apply(L3)

CO2 action verb is less than PO2.Then the correlation is moderate(2)

PO8 verb:Thumb Rule

Hadoop, python basics are effectively work as individual and collaboratively .Then the correlation is High(3)

PO9 verb:Thumb Rule

The concepts of Hadoop and basic concepts for a design the application for effectively communicate with the engineering community and society.Then the correlation is high(3)

CO3: Apply python on cloud applications.

Action Verb: Apply (L3)

PO1 verb:Apply(L3)

CO3 Action Verb is same as PO1.Then the correlation is high(3)

PO2 verb:Review(L2)

CO3 action verb greater than PO2.Then the correlation is high(3)

PO3 verb:Develop(3)

CO3 action verb is same as PO3.Then the correlation is high(3)

PO4 verb: Analyze(L4)

CO3 action verb is less than PO4.then the correlation is moderate(2)

PO8 verb:Thumb Rule

Python concepts are applicable for cloud applications as effectively work as individual and collaboratively as a member.Then the correlation is High(3)

CO4: Apply big data analytics,multimedia cloud on cloud applications

Action Verb: Apply (L3)

PO1 verb:Apply(L3)

CO4 Action Verb same as PO1. Then the correlation is high(3).

PO2 verb: Review(L2)

CO4 action verb is less than PO2.Then the correlation is high(3)

PO3 verb:Develop(L3)

CO4 action verb is same as PO3.Then the correlation is high(3)

PO5 verb:Apply(L3)

CO4 action verb is same as PO5.Then the correlation is high(3)

PO9 verb:Thumb Rule

Big data analytics, multimedia cloud is applicable on cloud applications for effectively communicate within engineering community and society .Then the correlation is High(3)

PO11 verb:Thumb Rule

Apply big data analytics, multimedia cloud on cloud applications as lifelong learning.Then the correlation is high(3)

CO5: Analyze cloud security on industry,healthcare and education

Action Verb: Analyze(L4)

PO1 verb:Apply(L3)

CO5 Action Verb is greater than by one level of PO1 .Then the correlation is moderate(2)

PO2 verb:Review(L2)

CO5 action verb is greater than by two levels of PO2.Then the correlation is low(1)

PO4 verb:Analyze(L4)

CO5 action verb is same as PO4.Then the correlation is high(3)

PO8 verb:Thumb Rule

Analyze cloud security on industry, healthcare and education as individual work .Then the correlation is High(3)

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE0103	DISASTER MANAGEMENT (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, and Ilan Kelman (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. Bimal Kanti Paul, *Environmental Hazards and Disasters: Contexts, Perspectives and Management*, 2nd Edition, Wiley-Blackwell, 2020.

WEB RESOURCES:

<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 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				Understand	L2	PO1 PO2	Apply (L3) Analyze (L4)	2 2

						PO6	Thumb Rule	2
4				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 2
5				Understand	L2	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	2 2 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).

CO5 Action Verb is of BTL 2. Using Thumb rule, L2 correlates PO6 as moderate (2).

Subject Code	Subject Name	L	T/CLC	P	CREDITS
23AOE0104	SUSTAINABILITY IN ENGINEERING PRACTICES (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 envelopes
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 CO₂ 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 envelopes	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. - CO₂ 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

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 Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
2. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2012.

WEB RESOURCES:

<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 CO₂ 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 envelopes

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).

Year/Sem	III/II	Branch of Study: EEE			
Subject Code	Subject Name		L	T/CLC/R	P Credits
23AOE0202	RENEWABLE ENERGY SOURCES (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	CO	Program	PO(s):	Level of
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No.	Lesson Plan (Hrs.)	%	correlation	Verb	BTL	Outcomes(PO)	Action verb and BTL (for PO1 to PO5)	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:Design(L6) 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).

AIATS TPT-CSE

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

Subject Code	Subject Name	L	T	P	Credits
23APE0322	Automation and Robotics (OE-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)													
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	
Automation & Robotics	CO 1	3	3				3								
	CO 2	3	3												
	CO 3	3	3			3	2								
	CO 4	3	3	3		2									
	CO 5	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			
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)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)
AK 23 REGULATIONS**

Course Code	Year & Sem	DIGITAL ELECTRONICS (Open Elective-II)	L	T/CLC	P	C
23AOE0402	III-I		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 demultiplexer (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			Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation					
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 %						
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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).

