ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(AUTONOMOUS)

B.Tech-CSE(DATA SCIENCE)

(Effective for the batches admitted in 2022-23)

Semester I (First year)

Sl.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P	C			
1	BS	20ABS9901	Algebra & Calculus	3	0	0	3	30	70	100
2	BS	20ABS9902	Applied Physics	3	0	0	3	30	70	100
3	ES	20AES0501	Problem Solving and Programming	3	0	0	3	30	70	100
4	ES	20AES0301	Engineering Graphics	1	0	4	3	30	70	100
5	HS	20AHS9901	Communicative English	3	0	0	3	30	70	100
6	HS LAB	20AHS9902	Communicative English Lab	0	0	2	1.5	30	70	100
7	BS LAB	20ABS9907	Applied Physics Lab	0	0	3	1.5	30	70	100
8	ES LAB	20AES0503	Problem Solving and Programming Lab	0	0	3	1.5	30	70	100
			Total credits				**19.5**	**240**	**560**	**800**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

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B.Tech-CSE(DATA SCIENCE)

(Effective for the batches admitted in 2022-23)

Semester II (First year)

Sl.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P	C			
1	BS	20ABS9904	Chemistry	3	0	0	3	30	70	100
2	BS	20ABS9911	Probability and Statistics	3	0	0	3	30	70	100
3	ES	20AES0505	Information Technology and Numerical Methods	3	0	0	3	30	70	100
4	ES	20AES0502	Data Structures	3	0	0	3	30	70	100
5	ES	20AES0509	Python Programming	1	0	4	3	30	70	100
6	ES LAB	20AES0506	Computer Science and Engineering Workshop	0	0	3	1.5	30	70	100
7	BS LAB	20ABS9909	Chemistry Lab	0	0	3	1.5	30	70	100
8	ES LAB	20AES0504	Data Structures Lab	0	0	3	1.5	30	70	100
9	MC	20AMC9903	Environmental Studies	3	0	0	0	30	0	30
			Total credits				**19.5**	**270**	**560**	**830**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

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Semester III (Second year) – AK20

Sl.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P	C			
1	BS	20ABS9914	Discrete Mathematical Structures	3	0	0	3	30	70	100
2	PC	20APC0503	Digital Electronics & Microprocessors	3	0	0	3	30	70	100
3	PC	20APC3201	Database Management Systems	3	0	0	3	30	70	100
4	PC	20APC3202	Advanced Python Programming for Data Science	3	0	0	3	30	70	100
5	ES	20AES0205	Basics of Electrical and Electronics Engineering	3	0	0	3	30	70	100
6	PC Lab	20APC3203	Database Management Systems Lab	0	0	3	1.5	30	70	100
7	PC Lab	20APC3204	Advanced Python Programming for Data Science Lab	0	0	3	1.5	30	70	100
8	ES Lab	20AES0206	Basics of Electrical and Electronics Engineering Lab	0	0	3	1.5	30	70	100
9	SC	20ASC3201	Exploratory Data Analysis with R	1	0	2	2	100	0	100
10	MC	20AMC9902	Constitution of India	3	0	0	0	30	0	30
			Total credits				**21.5**	**370**	**560**	**930**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

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Semester IV (Second year) – AK20

Sl.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P	C			
1	PC	20APC3205	Computer Organization	3	0	0	3	30	70	100
2	PC	20APC3206	Design And Analysis Of Algorithms	3	0	0	3	30	70	100
3	PC	20APC3207	Object Oriented Programming through Java	3	0	0	3	30	70	100
4	PC	20APC3208	Operating Systems	3	0	0	3	30	70	100
5	HS	20AHSMB01	Managerial Economics and Financial Analysis	3	0	0	3	30	70	100
6	HS	20AHS9905	Universal Human Values	2	1	0	3	30	70	100
7	PC Lab	20APC3209	Design And Analysis Of Algorithms Lab	0	0	3	1.5	30	70	100
8	PC Lab	20APC3210	Object Oriented Programming through Java Lab	0	0	3	1.5	30	70	100
9	PC Lab	20APC3211	Operating Systems Lab	0	0	3	1.5	30	70	100
10	SC	20ASC3202	Digital and Social Media Marketing	1	0	2	2	100	0	100
			Total credits				**24.5**	**370**	**630**	**1000**

Community service Project with credits

(To visit the selected community to conduct survey (Socio-economic & domain survey) and conduct sensitization/awareness program/activities at the end of IV- semester before commencement of V-semester and complete immersion programme also during V-Semester and submit report in V - semester. Assessment will be done at the end of V-Semester).

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B.Tech-CSE(DATA SCIENCE)

(Effective for the batches admitted in 2022-23)

Semester V (Third year)

Sl.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P	C			
1	PC	20APC3212	Computer Networks	3	0	0	3	30	70	100
2	PC	20APC3213	Formal Languages & Automata Theory	3	0	0	3	30	70	100
3	PC	20APC3214	Software Engineering	3	0	0	3	30	70	100
4	OE-1	20APE0418 20AOE0303 20AOE9925	Sensors and IoT Optimization Techniques Deterministic & Stochastic Statistical Methods	3	0	0	3	30	70	100
5	PE-1	20APE3201 20APE3202 20APE3203	Data Warehousing and Mining Design Patterns Computer Graphics	3	0	0	3	30	70	100
6	PC Lab	20APC3215	Software Engineering Lab	0	0	3	1.5	30	70	100
7	PC Lab	20APC3216	Computer Networks Simulation Lab	0	0	3	1.5	30	70	100
8	SC	20ASC3203	Mobile Application Development	1	0	2	2	100	0	100
9	MC	20AMC9901	Biology for Engineers	2	0	0	0	30	0	30
10	CSP	20CSP3201	Community service project	0	0	0	1.5	100	0	100
Total credits							**21.5**	**440**	**490**	**930**

OE/JOEs for NPTEL

S. No	Professional Elective (12 weeks)	Open Elective (12 weeks)
1	The Joy Of Computing Using Python	Blockchain and its Applications
2	Software Testing	Introduction to Cyber Security
3	Privacy And Security In Online Social Media	Business analytics and data mining modeling using R.
4	Data analytics with python	Decision making with spread sheet
5	Development using UML, JAVA and Patterns.	Introduction To Wireless And Cellular Communications
6	Programming In Modern C++	Text, Textuality And Digital Media
7	Data Structure And Algorithms Using Java	Psychology Of Learning
8	Computational Complexity	Public Speaking
9	Cyber Security and Privacy	Organizational Behaviour
10	Ethical Hacking	Entrepreneurship
11	Parameterized Algorithms	Introduction to Film Studies
12	Computational number theory and algebra	Partition of India in print media and Cinema.
13	Hardware Security	Data Analysis and decision making
14	GPU architecture and programming	Education for sustainable development
15	Introduction to game theory and mechanism	Training and development
16	Statistical learning for reliability analysis	Literature Culture and Media
17	Advanced distributed systems.	Introduction to Cultural Studies
18	Secure computation: part-1	Science, Technology and Society
19	Secure computation: part-2	Human Resource Development
20	Pattern recognition and application	E- Business.

*Student shall register any number of MOOC courses listed by the department as approved by the BOS from III year. But student is required to submit the pass certificate on NPTEL platform for at least one course with in the Programme duration (Before IV-II examination notification released).

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Semester VI (Third year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P	C			
1	PC	20APC3217	Artificial Intelligence	3	1	0	3	30	70	100
2	PC	20APC3218	Compiler Design	3	0	0	3	30	70	100
3	PC	20APC3219	Cloud Computing	3	0	0	3	30	70	100
4	PE-2	20APE3204 20APE3205 20APE3206	Machine Learning Real Time Operating Systems Agile Methodologies	3	0	0	3	30	70	100
5	PC Lab	20APC3220	Artificial Intelligence Lab	0	0	3	1.5	30	70	100
6	PC Lab	20APC3221	Compiler Design Lab	0	0	3	1.5	30	70	100
7	PC Lab	20APC3222	Cloud Computing Lab	0	0	3	1.5	30	70	100
8	SC	20ASC3204	Soft Skills	1	0	2	2	100	0	100
9	MC	20AMC9904	Professional Ethics and Human Values	3	0	0	0	30	0	30
			Total credits				**18.5**	**340**	**490**	**830**
Industry Internship (Mandatory) for 6-8 Weeks duration during summer vacation										