Year : III B.Tech II Semester

Branch of Study : Common to All

Subject Code: 23AOE9902	Subject Name: ADVANCED OPERATIONS RESEARCH (Open Elective II)	L	T	P	Credits 3	CLC 3
		2	1	0		

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).

Year : III B.Tech II Semester

Branch of Study : Common to all

Subject Code: 23AOE9903	MATHEMATICAL FOUNDATION OF QUANTUM TECHNOLOGIES (Open Elective-II)	L 2	T 1	P 0	Credits 3	CLC 3
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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 ($|\psi\rangle$, $\langle\phi|$, $\langle\phi|\psi\rangle$), 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 ($\int \psi^* \phi dx$), 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								

(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				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).

AIATS TPT-CSE(DS)



Course Code	PHYSICS OF ELECTRONIC MATERIALS AND DEVICES	L	T	P	C
23AOE9907	(Open Elective-II)	2	1	0	3
Regulation: AK23	Common to all branches				
Course Outcomes (CO): At the end of the course students will be able to					
<ol style="list-style-type: none"> 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. Electroluminescence : 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., 4th edition, 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, Dhanpat Rai 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												

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

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).

AIATS TPT-CSE(ODS)


ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI
(Autonomous)

(Effective for the batches admitted from 2023-24)

Year: III-II B.Tech
Common to All

Subject Code 23AOE9912	Chemistry of Polymers and Applications (Open Elective-II)	L 2	T/CLC 1	P 0	Credits:3
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Course Outcomes (CO): At the end of the course students will be able to

6. Understand polymer fundamentals and classification systems.
7. Analyze the chemical and physical properties of natural polymers and their applications.
3. Apply the knowledge of thermoplastic and thermoset polymers in practical situations.
4. Understand the fundamental principles of hydrogel in polymer networks.
5. 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 cellulose

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 cellulose: 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												

(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					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	3

							(L3)	
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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).



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES:
TIRUPATI**

(Autonomous)

(Effective for the batches admitted from 2023-24)

Year: III B.Tech

(Common to all branches)

Semester: II

Subject Code 23AOE9916	ACADEMIC WRITING AND PUBLIC SPEAKING (Common to All Branches of Engineering) OPEN ELECTIVE - II	L 2	T 1	P 0	Credit: 3	CLC 2
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Pre-Requisites		Semester	II
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 – Oculistics – Proxemics – Haptics – Chronemics - Paralanguage - Signs		
Textbooks:		
3. <i>Critical Thinking, Academic Writing and Presentation Skills</i> : MG University Edition Paperback – 1 January 2010 Pearson Education; First edition (1 January 2010)		
4. Pease, Allan & Barbara. <i>The Definitive Book of Body Language</i> RHUS Publishers, 2016		
Reference Books:		
1. <u>Alice Savage, Masoud Shafiei</u> <i>Effective Academic Writing</i> , 2Ed. , 2014 .sserP ytisrevinU drofxO		
2. Shalini Verma, <i>Body Language</i> , S Chand Publications 2011.		
3. Sanjay Kumar and Pushpalata, <i>Communication Skills 2E</i> 2015, Oxford.		
4. Sharon Gerson, Steven Gerson, <i>Technical Communication Process and Product</i> , Pearson, New Delhi, 2014		
5. <i>Elbow, Peter. Writing with Power. OUP USA, 1998</i>		

Online Learning Resources:

- <https://youtu.be/NNhTIT81nH8>
- <https://www.youtube.com/watch?v=478ccrWKY-A>
- <https://www.youtube.com/watch?v=nzGo5ZC1gMw>
- <https://www.youtube.com/watch?v=Qve0ZBmJMh4>
- <https://courses.lumenlearning.com/publicspeakingprinciples/chapter/chapter-12-nonverbal-aspects-of-delivery/>
- https://onlinecourses.nptel.ac.in/noc21_hs76/preview
- <https://archive.nptel.ac.in/courses/109/107/109107172/#>
- <https://archive.nptel.ac.in/courses/109/104/109104107/>

**Correlation of COs with the POs & PSOs for B.Tech
AK-23 Regulations**

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

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	
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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.