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Semester VII (Fourth year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P	C			
1	PE-3	20APE3207 20APE3208 20APE3209 20APE3210	Predictive Analytics Natural Language Processing Deep Learning Techniques Computer Vision	3	0	0	3	30	70	100
2	PE-4	20APE3211 20APE3212 20APE3213	Cryptography and Network Security Adhoc & Sensor Networks Distributed Systems	3	0	0	3	30	70	100
3	PE-5 CBCC	20APE3214 20APE3215 20APE3216	Data Analytics Software Project Management Linux Environment System	3	0	0	3	30	70	100
4	JOE/OE-2	20AOE3201 20AOE3202 20AOE3203	Information Retrieval Techniques Soft Computing Principles of Data science	3	0	0	3	30	70	100
5	OE-3	20APE0407 20APE0411 20AOE3601 20APE0415	Digital Image Processing Embedded Systems Enabling Technologies for data science and analytics :IOT Wireless Communications	3	0	0	3	30	70	100
6	HE	20AOE0302 20AOE9901 20AHSMB02	Management Science English for Research Paper Writing Entrepreneurship Development	3	0	0	3	30	70	100
7	SC	20ASC3205	Devops	1	0	2	2	100	0	100
8	PR	20APR3201	Evaluation of Industry Internship(III-II Summer Internship)	0	0	0	3	100	0	100
			Total credits				**23**	**380**	**420**	**800**

Semester VIII (Fourth year)

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P	C			
1	OE-4	20AOE3204	MOOCS	**0**	**0**	**0**	**3**	25	75	100
2	PR	20APR3202	Internship	**0**	**0**	**0**	**3**	100		100
3	PR	20APR3203	Project work	0	0	0	9	60	140	200
			Total credits				15	185	215	400

LIST OF COURSES FOR HONOURS In B.Tech -CSE

Note: Students can choose a few courses from the following list approved by BOS either 3 credits/ 4 credits courses based on the availability in SWYAM-NPTEL portal, and secure minimum of 20 credits on passing the selected courses.

S.NO	SUB.CODE	COURSE NAME	WEEKS	CREDITS
1	20AHN3201	DESIGN AND IMPLEMENTATION OF HUMAN COMPUTER INTERFACES	12 Weeks	3 or 4
2	20AHN3202	SOCIAL NETWORKS	12 Weeks	3 or 4
3	20AHN3203	NO SQL DATABASES	12 Weeks	3 or 4
4	20AHN3204	ADVANCED IOT APPLICATIONS	12 Weeks	3 or 4
5	20AHN3205	INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS	12 Weeks	3 or 4
6	20AHN3206	GETTING STARTED WITH COMPETITIVE PROGRAMMING	12 Weeks	3 or 4
7	20AHN3207	COMMUNICATION NETWORKS	12 Weeks	3 or 4
8	20AHN3208	COMPUTER NETWORKS AND INTERNET PROTOCOL	12 Weeks	3 or 4
9	20AHN3209	ALGORITHMIC GAME THEORY	12 Weeks	3 or 4
10	20AHN3210	SCALABLE DB.	12 Weeks	3 or 4
11	20AHN3211	APPLIED ACCELERATED ARTIFICIAL INTELLIGENCE.	12 Weeks	3 or 4
12	20AHN3212	AI: SEARCH METHODS FOR PROBLEM SOLVING.	12 Weeks	3 or 4
13	20AHN3213	ARTIFICIAL INTELLIGENCE: KNOWLEDGE REPRESENTATION AND REASONING	12 Weeks	3 or 4
14	20AHN3214	MULTI-CORE COMPUTER ARCHITECTURE-STORAGE	12 Weeks	3 or 4
15	20AHN3215	SOCIAL NETWORK ANALYSIS.	12 Weeks	3 or 4
		TOTAL		**20**

MINOR DEGREE IN COMPUTER SCIENCE AND ENGINEERING FOR ECE, EEE, CE & ME

Note: Students of other programmes to get "minor in CSE" shall pass a few SWAYAM-NPTEL courses listed below which are approved by BOS and obtain 15 credits and submitting a minor discipline project in CSE for scoring 5 credits is compulsory and all together total credits requirement count to be minimum of 20.

S.NO	SUB.CODE	COURSE NAME	WEEKS	CREDITS
1	20AMN3201	OPERATING SYSTEMS	12 Weeks	3 or 4
2	20AMN3202	COMPUTER ORGANIZATION	12 Weeks	3 or 4
3	20AMN3203	COMPUTER NETWORKS	12 Weeks	3 or 4
4	20AMN3204	DESIGN AND ANALYSIS OF ALGORITHMS	12 Weeks	3 or 4
5	20AMN3205	OBJECT ORIENTED PROGRAMMING THROUGH JAVA	12 Weeks	3 or 4
6	20AMN3206	PROGRAMMING IN MODERN C++	12 Weeks	3 or 4
7	20AMN3207	DATA ANALYTICS WITH PYTHON	12 Weeks	3 or 4
8	20AMN3208	SOFTWARE ENGINEERING	12 Weeks	3 or 4
9	20AMN3209	SOFTWARE PROJECT MANAGEMENT	12 Weeks	3 or 4
10	20AMN3210	INTRODUCTION TO DATABASE SYSTEMS	12 Weeks	3 or 4
11	20AMN3211	CLOUD COMPUTING	12 Weeks	3 or 4
12	20AMN3212	FOUNDATION OF CRYPTOGRAPHY	12 Weeks	3 or 4
13	20AMN3213	HARDWARE SECURITY	12 Weeks	3 or 4
14	20AMN3214	COMPUTER NETWORKS AND INTERNET PROTOCOL	12 Weeks	3 or 4
15	20AMN3215	COMMUNICATION NETWORKS	12 Weeks	3 or 4
16	20AMN3216	**MINOR DISCIPLINE PROJECT IN CSE (COMPULSORY)**	-	5
		TOTAL		**20**

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Semester I (First year)

Sl.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P	C			
1	BS	20ABS9901	Algebra & Calculus	3	0	0	3	30	70	100
2	BS	20ABS9902	Applied Physics	3	0	0	3	30	70	100
3	ES	20AES0501	Problem Solving and Programming	3	0	0	3	30	70	100
4	ES	20AES0301	Engineering Graphics	1	0	4	3	30	70	100
5	HS	20AHS9901	Communicative English	3	0	0	3	30	70	100
6	HS LAB	20AHS9902	Communicative English Lab	0	0	2	1.5	30	70	100
7	BS LAB	20ABS9907	Applied Physics Lab	0	0	3	1.5	30	70	100
8	ES LAB	20AES0503	Problem Solving and Programming Lab	0	0	3	1.5	30	70	100
			Total credits				**19.5**	**240**	**560**	**800**

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

Course Code	Year & Sem	Algebra and Calculus	L	T	P	C
20ABS9901	I-I		3	0	0	3

Course Outcomes:

After studying the course, student will be able to

CO1. Apply the matrix algebra techniques for solving various linear equations.
CO2. Analyze the linear transformations of quadratic forms and mean value theorems.
CO3. Apply the fundamental concepts of partial derivatives for multi variable functions.
CO4. Evaluate the multiple integrals in cartesian, polar, cylindrical, and spherical co-ordinate systems.
CO5. Evaluate the improper integrals using special functions like Beta and Gamma.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Apply**	the matrix algebra techniques	for solving various linear equations		**L3**
2	**Analyze**	the linear transformations of quadratic forms and mean value theorems.			**L4**
3	**Apply**	the fundamental concepts of partial derivatives	for multi variable functions		**L3**
4	**Evaluate**	the multiple integrals	in cartesian, polar, cylindrical, and spherical co-ordinate systems		**L5**
5	**Evaluate**	the improper integrals	using special functions like Beta and Gamma		**L5**

Unit I : Matrix Operations and Solving Systems of Linear Equations 12hrs

Rank of a matrix by echelon form, solving system of homogeneous and non-homogeneous equations linear equations. Eigen values and Eigen vectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem,

Unit II : Quadratic Forms and Mean Value Theorems 9hrs

Diagonalisation of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.

Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof);

Unit III: Multivariable calculus 9hrs

Partial derivatives, total derivatives, chain rule, change of variables, Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

Unit IV: Multiple Integrals 10hrs

Double integrals, change of order of integration, double integration in polar coordinates, change of Variables in double integration (Cartesian to polar),areas enclosed by plane curves.Evaluation of triple integrals.

Unit V: Special Functions 10hrs

Beta and Gamma functions and their properties, relation between beta and gamma functions, Bessel functions, Bessel's equation, Recurrence formulae or $J_n(x)$, Generating function- Orthoganality of Bessels functions.

Textbooks:

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

References:

1. Dr.T.K.VIyengar, B.Krishna Gandhi, S. Ranganathamamd M.V.S.S.N Prasad, Mathematics – 1, S.Chand publications.

2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
3. B.V.Ramana, Higher Engineering Mathematics, McGraw Hill Education.
4. N.Bali, M.Goyal, C.Watkins, Advanced Engineering Mathematics, Infinity Science Press.

Mapping of COs to POs

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

(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	14	21.21	3	Apply	L3	PO2	Apply (L3)	3
2	10	15.15	2	Analyze	L4	PO2	Analyze (L4)	3
3	14	21.21	3	Apply	L3	PO1	Apply (L3)	3
4	14	21.21	3	Evaluate	L5	PO1	Apply (L3)	3
5	14	21.21	3	Evaluate	L5	PO1	Apply (L3)	3

Justification:

CO1: Apply the matrix algebra techniques for solving various linear equations.
Action Verb: Analyze (L4)
PO2 Verbs: Analyze (L4)
CO1 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
CO2: Analyze the linear transformations of quadratic forms and mean value theorems.
Action Verb: Analyze (L4)
PO2 Verbs: Analyze (L4)
CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
CO3: Apply the fundamental concepts of partial derivatives for multi variable functions.
Action Verb: Apply (L3)
PO2 Verbs: Analyze (L4)
CO3 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO4: Evaluate the multiple integrals in cartesian, polar, cylindrical, and spherical co-ordinate systems.
Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3)
CO4 Action Verb is high level to PO1 verb; Therefore correlation is high (3).

CO5: Evaluate the improper integrals using special functions like Beta and Gamma.
Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3)
CO5 Action Verb is high level to PO1 verb; Therefore correlation is high (3).

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Course Code	Year & Sem	APPLIED PHYSICS	L	T	P	C
20ABS9902	I-I		3	0	0	3

Course Outcomes:

After studying the course, student will be able to

CO 1: Understand the properties of light and electromagnetic waves.

CO 2: Analyze the fundamentals of Lasers and optical fibers.

CO 3: Analyze the properties of dielectric and magnetic materials.

CO 4: Analyze the charge carrier dynamics in semiconductors by implementing the equations of state.

CO 5: Apply the basic concepts of superconductors and nanomaterials for engineering problems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	The properties of light and electromagnetic waves.			L2
2	**Analyze**	The fundamentals of Lasers and optical fibers.			L4
3	**Analyze**	The properties of dielectric and magnetic materials.			L4
4	**Analyze**	The charge carrier dynamics in semiconductors.	By implementing the equations of state.		L4
5	**Apply**	The basic concepts of superconductors and nanomaterials		for engineering problems.	L3

Unit I: Optics and EM Theory **10 Hrs**

Interference of light -principle of superposition-Conditions for sustained Interference-Interference in thin films (reflected light) - Newton's Rings -Determination of Wavelength. Diffraction-Fraunhofer diffraction- Single slit and double slit- Diffraction Grating.
Divergence and Curl of Electric and Magnetic Fields - Gauss' theorem for divergence and Stokes' theorem for curl - Maxwell's Equations (Quantitative) – Electromagnetic wave - propagation in non-conducting medium - Poynting's Theorem.

Unit II : Lasers and Fiber Optics **10 Hrs**

Lasers – Introduction – Characteristics – Spontaneous and Stimulated Emission – Einstein Coefficients – Population Inversion – Excitation Mechanism and Optical Resonator - He-Ne Laser - Nd:YAG Laser – Semiconductor Diode Laser – Applications of Lasers.

Introduction to Optical Fibers – Total Internal Reflection – Critical angle of propagation –Acceptance angle – Numerical Aperture – Classification of fibers based on Refractive index profile – Propagation of electromagnetic wave through optical fiber – modes – importance of V-number-Attenuation, Block Diagram of Fiber optic Communication – Industrial Applications –Fiber optic Sensors.

Unit III : Dielectric and Magnetic Materials **8 Hrs**

Introduction—Dielectric polarization-Dielectric polarizability, Susceptibility and Dielectric constant-Types of polarizations : Electronic and Ionic,(Quantitative), Orientation Polarizations (Qualitative) - Frequency dependence of polarization-Lorentz (internal) field-Claussius-Mosotti equation-Applications of Dielectrics: Ferroelectricity.
Introduction-Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability-Origin of permanent magnetic moment – Classification of Magnetic materials - Weiss theory of ferromagnetism (qualitative) – Hysteresis– soft and hard magnetic materials – Magnetic memory device applications.

Unit IV: Semiconductors **8 Hrs**

Origin of Energy bands (Qualitative)-Intrinsic and Extrinsic semiconductors –Direct and indirect band gap semiconductors- Density of charge carriers – Fermi energy–-Dependence of Fermi energy on carrier concentration and temperature – Electrical conductivity – Drift and Diffusion currents – Continuity equation - Hall effect -Applications of Hall effect and Semiconductors.

Unit V: Superconductors and Nanomaterials

Superconductors-Properties-Meissner'seffect-BCSTheory(Qualitative) - Josephson effect (AC&DC)-Types of Superconductors-Applications of superconductors.
Nanomaterials–Significance of nanoscale–: Physical, Mechanical, Magnetic, Optical properties of nanomaterials –Synthesis of nanomaterials:Top-down-Ball Milling, Bottom-up-Chemical vapour deposition–Characterization of nanomaterials : X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM)-Applications of Nanomaterials.

Textbooks:

1. M. N. Avadhanulu, P. G. Kshirsagar &TVS Arun Murthy" A Text book of Engineering Physics"-S. Chand Publications,11th Edition2019.
2. B.K.Pandey and S.Chaturvedi, Engineering Physics, Cengage Learning,2012.

References:

1. K Thyagarajan "Engineering Physics",-Mc Graw Hill Publishing Company Ltd, 2016
2. Shatendra Sharma, Jyotsna Sharma, " Engineering Physics", Pearson Education,2018
3. David J.Griffiths,"Introduction to Electrodynamics"-4/e, Pearson Education, 2014
4. T Pradeep, "A Text book of NanoScience and NanoTechnology"-Tata Mc Graw Hill 2013.

Mapping of COs to POs and PSOs

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

(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	16	23.8	3	Understand	L2	PO1	PO1: Apply (L3)	2
2	11	16.4	2	Analyze	L4	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
3	12	17.9	2	Analyze	L4	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
4	13	19.4	2	Analyze	L4	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
5	15	22.3	3	Apply	L3	PO1, PO4	PO1: Apply (L3)	3
	67							

Justification Statements :

CO1: 1.Understand the properties of light and electromagnetic waves.
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 fundamentals of Lasers and optical fibers.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3);
PO4 Verbs: Analyze (L4);
CO2 Action Verb is greater than PO1 verb; Therefore, correlation is high (3).
CO2 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).
CO3: Analyze the properties of dielectric and magnetic materials.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3);
PO4 Verbs: Analyze (L4);
CO3 Action Verb is greater than PO1 verb; Therefore, correlation is high (3).
CO3 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).
CO4: Analyze the charge carrier dynamics in semiconductors by implementing the equations of state.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3); PO4 Verbs: Analyze (L4);
CO4 Action Verb is greater than PO1 verb; Therefore, correlation is high (3).
CO4 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).
CO5: 5.Apply the basic concepts of superconductors and nanomaterials for engineering problems.
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
(AUTONOMOUS)
CSE(DATA SCIENCE)

Course Code	Year & Sem	Problem Solving And Programming	L	T	P	C
20AES0501	I-I		3	0	0	3

Course Outcomes:

After studying the course, student will be able to

CO 1: **Understand** the Programming and Algorithms concepts to Perform Basic operations.
CO 2: **Apply** the problem solving approaches to generate different algorithms.
CO 3: **Understand** the various operators to perform mathematical operations.
CO 4: **Apply** the Pointers and Array Techniques to manipulate the data.
CO 5: **Analyze** the Sorting and Searching Techniques to arrange the data in sorted order.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the Programming and Algorithms concepts		to Perform Basic operations.	L2
CO2	Apply	the problem solving approaches		to generate different algorithms	L3
CO3	Understand	the various operators		to perform mathematical operations	L2
CO4	Apply	the Pointers and Array Techniques		to manipulate the data	L3
CO5	Analyze	the Sorting and Searching Techniques		to arrange the data in sorted order.	L4