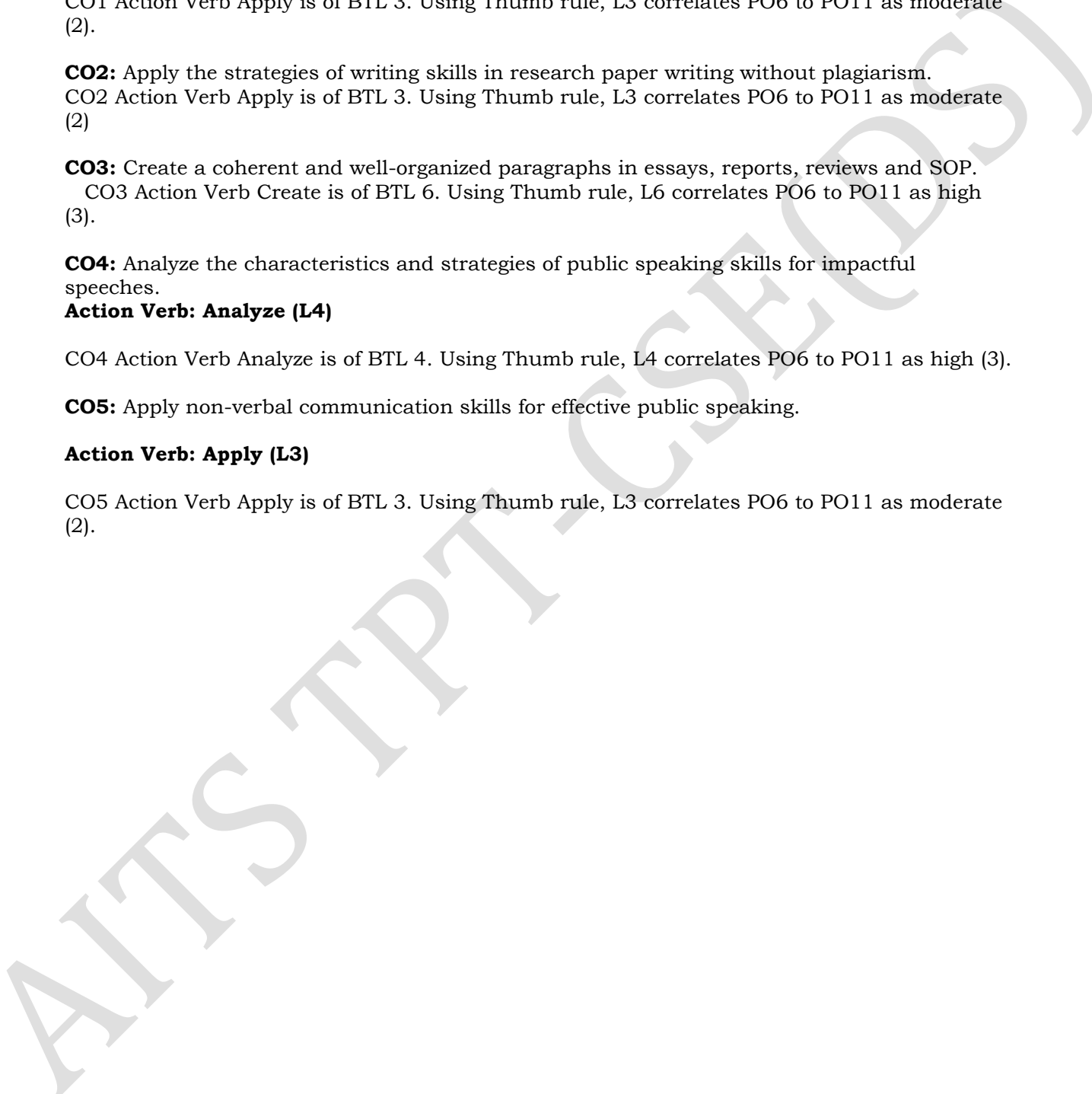
Action Verb: Analyze (L4)

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 (2).





**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Predictive Analytics lab	L	T / CLC	P	C
23APC3213	III-II		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the basic SPSS operations for data preprocessing and management.

CO2: Apply the appropriate statistical tests to analyze data and interpret results.

CO3: Apply the multivariate analysis techniques for data reduction and grouping.