UNIT - I		8 Hrs
Computer Fundamentals: What is a Computer, Evolution of Computers, Generations of Computers, Classification of Computers, Anatomy of a Computer, Memory revisited, Introduction to Operating systems, Operational overview of a CPU. Introduction to Programming, Algorithms and Flowcharts: Programs and Programming, Programming languages, Compiler, Interpreter, Loader, Linker, Program execution, Fourth generation languages, Fifth generation languages, Classification of Programming languages, Structured programming concept, Algorithms, Pseudo-code, Flowcharts, Strategy for designing algorithms, Tracing an algorithm to depict logic, Specification for converting algorithms into programs.		
UNIT - II		9 Hrs
Introduction to computer problem solving: Introduction, the problem-solving aspect, top-down design, implementation of algorithms, the efficiency of algorithms, and the analysis of algorithms. **Fundamental algorithms**: Exchanging the values of two variables, counting, summation of a set of numbers, factorial computation, sine function computation, generation of the Fibonacci sequence, reversing the digits of an integer.		
UNIT - III		8 Hrs
Types, Operators, and Expressions: Variable names, data types and sizes, constants, declarations, arithmetic operators, relational and logical operators, type conversions, increment and decrement operators, bitwise operators, assignment operators and expressions, conditional expressions precedence and order of evaluation. **Input and output**: standard input and output, formatted output-Printf, formatted input-Scanf. Control Flow: Statements and blocks, if-else, else-if, switch, Loops-while and for, Loops-Do- while, break and continue, Goto and labels. **Functions and Program Structure**: Basics of functions, functions returning non-integers, external variables, scope variables, header variables, register variables, block structure, initialization, recursion, the C processor.		
UNIT - IV		9 Hrs
Factoring methods: Finding the square root of a number, the smallest divisor of a number, the greatest common divisor of two integers, generating prime numbers.		

Pointers and arrays: Pointers and addresses, pointers and function arguments, pointers and arrays, address arithmetic, character pointers and functions, pointer array; pointers to pointers, Multi-dimensional arrays, initialization of arrays, pointer vs. multi-dimensional arrays, command line arguments, pointers to functions, complicated declarations. **Array Techniques**: Array order reversal, finding the maximum number in a set, removal of duplicates from an order array, finding the kth smallest element

UNIT - V		9 Hrs

Sorting and Searching: Sorting by selection, sorting by exchange, sorting by insertion, sorting by partitioning, binary search. **Structures**: Basics of structures, structures and functions, arrays of structures, pointers to structures, self referential structures, table lookup, typedef, unions, bit-fields. **Some other Features**: Variable-length argument lists, formatted input-Scanf, file access, Error handling-stderr and exit, Line Input and Output, Miscellaneous Functions.
Textbooks:
1. Pradip Dey, and Manas Ghosh, "Programming in C", 2018, Oxford University Press. 2. R.G. Dromey, "How to Solve it by Computer". 2014, Pearson. 3. Brian W. Kernighan, and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, Pearson.
Reference Books:
1. RS Bichkar "Programming with C", 2012, Universities Press. 2. Pelin Aksoy, and Laura Denardis, "Information Technology in Theory", 2017, Cengage Learning. 3. Byron Gottfried and Jitender Kumar Chhabra, "Programming with C", 4th Edition, 2019, McGraw Hill Education.
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	PO12	PSO1	PSO2
CO1	2	3											3	
CO2	3	2	3									2	2	
CO3	2	3										2	2	
CO4	3	3	3									2	2	
CO5	3	3	3									2	2	2

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	19	25%	3	CO1: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	10	14%	2	CO2: Apply	L3	PO1 PO2 PO3 PO12	PO1: Apply(L3) PO2: Analyze (L4) PO3: Develop (L3) PO12: Thumb rule	3 2 3 2
3	19	25%	3	CO3: Understand	L2	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review (L2) PO12: Thumb rule	2 3 2
4	15	20%	2	CO4: Apply	L3	PO1 PO2 PO3 PO12	PO1: Apply(L3) PO2: Review (L2) PO3: Develop (L3) PO12: Thumb rule	3 3 3 2
5	12	16%	2	CO5: Analyze	L4	PO1 PO2 PO3 PO12	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO12: Thumb rule	3 3 3 2
	75	100 %						

Justification Statements :

CO1: Analyze the Programming and Algorithms concepts to Perform Basic operations.
Action Verb: Analyze (L4)
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)

CO2: Apply the problem solving approaches to generate different algorithms.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO2 Action verb is less than PO2 verb by one level. Therefore, the correlation is medium (2)
PO3: Develop (L3)
CO2 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO12: Thumb rule
Some of the Algorithm knowledge are used to solve various problems. Therefore, the correlation is medium (2)

CO3: Understand the various operators to perform mathematical operations.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO3 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)
PO2: Review (L2)
CO3 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO12: Thumb rule
For some mathematical operations to perform operators are used to create programs. Therefore, the correlation is medium (2)

CO4: Apply the Pointers and Array Techniques to manipulate the data.
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 by one level. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO12: Thumb rule
For some mathematical operations to perform Pointers and Array Techniques are used to create programs. Therefore, the correlation is medium (2)

CO5: Analyze the Sorting and Searching Techniques to arrange the data in sorted order.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO5 Action verb is less than PO1 verb by two levels. Therefore, the correlation is low (1)
PO2: Review (L2)
CO5 Action verb is greater than PO2 verb by one level. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO5 Action verb is greater than PO3 verb by one level. Therefore, the correlation is high (3)
PO12: Thumb rule
For some Data Structures operations to perform Sorting and Searching Techniques are used to create programs. Therefore, the correlation is medium (2)

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

Course Code	Year & Sem	Engineering Graphics	L	T	P	C
20AES0301	I-I		1	0	4	3

Course Outcomes:

After studying the course, student will be able to

CO1. **Apply** the concepts of engineering curves for technical drawing
CO2. **Understand** the quadrant system to locate the position of points and projection of lines
CO3. **Analyze** the projection of planes as well as solids located in quadrant system
CO4. **Analyze** the sectional views and development of surfaces of regular solids
CO5. **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		for technical drawing	L3
CO2	Understand	the quadrant system to locate the position of points and projection of lines			L2
CO3	Analyze	draw the projection of planes as well as 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 to Engineering graphics: Principles of Engineering Graphics and their significance Conventions in drawing - lettering - BIS conventions.
a) Conic sections including the rectangular hyperbola- general method only,
b) Cycloid, epicycloids and hypocycloid

Unit II: Projection of points, lines: Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line, traces.

Unit III: Projections of Planes: Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line. Projections of regular plane surfaces.
Projections of Solids: Projections of regular solids inclined to one or both planes by rotational or auxiliary views method.

Unit IV: Sections of solids: Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone. True shapes of the sections.
Development of surfaces: Development of surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts.
Unit V: Orthographic Projections: Systems of projections, conventions and application to orthographic projections.
Isometric Projections: Principles of isometric projection- Isometric scale; Isometric views -lines, planes, figures, simple and compound solids.

Text Books:

1. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers
2. N.D.Bhatt, Engineering Drawing, 53/e, Charotar Publishers
3. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill

4. Shah and Rana, Engineering Drawing, 2/e, Pearson Education
5. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill

Articulation Matrix

COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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

Co-relation 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 PO3 PO10 PSO1 PSO2	Apply (L3) Develop (L3) TR TR TR	3 3 1 2 2
2	15	20	2	Understand	L2	PO1 PO3 PO10 PSO1 PSO2	Apply (L3) Develop (L3) TR TR TR	2 2 1 2 2
3	15	20	2	Analyze	L4	PO1 PO3 PO10 PSO1 PSO2	Apply (L3) Develop (L3) TR TR TR	3 3 1 2 2
4	15	20	2	Analyze	L4	PO1 PO3 PO10 PSO1 PSO2	Apply (L3) Develop (L3) TR TR TR	3 3 1 2 2
5	12	16	2	Apply	L3	PO1 PO3 PO10 PSO1 PSO2	Apply (L3) Develop (L3) TR TR TR	3 3 1 2 2

Justification Statements:

CO1: Apply the concepts of engineering curves 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 and projection of lines.
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 planes as well as solids located in quadrant system**.**
Action Verb: Analyze (L4)
PO1 Verb: **Apply (L3)**
CO3: Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Develop (L3)**
CO3: Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO10 Verb: Thumb Rule (TR)
CO3: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO4: Analyze the sectional views and development of surfaces of regular solids
Action Verb: Analyze (L4)
PO1 Verb: **Apply (L3)**
CO4: Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Develop (L3)**
CO4: Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO10 Verb: Thumb Rule (TR)
CO4: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO5: Apply orthographic and isometric projections concepts to construct the given object**.**
Action Verb: Apply (L3)
PO1 Verb: **Apply (L3)**
CO5: Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Develop (L3)**
CO5: Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO10 Verb: Thumb Rule (TR)
CO5: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

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

Course Code	Year & Sem	COMMUNICATIVE ENGLISH	L	T	P	C
20AHS9901	I-I		3	0	0	3

Course Outcomes:

After studying the course, student will be able to

CO1. Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English (Listening and Writing)

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

CO3: Analyze discourse markers to speak clearly on a specific topic in informal discussions (Speaking)

CO4: Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.(Reading and Writing)

CO5: Create a coherent paragraph interpreting a figure/graph/chart/table (Writing)

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English.			L2
2	Apply	grammatical structures to formulate sentences and correct word forms.			L3
3	Analyze	discourse markers to speak clearly on a specific topic in informal discussions.			L4
4	Evaluate	reading/listening texts and to write summaries based on global comprehension of these texts.			L5
5	Create	a coherent paragraph interpreting a figure/graph/chart/table.			L6

UNIT – I		**10 Hours (4L+6P)**

Lesson: On the Conduct of Life: William Hazlitt

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 : Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph.