CO4: Analyse the model relationships among variables using advanced statistical models

CO5: Analyse the consumer preferences and choices using specialized models.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The Basic SPSS operations		For data preprocessing and management.	L2
CO2	Apply	The appropriate statistical tests		to analyze data and interpret results.	L3
CO3	Apply	The multivariate analysis techniques		for data reduction and grouping.	L3
CO4	Analyze	The model relationships among variables	using advanced statistical models		L4
CO5	Analyze	The consumer preferences and choices	using specialized models		L4

List of Experiments

1. Introduction to SPSS, Sorting File, Split File, Compute File, Recode File and Select Cases[CO1]
2. Chi- Square Test (Parametric and Non-Para)[CO1]
3. Exploratory Factor Analysis [CO2]
4. Cluster Analysis [CO2]
5. Logistic Regression [CO3]
6. Discriminant Analysis [CO3]
7. Confirmatory Factor Analysis[CO4]
8. Conjoint Analysis [CO4]
9. Time Series [CO5]
10. MANOVA [CO5]
11. Decision Tree Analysis[CO5]

References:

- **Andy Field (2017)**, *Discovering Statistics Using IBM SPSS Statistics* (5th Edition)
- **Norusis, M. J. (2012)**. *IBM SPSS Statistics 19 Guide to Data Analysis*
- **Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019)**. *Multivariate Data Analysis* (8th Edition)
- **Gujarati, D. N. (2012)**. *Basic Econometrics* (5th Edition)
- **Tabachnick, B. G., & Fidell, L. S. (2013)**. *Using Multivariate Statistics* (6th Edition)

Online Learning Resources/Virtual Labs:

<https://www.ibm.com/docs/en/spss-statistics>

<https://statistics.laerd.com>

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	2
CO2	3	3	3		3						2	1	2
CO3	3	3	3		3							1	2
CO4	3	3		3	3							1	2
CO5	3				3							1	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 PO5	PO1: Apply(L3) PO5: Apply (L3)	2 2
2	CO2: Apply	L3	PO1 PO2 PO3 PO5 PO11	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO5: Apply (L3) PO11:Thumb Rule	3 3 3 3 2
3	CO3: Apply	L3	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO5: Apply(L3)	3 3 3 3
4	CO4: Analyze	L4	PO1 PO2 PO4 PO5	PO1:Apply(L3) PO2:Identify (L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 3
5	CO5: Analyze	L4	PO1 PO5	PO1: Apply(L3) PO5: Apply (L3)	3 3

Justification Statements :

CO1: Understand the basic SPSS operations for data preprocessing and management.

Action Verb: Understand (L2)

PO1 Verb: Apply (L3)

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

PO5 Verb: Apply (L3)

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

CO2: Apply the appropriate statistical tests to analyze data and interpret results.

Action Verb: Apply (L3)

PO1 Verb: 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 as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: Develop (L6)

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

PO5 Verb: Apply (L3)

CO2 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)

PO11 Verb: Thumb rule

Algorithms analysis is learning process to find the solution better manner the correlation is moderate (2)

CO3: Apply the multivariate analysis techniques for data reduction and grouping.

Action Verb: Apply(L3)

PO1 Verb: 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 as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: Develop (L3)

CO3 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)

PO5 Verb: Apply(L3)

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

CO4: Analyze model relationships among variables using advanced statistical models

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

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

PO2 Verb: Identify(L3)

CO4 Action verb is greater than as PO2 verb by one level. Therefore, the correlation is high (3)

PO4 Verb: Analyze (L4)

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

PO5 Verb: Apply (L3)

CO4 Action verb is greater than as as PO5 verb by two levels. Therefore, the correlation is high (3)

CO5: Analyze the consumer preferences and choices using specialized models.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

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

PO5 Verb: Apply (L3)

CO5 Action verb is greater than as as PO5 verb by two levels. Therefore, the correlation is high (3)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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Course Code	Year & Sem	NLP AND DATA VISUALIZATION LAB (Using Power BI / Tableau etc.)	L	T / CLC	P	C
23APC3214	III-II		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1:**Understand** the fundamental concepts and techniques of Natural Language Processing (NLP).

CO2:**Analyze** the grammar formalism and context free grammars to structure the language.

CO3:**Apply** the statistical estimation and statistical alignment to estimate model parameters in sequences.

CO4:**Apply** data visualization tools and libraries to create interactive and dynamic dashboards.