Grammar and Vocabulary- I : Parts of Speech, Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countable and uncountable; singular and plural; basic sentence structures; simple question form – wh questions; word order in sentences.

UNIT – II	**Probability**	**10 Hours (4L+6P)**

Lesson: The Brook: Alfred Tennyson

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

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

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

Writing: Paragraph writing (specific topics) using suitable cohesive devices; mechanics of writing - punctuation, capital letters.

Grammar & Vocabulary building-1: Cohesive devices - linkers, sign posts and transition signals; use of articles and zero article; prepositions.

Vocabulary building:2 Idioms and Phrases, Homonyms, Homophones and Homographs.

UNIT – III		10 Hours (4L+6P)

Lesson: The Death Trap: Saki

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 – identifying main idea/s and rephrasing what is read.

Grammar and Vocabulary building-II: Direct and indirect speech, reporting verbs for academic purposes.

Technical Writing-1: personal experiences, unforgettable incidents, travelogues. (Imaginative, Narrative and Descriptive).

UNIT – IV		**10 Hours (4L+6P)**

Lesson: **Innovation: Muhammad Yunus**

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/Report writing, e-mail writing

Grammar and Vocabulary: Quantifying expressions - adjectives and adverbs; comparing and contrasting; Voice - Active & Passive Voice.

Vocabulary:2 : Jigsaw Puzzles, Vocabulary Activities through Web tools

UNIT – V		**10 Hours (4L+6P)**

Lesson: **Politics and the English Language: George Orwell**

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 - without the use of PPT slides.

Reading: Reading for comprehension.

Writing: Writing structured essays on specific topics using suitable claims and evidences.

Grammar and Vocabulary: Editing short texts –identifying and correcting common errors in grammar and usage.

Technical Writing-2: Narrative short story, News paper articles on science fiction.

Textbooks:

1.Language and Life: A Skills Approach- I Edition 2019, Orient Black Swan

Reference Books:

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Raymond Murphy's English Grammar in Use Fourth Edition (2012) E-book
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.
5. Oxford Learners Dictionary, 12th Edition, 2011
6. Norman Lewis Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary (2014)
7. Speed Reading with the Right Brain: Learn to Read Ideas Instead of Just Words by David Butler

Web Links

www.englishclub.com
www.easyworldofenglish.com
www.languageguide.org/english/
www.bbc.co.uk/learningenglish
www.eslpod.com/index.html
www.myenglishpages.com

Mapping of course outcomes with program outcomes

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

CO5										**3**				

Corelation 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)	**%**	**corr**	**Verb**	**BTL**			
1	10	20	2	**Understand**	**L2**	PO10	Communication	2
2	10	20	2,2	**Apply**	**L3**	PO9,PO10	Individual and Team work, Communication	2,2
3	10	20	**3**	**Analyze**	**L4**	PO10	Communication	3
4	10	20	**3**	**Evaluate**	**L5**	PO10	Communication	3
5	10	20	**3**	**Create**	**L6**	PO10	Communication	3

Justification Statements :

CO1: Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English

Action Verb: Understand (L2)

CO1 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 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 PO12 as moderate (2)

CO3: Analyze discourse markers to speak clearly on a specific topic in informal discussions
Action Verb: Analyze (L4)

CO3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO12 as high (3).

CO4: Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.
Action Verb: Evaluate (L5)

CO4 Action Verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 to PO12 as high (3).

CO5: Create a coherent paragraph interpreting a figure/graph/chart/table
Action Verb: Create (L6)

CO5 Action Verb Create is of BTL 6. Using Thumb rule, L6 correlates PO6 to PO12 as high (3).

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

Course Code	Year & Sem	COMMUNICATIVE ENGLISH LAB	L	T	P	C
20AHS9902	I-I		0	0	2	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: Evaluate awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.

CO2: Understanding the different aspects of the language with emphasis on LSRW skills and make use of different strategies in discussions.

CO3: Apply knowledge of vocabulary and skills in various language learning activities.

CO4: Analyze speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.

CO5: Evaluate the acceptable etiquette essentials in social and professional presentations.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Evaluate**	awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.			**L5**
2	**Understand**	The different aspects of the language with emphasis on LSRW skills and make use of different strategies in discussions.			**L2**
3	**Apply**	knowledge of vocabulary and skills in various language learning activities			**L3**
4	**Analyze**	speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.			**L4**
5	**Evaluate**	the acceptable etiquette essentials in social and professional presentations.			**L5**

UNIT – I		
1. Phonetics 2. Non - verbal communication 3. Vocabulary (word formation, one word substitutes, words often misused & confused, collocations idioms & phrases)		
UNIT – II		
1. Reading Comprehension 2. JAM 3. Distinction between Native and Indian English accent (Speeches by TED and Kalam).		
UNIT – III		
1. Situational dialogues/Giving Directions 2. Describing objects/places/persons		
UNIT – IV		
1. Fun – Buzz (Tongue twisters, riddles, puzzles etc) 2 Formal Presentations		
UNIT – V		
1. Debate (Contemporary / Complex topics) 2. Group Discussion		
Software Source		
K-Van Solutions Software		
Reference Books:		

Mapping of course outcomes with program outcomes

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

Corelation Matrix

CO	Percentage of contact hours over the total planned contact hours (Approx. Hrs)			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
		%	corr	Verb	BTL			
1	9	25	3	**Evaluate**	**L5**	PO10	Communicate	3
2	6	16	2	**Understand**	**L2**	PO9	Function	2
3	6	16	**2**	**Apply**	**L3**	PO10	Communicate	2
4	6	16	**3**	**Analyze**	**L4**	PO10	Communicate	3
5	9	25	**3**	**Evaluate**	**L5**	PO10	Communicate	3

Justification Statements:

CO1: Evaluate awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.
Action Verb: Evaluate (L5)
CO1 Action Verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 to PO12 as high (3).

CO2: Understanding the different aspects of the language with emphasis on LSRW skills and make use of different strategies in discussions
Action Verb: Understand(L2)
CO2 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2)

CO3: Apply knowledge of vocabulary and skills in various language learning activities
Action Verb: Apply (L3)
CO3 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO12 as moderate (2).

CO4: Analyze speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension
Action Verb: Analyze (L4)
CO4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO12 as high (3).

CO5: : Evaluate the acceptable etiquette essentials in social and professional presentations.
Action Verb: Evaluate (L5)
CO5 Action Verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 to PO12 as high (3).