CO5:**Analyze** the visualizations to derive actionable insights and support data-driven decision-making.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the fundamental concepts and techniques of Natural Language Processing (NLP).			L2
CO2	Analyze	the grammar formalism and context free grammars to structure the language.			L4
CO3	Apply	the statistical estimation and statistical alignment		to estimate model parameters in sequences.	L3
CO4	Apply	data visualization tools and libraries		to create interactive and dynamic dashboards.	L3
CO5	Analyze	the visualizations to derive actionable insights and support data-driven decision-making			L4

List of Experiments:
<ol style="list-style-type: none"> 1. Word Analysis[CO1] 2. Word Generation [CO1] 3. Morphology[CO2] 4. N-Grams[CO2] 5. N-Grams Smoothing[CO2] 6. POS Tagging: Hidden Markov Model[CO2] 7. POS Tagging: Viterbi Decoding[CO2] 8. Building POS Tagger[CO3] 9. Chunking[CO4] 10. Building Chunker[CO4]
Refer: https://nlp-iiith.vlabs.ac.in/List%20of%20experiments.html
References:
<ol style="list-style-type: none"> 1. James Allen, Natural Language Understanding, 2nd Edition, 2003, Pearson Education. 2. Natural Language Processing, A paninian perspective, AksharBharathi, Vineet Chaitanya, Prentice-Hall of India.
Online Learning Resources/Virtual Labs:
1. Natural Language Processing in TensorFlow Coursera
PART-2
<ol style="list-style-type: none"> 1. Connecting to the data[CO4] 2. Formatting and insertion of data[CO4] 3. Creating worksheets, navigating the sheets, applying filters, aggregating the data[CO4] 4. Organize the data into dashboards[CO4] 5. Create story[CO4] 6. Develop interactive plots in Python[CO4] 7. Create Time series Data Visualization in Python[CO4] 8. Visualization of Semi-Structured data[CO5] 9. Create Sales Growth Dashboard – for the tracking of sales teams progress[CO5] 10. Design Social media Dashboard – find how well your sponsored social activating are performing, monitor your PPC campaigns[CO5] 11. Develop Healthcare Data Dashboard – Allows hospital administrators to manage and identify patient hazards from a single screen.[CO5]
References:
<ol style="list-style-type: none"> 1. Andy Kirk, Data Visualization A Handbook for Data Driven Design, Sage Publications, 2016 2. Philipp K. Janert, Gnuplot in Action, Understanding Data with Graphs, Manning Publications, 2010
Online Learning Resources/Virtual Labs:
1. Data Visualization with Tableau Coursera

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								
CO2	3	3			3							1	
CO3	3	3		3	3							2	2
CO4	3	3		3	3								
CO5			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 PO3	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3)	2 3 2

			PO5	PO5: Apply(L3)	2
2	CO2: Analyze	L4	PO1 PO2 PO5	PO1:Apply(L3) PO3:Develop(L3) PO5:Apply(L3)	3 3 3
3	CO3: Apply	L3	PO1 PO2 PO4 PO5	PO1:Apply(L3) PO2:Review(L2) PO4:Interpret(L2) PO5:Apply(L3)	3 3 3 3
4	CO4: Apply	L3	PO1 PO2 PO4 PO5	PO1:Apply(L3) PO2:Review(L2) PO4:Interpret(L2) PO5:Apply(L3)	3 3 3 3
5	CO5: Analyze	L4	PO3 PO5 PO6 PO11	PO3:Develop(L3) PO5:Apply(L3) PO6:Thumb rule PO11:Thumb rule	3 3 3 3

Justification Statements :

CO1: Understand the fundamental concepts and techniques of Natural Language Processing (NLP).

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 same as PO3 verb. Therefore, the correlation is moderate (2)

PO5 Verb: Apply(L3)

CO1 Action verb is same as PO5 verb. Therefore, the correlation is moderate (2)

CO2: Analyze the grammar formalism and context free grammars to structure the language.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

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

PO2 Verb : Review(L2)

CO2 Action verb is same as PO2 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)

CO3: Apply the statistical estimation and statistical alignment to estimate model parameters in sequences.

Action Verb: Apply(L3)

PO1 Verb: Apply (L3)

CO3 Action verb is same as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: Review(L2)

CO3 Action verb is same as PO2 verb. Therefore, the correlation is high(3)

PO4 Verb: Interpret (L2)

CO3 Action verb is greater than as PO4 verb. Therefore, the correlation is high (3)

PO5 Verb: Apply (L3)

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

CO4: Apply data visualization tools and libraries to create interactive and dynamic

dashboards.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO4 Action verb is same as 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)

PO4 Verb: Interpret (L2)

CO4 Action verb is greater than as PO4 verb. Therefore, the correlation is high (3)

PO5 Verb: Apply (L3)

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

CO5: Analyze the visualizations to derive actionable insights and support data-driven decision-making.

Action Verb: Analyze (L4)

PO3 Verb: Develop (L3)

CO5 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)

PO5 Verb: Apply (L3)

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

PO6 Verb:Thumb rule

Data visualization skills are applied to real-world problems for making data-driven decisions.

So the correlation is high (3)

PO11: Verb:Thumb rule

Data visualization supports lifelong learning by enabling individuals to effectively explore, understand, and communicate complex information, fostering continuous skill development.

Hence the correlation is high (3)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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Course Code	Year & Sem	FULL STACK DEVELOPMENT – 1 (Skill Enhancement Course-III)	L	T	P	C
23ASC3202	III-II			0	1	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	Conditio	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 [CO1]

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 an unordered 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 [CO1]

a. Write a HTML program, to explain the working of tables. (use tags: <table>, <tr>, <th>, <td> and attributes: border, rowspan, colspan)

b. 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.).
- c. 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).
 - d. 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 to be fixed).

3. HTML 5 and Cascading Style Sheets, Types of CSS [CO2]

- a. Write a HTML program, that makes use of <article>, <aside>, <figure>, <figcaption>, <footer>, <header>, <main>, <nav>, <section>, <div>, 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 and value).

4. Selector forms [CO2]

- a. Write a program to apply different types of selector forms
 - i. Simple selector (element, id, class, group, universal)
 - ii. Combinator selector (descendant, child, adjacent sibling, general sibling)
 - iii. Pseudo-class selector iv. Pseudo-element selector v. Attribute selector

5. CSS with Color, Background, Font, Text and CSS Box Model[CO3]

- 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 it horizontally. 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[CO3]

- 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 webpage which uses prompt dialogue box to ask a voter for his name and age. Display the information in table format along with either the voter can vote or not

7. Java Script Pre-defined and User-defined Objects[CO4]

- 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. Java Script Conditional Statements and Loops[CO4]

- a. Write a program which asks the user to enter three integers, obtains the numbers from the uses 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, output HTML 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 is equal to the number i.e., $1^3 + 5^3 + 3^3 = 153$]
- 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. Java Script Functions and Events[CO5]

- a. Design a appropriate function should be called to display
 - i. Factorial of that number
 - ii. Fibonacci series up to that number
 - iii. Prime numbers up to that number
 - iv. Is it palindrome or not
- 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
 - i. Factorial of that number
 - ii. Fibonacci series up to that number
 - iii. Prime numbers up to that number
 - iv. Is it palindrome or not
- c. Write a program to validate the following fields in a registration page
 - ii. Name (start with alphabet and followed by alphanumeric and the length should not be less than 6 characters)
 - iii. Mobile (only numbers and length 10 digits)
 - iv. E-mail (should contain format like xxxxxxxx@xxxxxxx.xxx)

10. JavaScript Database Connectivity [CO5]

- a. Introduction to server-side JavaScript with Node.js
- b. Connecting JavaScript applications to MySQL and Mongo DB databases

Textbooks:

- 1. John Dean, Web Programming with HTML5, CSS and JavaScript, Jones & Bartlett Learning, 2019.

Reference Books:

- 1. Programming the World Wide Web, 7thEdition, Robert W Sebesta, Pearson, 2013.
- 2. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasani 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				3				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 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
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 high (3)

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)

AIATS TPT-CSE(ODS)



**ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF CSE(DATA SCIENCE)**

Course Code	Year & Sem	Technical Paper Writing & IPR Audit Course	L	T / CLC	P	C
23AMC9902	III-II		2	0	0	-

Pre-Requisites		Semester	II
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.

UNIT – II:

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/TechPaperWriting.html>
3. <https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriting.html>
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>

**Correlation of COs with the POs & PSOs for B.Tech
AK-23 Regulations**

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

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 Analyze is of BTL 4. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

AIITS TPT-CSE(DS)