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

Course Code	Year & Sem	Applied Physics Lab	L	T	P	C
20ABS9907	I-I		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: Analyze the properties of light for solving engineering problems.
CO2: Understand the basic concepts of electromagnetic induction.
CO3: Evaluate the crystallite size using X-ray diffraction.
CO4: Analyze the basic properties of dielectric and magnetic behavior of the 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 solving engineering problems.**			**L4**
2	**Understand**	**The basic concepts of electromagnetic induction.**			**L2**
3	**Evaluate**	**The crystallite size**	**using X-ray diffraction.**		**L5**
4	**Analyze**	**The basic properties of dielectric and magnetic behavior of the given material.**			**L4**
5	**Evaluate**	**The basic parameters of a given semiconductor material.**			**L5**

List of Experiments

1. Determination of the thickness of the wire using wedge shape method. **(CO1)**
2. Determination of the radius of curvature of the lens by Newton's ring method. **(CO1)**
3. Determination of wavelength by plane diffraction grating method. **(CO1)**
4. Dispersive power of a diffraction grating. **(CO1)**
5. Study of the Magnetic field along the axis of a circular coil carrying current. **(CO2)**
6. Study the variation of B versus H of the magnetic material (B-H curve) **(CO4)**
7. Determination of the numerical aperture of a given optical fiber and angle of acceptance. **(CO1)**
8. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect. **(CO5)**
9. Determination of the energy gap of a semiconductor. **(CO5)**
10. Determination of crystallite size using X-Ray diffraction spectra. **(CO3)**
11. Determination of Wavelength of LASER using diffraction grating. **(CO1)**
12. Determination of particle size using LASER. **(CO1)**
13. Determination of the resistivity of semiconductor by Four probe method. **(CO5)**
14. Determination of dielectric constant by charging and discharging method. **(CO4)**
15. Study the temperature dependence of resistance of a thermister. **(CO5)**

Reference Books:

1. S. Balasubramanian, M.N.Srinivasan, "A Text book of Practical Physics"-S Chand Publishers, 2017.
2. http://vlab.amrita.edu/index.php-VirtualLabs, Amrita University.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			3										
CO2	2			1										
CO3	3			3										
CO4	3			3										
CO5	3			3										

Corelation 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	9	25	3	Analyze	L4	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
2	6	16	2	Understand	L2	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	2 1
3	6	16	2	Evaluate	L5	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
4	9	25	3	Analyze	L4	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							

Justification Statements:

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: Understand the basic concepts of electromagnetic induction.

Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
CO2 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
CO2 Action Verb is greater than PO1 verb by two levels; Therefore correlation is low (1).

CO3: Evaluate the crystallite size using X-ray diffraction.

Action Verb: Evaluate (L5)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
CO3 Action Verb level is greater than PO1 action verb by two levels; Therefore correlation is high (3).
CO3 Action Verb level is greater than PO4 action verb by one level; Therefore correlation is high (3).

CO4: 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)
CO4 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
CO4 Action Verb is equal to PO4 verb; 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)
CSE(DATA SCIENCE)

Course Code	Year & Sem	Problem Solving And Programming Lab	L	T	P	C
20AES0503	I-I		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO 1: Analyze the basics of computer and concepts of C for writing simple programs.

CO 2: Analyze the control statements for solving the problems using C

CO 3: Design the algorithm for implementing complex problems using C.

CO 4: Analyze the arrays to store and retrieve the elements.

CO 5: Apply the different sorting techniques for solving real world problems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Analyze**	the basics of computer and concepts of C		for writing simple programs	L4
CO2	**Analyze**	the control statements	using C	for solving the problems	L4
CO3	**Design**	the algorithm	using C	for implementing complex problems	L6
CO4	**Analyze**	the arrays		to store and retrieve the elements.	L4
CO5	**Apply**	the different sorting techniques		for solving real world problems	L3

List of Experiments

1. Assemble and disassemble parts of a Computer **(CO1)**
2. Design a C program which reverses the number**(CO1)**
3. Design a C program which finds the second maximum number among the given list of numbers. **(CO2)**
4. Construct a program which finds the kth smallest number among the given list of numbers. **(CO2)**
5. Design an algorithm and implement using C language the following exchanges a ← b ← c ← d ← a**(CO2)**
6. Develop a C Program which counts the number of positive and negative numbers separately and also compute the sum of them. **(CO2)**
7. Implement the C program which computes the sum of the first n terms of the series Sum = 1 – 3 + 5 -7 + 9**(CO2)**
8. Design a C program which determines the numbers whose factorial values are between 5000 and 32565. **(CO2)**
9. Design an algorithm and implement using a C program which finds the sum of the infinite series 1 – x2/2! + x4/4! – x6/6! + …. **(CO3)**
10. Design a C program to print the sequence of numbers in which each number is the sum of the three most recent predecessors. Assume first three numbers as 0, 1, and 1. **(CO3)**
11. Implement a C program which converts a hexadecimal, octal and binary number to decimal number and vice versa. **(CO3)**
12. Develop an algorithm which computes the all the factors between 1and100 for a given number and implement it using C. **(CO3)**
13. Construct an algorithm which computes the sum of the factorials of numbers between m and n. **(CO3)**
14. Design a C program which reverses the elements of the array. **(CO4)**
15. Given a list of n numbers, Design an algorithm which prints the number of stars equivalent to the value of the number. The starts for each number should be printed horizontally. **(CO4)**
16. Implement the sorting algorithms a. Insertion sort b. Exchange sort c. Selection sort d. Partitioning sort. **(CO5)**
17. Illustrate the use of auto, static, register and external variables. **(CO5)**
18. Design algorithm and implement the operations creation, insertion, deletion, traversing on a singly linked list. **(CO5)**
19. Develop a C program which takes two numbers as command line arguments and finds all the common factors of those two numbers. **(CO5)**
20. Design a C program which sorts the strings using array of pointers. **(CO5)**

Instructors may add some experiments to the above list. Moreover, 50% of the experiments are to be changed every academic year. Instructors can choose the experiments, provided those experiments are not repetitions.

Mapping of course outcomes with program outcomes

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

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: Analyze	L4	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	3 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: Design	L6	PO1 PO2 PO3 PO4 PO5 PO12	PO1: Apply(L3) PO2: Formulate (L6) PO3: Design(L6) PO4: Analyze (L4) PO5: Create (L6) PO12: Thumb rule	3 3 3 3 3 3
4	CO4: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO12	PO1: Apply(L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze (L4) PO5: Apply (L3) PO12: Thumb rule	3 3 3 3 3 3
5	CO5: Apply	L3	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 2 3

Justification Statements :

CO1: Analyze the basic concepts of C for writing simple programs.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

CO1 Action verb is Greater than 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: Analyze the control statements for solving the problems.

Action Verb: Analyze (L4)

PO1: Apply (L3)

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

PO2: idetify(L3)

CO2 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO2 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Apply (L3)
CO2 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)

CO3: Design the algorithm for implementing complex problems using C.
Action Verb: Design (L6)
PO1: Apply (L3)
CO3 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Formulate(L6)
CO3 Action verb is same as PO2 verb. Therefore, the correlation is high (3)
PO3: Design (L6)
CO3 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO3 Action verb is greater than as PO4 verb. Therefore, the correlation is high (3)
PO5: create (L6)
CO3 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

PO12: Thumb rule
Algorithms analysis is learning process to find the solution better manner the correlation is high (3)

CO4: Analyze the arrays to store and retrieve the elements.

Action Verb: Analyze (L4)
PO1: Apply (L3)
CO4 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: idetify(L3)
CO4 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is greater than as 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 as PO5 verb. Therefore, the correlation is high (3)

PO12: Thumb rule
Data analysis is the trending approach in the current days Therefore, the correlation is high (3)

CO5: Apply the different sorting techniques for solving real world problems.

Action Verb: Apply (L3)
PO1: Apply (L3)
CO5 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2: idetify(L3)
CO5 Action verb is same as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO5 Action verb is same as PO3 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)
PO5: Apply (L3)
CO5 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(AUTONOMOUS)

B.Tech-CSE(DATA SCIENCE)

(Effective for the batches admitted in 2022-23)

Semester II (First year)

Sl.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P	C			
1	BS	20ABS9904	Chemistry	3	0	0	3	30	70	100
2	BS	20ABS9911	Probability and Statistics	3	0	0	3	30	70	100
3	ES	20AES0505	Information Technology and Numerical Methods	3	0	0	3	30	70	100
4	ES	20AES0502	Data Structures	3	0	0	3	30	70	100
5	ES	20AES0509	Python Programming	1	0	4	3	30	70	100
6	ES LAB	20AES0506	Computer Science and Engineering Workshop	0	0	3	1.5	30	70	100
7	BS LAB	20ABS9909	Chemistry Lab	0	0	3	1.5	30	70	100
8	ES LAB	20AES0504	Data Structures Lab	0	0	3	1.5	30	70	100
9	MC	20AMC9903	Environmental Studies	3	0	0	0	30	0	30
			Total credits				**19.5**	**270**	**560**	**830**

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

Course Code	Year & Sem	Chemistry	L	T	P	C
20ABS9904	I-II	**(Common to I Sem- CSE & CIC, II Sem EEE, ECE)**	**3**	**0**	**0**	**3**

Course Outcomes:

After studying the course, student will be able to

CO 1: **Understand** the interaction of energy levels between atoms and molecules

CO 2: **Apply** the electrochemical principles to the construction of batteries, fuel cells and electrochemical sensors

CO 3: **Analyze** the preparation and mechanism of polymers

CO 4: **Analyze** the separation of gaseous and liquid mixtures using instrumental methods

CO 5: **Apply** the purification technique to remove hardness of water and to check the quality of water

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	The interaction of energy levels between atoms and molecules			L2
2	**Apply**	The electrochemical principles		to the construction of batteries, fuel cells and electrochemical sensors	L3
3	**Analyze**	The preparation and mechanism of polymers			L4
4	**Analyze**	The separation of gaseous and liquid mixtures	Using instrumental methods		L4
5	**Apply**	The purification technique to remove hardness of water		to check the quality of water	L3

Unit 1: Structure and Bonding Models **(10 hrs)**

Planck's quantum theory, Schrodinger wave equation, significance of Ψ^1 and Ψ^2 , applications to hydrogen, particle in a box and their applications for conjugated molecules, crystal field theory – salient features – energy level diagrams for transition metal ions – splitting of orbital's in tetrahedral and octahedral complexes, magnetic properties, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of O_2 , N_2 and CO, calculation of bond order.

Unit 2: Electrochemistry and Applications **(10 hrs)**

Electrodes – concepts, reference electrodes (Calomel electrode, Ag/AgCl electrode and glass electrode) electrochemical cell, Nern'st equation, cell potential calculations, numerical problems, concept of pH, pH meter and applications of pH metry (acid-base titrations), potentiometry- potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations), photovoltaic cell – working and applications, photogalvanic cells with specific examples. Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with examples.

Primary cells – Zinc-air battery, alkali metal sulphide batteries, Fuel cells, hydrogen-oxygen, methanol fuel cells – working of the cells.

Secondary cells – lead acid, nickel-metal hydride and lithium ion batteries- working of the batteries including cell reactions, button cells,

Unit 3: Polymer Chemistry **(10 hrs)**

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, copolymerization (stereospecific polymerization) with specific examples and mechanisms of polymer formation. Plastics - Thermoplastics and Thermosettings, Preparation,

properties and applications of – Bakelite, urea-formaldehyde, Nylon-66, carbon fibres, Elastomers– Buna-S, Buna-N–preparation, properties and applications.

Conducting polymers – polyacetylene, polyaniline, polypyrroles – mechanism of conduction and applications.

Unit 4: Instrumental Methods and Applications (10 hrs)

Principle and applications of Colorimetry, AAS, AES, UV-Viscible spectrophotometry (Beer-Lambert's law, Instrumentation ,Principles and applications of Chromatographic techniques(GC & HPLC), separation of gaseous mixtures and liquid mixtures(GC & HPLC methods).

Unit 5: Water Technology (10 hrs)

Introduction –Soft Water and hardness of water, Estimation of hardness by EDTA Method - Boiler troubles - scale and sludge, Industrial water treatment – specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, zeolite and ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electrodialysis.

Text books:

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

Reference books:

1. J. D. Lee, Concise Inorganic Chemistry, 5/e, Oxford University Press, 2008.
2. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
3. Ben L. Feringa and Wesley R. Browne, Molecular Switches, 2/e, Wiley-VCH, 2011.
4. Willard Merritt Dean Settle, 7 th Edition Instrumental methods for analysis

Mapping of COs to POs and PSOs

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

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

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours				CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	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	Analyze	L4	PO2	PO2: Analyze (L4)	3
4	10	13	20.3	3	Analyze	L4	PO2	PO2: Analyze (L4)	3
5	10	12	18.7	3	Apply	L3	PO1	PO1: Apply (L3)	3
	50	64							

CO1: Understand the interaction of energy levels between 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 the electrochemical principles to the construction of batteries, fuel cells and electrochemical sensors
Action Verb: Apply (L3)
PO1 Verbs: Apply (L3)
CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
CO3: Analyze the preparation and mechanism of polymers
Action Verb: Analyze (L4)
PO2 Verb: Analyze (L4)
CO3 Action Verb level isequal to PO2 verb; Therefore correlation is high (3).
CO4: Analyze the separation of gaseous and liquid mixtures using instrumental methods
Action Verb: Analyze (L4)
PO2 Verb: Analyze (L4)
CO4 Action Verb level isequal to PO2 verb; Therefore correlation is high (3).
CO5: Apply the purification technique to remove hardness of water and to check the quality of water
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
(AUTONOMOUS)
CSE(DATA SCIENCE)

Course Code	Year & Sem	Probability and Statistics	L	T	P	C
20ABS9911	I-II		3	0	0	3

Course Outcomes:

After studying the course, student will be able to

CO1:Understand the discrete and continuous data through various statistical methods.
CO2:Analyze the concepts of probability, Baye's theorem and its applications.
CO3:Analyze the discrete and continuous probability distributions for random data.
CO4: Apply the techniques for testing of hypothesis for large samples.
CO5:Apply the techniques for testing of hypothesis for small samples.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the discrete and continuous data	through statistical methods.		**L2**
CO2	Analyze	The concepts of probability and its applications			**L4**
CO3	Analyze	The discrete and continuous probability distributions	for random data.		**L4**
CO4	Apply	The techniques for testing of hypothesis	For large samples		**L3**
CO5	Apply	The techniques for testing of hypothesis	For small samples		**L3**

UNIT – I	**Descriptive statistics and methods for data science**	9 Hrs
Data science, Statistics Introduction, Population vs Sample, Collection of data, primary and secondary data, Type of variable: dependent and independent Categorical and Continuous variables, Data visualization, Measures of Central tendency, Measures of Variability (spread or variance) Skewness Kurtosis, correlation, correlation coefficient, rank correlation, regression coefficients, principle of least squares, method of least squares, regression lines		
UNIT – II	**Probability**	9 Hrs
Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation.		
UNIT – III	**Probability distributions**	9 Hrs
Probability distribution - Binomial, Poisson approximation to the binomial distribution and normal distribution-their properties.		
UNIT – IV	**Estimation and Testing of hypothesis, large sample tests**	9 Hrs
Estimation-parameters, statistics, sampling distribution, point estimation, Formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level of significance, two types of errors and power of the test. Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems.		
UNIT – V	**Small sample tests**	9 Hrs
Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), x2 - test for goodness of fit.		

Textbooks:

1. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012.

Reference Books:

1. S.Chand ,Probability and Statistics, Dr.T.K.V.Iyengar, Dr.B.Krishna Gandhi, S.Ranganatham, Dr.M.V.S.S.N.Prasad

2. S. Ross, a First Course in Probability, Pearson Education India, 2002.
3. W. Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		1												
CO2		3												
CO3		3												
CO4	3													
CO5	3													

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**	15.06	**2**	Understand	**L2**	PO2	Analyze (L4)	1
2	**15**	20.52	**3**	Analyze	**L4**	PO2	Analyze (L4)	3
3	**16**	21.9	**3**	Analyze	**L4**	PO2	Analyze (L4)	3
4	**16**	21.9	**3**	Apply	**L3**	PO1	Apply (L3)	3
5	**14**	20	**3**	Apply	**L3**	PO1	Apply (L3)	3

Justification Statements :
CO1: Understand the discrete and continuous data through various statistical methods.
Action Verb: Understand (L2)
PO2 Verbs: Analyze(L4)

CO1 Action Verb is low level to PO2 verb by two levels; Therefore correlation is low (1).
CO2: Analyze the concepts of probability, Baye's theorem and its applications.
Action Verb: analyze (L4)

PO2 Verbs: Analyze (L4)

CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
CO3: Analyze the discrete and continuous probability distributions for random data.
Action Verb: Analyze (L4)

PO2 Verb: Analyze (L4)

CO3 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).
CO4: Apply the techniques for testing of hypothesis for large samples.
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 techniques for testing of hypothesis for small samples.
Action Verb: Apply
PO1 Verb: Apply (L3)
CO5 Action verb is equal to PO1 verb ; therefore the correlation is high (3).

(AUTONOMOUS)
CSE(DATA SCIENCE)

Course Code	Year & Sem	Information Technology and Numerical Methods	L	T	P	C
20AES0505	I-II	(common to CSE,CSE(DS),CIC)	3	0	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: **Understand** the Digital World and Exploring Cyber space.
CO2: **Analyze** the needs of hardware and software required for a computation task.
CO3: **Analyze** Peripheral devices networking and internet concepts.
CO4: **Apply** the concepts of Errors, Algebraic & Transcendental Equations to solve different Engineering problems.
CO5: **Analyze** the relevant numerical methods in interpolation, curve fitting, numerical differentiation and integration.
CO6: **Evaluate** the numerical solutions of ordinary differential equations by using different methods.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the Digital World		Exploring Cyber space.	L2
CO2	Analyze	the needs of hardware and software required for a computation task			L4
CO3	Analyze	Peripheral devices, networking and internet concepts			L4
CO4	Apply	the concepts of Errors, Algebraic & Transcendental Equations		to solve different Engineering problems.	L3
CO5	Analyze	the relevant numerical methods in interpolation, curve fitting, numerical differentiation and integration.			L4
CO6	Evaluate	the numerical solutions of ordinary differential equations	by using different methods.		L5

Information Technology

UNIT – I — 8 Hrs

INTRODUCTION TO INFORMATION TECHNOLOGY Your Digital World: The Practical User: How Becoming Computer Savvy Benefits You, Information Technology & Your Life: The Future Now, Infotech Is All Pervasive: Cell phones, Email, the Internet, & the E-World, The "All-Purpose Machine": The Varieties of Computers, Understanding Your Computer: How Can You Customize (or Build) Your Own PC?, Where Is Information Technology Headed?

THE INTERNET & THE WORLD WIDE WEB Exploring Cyberspace: Connecting to the Internet: Narrowband, Broadband, & Access Providers, How Does the Internet Work? The World Wide Web, Email & Other Ways of Communicating over the Net, The Online Gold Mine: Telephony, Multimedia, Webcasting, Blogs, E-Commerce, & the Social Web, The Intrusive Internet: Snooping, Spamming, Spoofing, Phishing, Pharming, Cookies, & Spyware.

UNIT – II — 9 Hrs

SOFTWARE Tools for Productivity & Creativity: SOFTWARE: TOOLS FOR PRODUCTIVITY & CREATIVITY, **System Software:** The Power Behind the Power, The Operating System: What It Does? Other System Software: Device Drivers & Utility Programs, Common Features of the User Interface, Common

Operating Systems, Application Software: Getting Started, Word Processing, Spreadsheets, Database Software, Specialty Software

HARDWARE: THE CPU & STORAGE How to Choose a Multimedia Computer System: HARDWARE: THE CPU & STORAGE: HOW TO CHOOSE A MULTIMEDIA COMPUTER SYSTEM, Microchips, Miniaturization, & Mobility, the System Unit: The Basics, More on the System Unit, Secondary Storage, Future Developments in Processing & Storage

UNIT – III		8 Hrs

HARDWARE: INPUT & OUTPUT Taking Charge of Computing & Communications: Input & Output, Input Hardware, Output Hardware, Input & Output Technology & Quality of Life: Health & Ergonomics, The Future of Input & Output

COMMUNICATIONS, NETWORKS, & SAFEGUARDS The Wired & Wireless World: From the Analog to the Digital Age, Networks, Wired Communications Media, Wireless Communications Media, Cyber Threats, Hackers, & Safeguards

Textbooks:

1. Using Information Technology 9th Edition By Brian Williams and Stacey Sawyer, Mcgraw Hill Publications
2. "Computer Oriented Numerical Methods" by V Rajaraman

Reference Books:

1. Uttam K Roy, ―Web Technologies‖, Oxford University Press, 1st Edition, 2010.
2. HTML and CSS: Design and Build Websites 1st Edition by Jon Duckett (Author) india price
3. Steven Holzner, ―The Complete Reference PHP‖, Tata McGraw-Hill, 1st Edition, 2007.
4. HTML & CSS: The Complete Reference, Fifth Edition (Complete Reference Series)
5. Deitel and Deitel and Nieto, ―Internet and World Wide Web - How to Program‖, Prentice Hall, 5 th Edition, 2011.
6. Numerical Methods by E Balaguruswamy

Numerical Methods

UNIT – I		15 Hrs

Errors in Numerical computations: Errors and their Accuracy, Mathematical Preliminaries, Errors and their Analysis, Absolute, Relative and Percentage Errors, A general error formula, Error in a series approximation.

Solution of Algebraic and Transcendental Equations: The Bisection Method – The Method of False Position– NewtonRaphson Method, Solution of linear simultaneous equation: Crout's triangularisation method, Gauss - Seidal iteration method

UNIT – II		15 Hrs

Interpolation: Newton's forward and backward interpolation formulae – Lagrange's formulae. Gauss forward and backward formula, Stirling's formula, Bessel's formula.

Curve fitting: Fitting of a straight line – Second degree curve – Exponential curve-Power curve by method of least squares. Numerical Differentiation for Newton's interpolation formula. Numerical Integration: Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule.

UNIT – III		16 Hrs

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations-Euler's Method- Runge - Kutta Methods. Numerical solutions of Laplace equation using finite difference approximation. Initial Value Problem, Eigen Value Problem and Boundary-value Problem

TEXT BOOKS:

1. Higher Engineering Mathematics, B.S.Grewal, Khanna publishers.
2. Introductory Methods of Numerical Analysis, S.S. Sastry, PHI publisher.

Mapping of course outcomes with program outcomes

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

CO5		3											
CO6		3											

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	11	36%	3	CO1: understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	10	33%	3	CO2: Analyze	L4	PO2 PO4 PO5	PO2: Identify(L3) PO4: Analyze (L4) PO5: Apply(L3)	3 3 3
3	9	31%	3	CO3: Analyze	L4	PO1 PO2 PO10	PO1: Apply(L3) PO2: Identify(L3) PO12:Thumbrule	3 3 3
	30	100 %						

Justification Statements :

CO1: Understand the Digital World and Exploring Cyber space.

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 medium of (2)
PO2 Verb : Review(L2)
CO1 Action verb is Same as level of PO2 Therefore, the correlation is High(3)
CO2: Analyze the needs of hardware and software required for a computation task.
Action Verb : Analyze(L4)
PO2 Verb Identify(L3)
CO2 Action verb is more than level of PO2 verb by one level. Therefore, the correlation is High(3)
PO4 Verb : Analyze(L4)

CO2 Action verb is same as level of PO4 verb Therefore, the correlation is High(3)
PO5: Apply(L3)
CO2 Action verb is hreater than level of PO2 verb by one level. Therefore, the correlation is High(3)

CO3: Analyze Communications, networking and internet concepts.
Action Verb : Analyze(L4)

PO1: Apply(L3)
CO3 Action verb is greater than level of PO1 verb by one level. Therefore, the correlation is High(3)
PO2: Identify(L3)

CO3 Action verb is greater than level of PO2 verb by one level. Therefore, the correlation is High(3)
PO12:Thumbrule
CO3:Networking and Peripheral concepts of updates required .so one its to learn frequently Therefore, the correlation is High(3)

Correlation matrix

	CO			

Unit No.	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
4	15	33%	3	CO4: **Apply**	L3	PO1	PO1: Apply(L3)	3
5	15	33%	3	CO5: Analyze	L4	PO2	PO2: Analyze(L4)	3
6	16	34%	3	CO6: **Evaluate**	L5	PO2	PO2: Analyze(L4)	3
	30	100 %						

Justification Statements :

CO4: **Apply** the concepts of Errors, Algebraic & Transcendental Equations to solve different Engineering problems.

Action Verb : Apply (L3)
PO1 Verb : Apply(L3)
CO4 Action verb is same as PO1 verb. Therefore, the correlation high (3)

CO5: **Analyze** the relevant numerical methods in interpolation, curve fitting, numerical differentiation and integration.

Action Verb : Analyze(L4)
PO2 Verb Analyze(L4)
CO5 Action verb is same as PO2 verb. Therefore, the correlation is High(3)

CO6: **Evaluate** the numerical solutions of ordinary differential equations by using different methods.

Action Verb : Evaluate (L5)

PO2: Analyze(L4)

CO6 Action verb is greater than level of PO2 verb. Therefore, the correlation is High(3)

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

Course Code	Year & Sem	Data Structures (common to CSE,CIC,CSE(DS))	L	T	P	C
20AES0502	I-II		3	0	0	3

Course Outcomes:

After studying the course, student will be able to

CO 1: Understand the basic concepts of an Algorithm to measure its performance

CO 2: Apply the Linear Data Structure to arrange the data in memory

CO 3: Apply the Non-Linear Data Structure to organize the data in hierarchical structure

CO 4: Evaluate the real time problems using graphs and hashing techniques

CO 5: Apply the File handling and sorting methods to rearrange the data**.**

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the basic concepts of an Algorithm		to measure its performance	L2
CO2	**Apply**	the Linear Data Structure		to arrange the data in memory	L3
CO3	**Apply**	the Non-Linear Data Structure		to organize the data in hierarchical structure	L3
CO4	**Evaluate**	the Real Time Problems	using Graphs and Hashing Techniques		L5
CO5	**Apply**	the File handling and sorting methods		to rearrange the data	L3

UNIT – I		9 Hrs
Introduction		
Algorithm Specification, Performance analysis, Performance Measurement. Arrays: Arrays, Dynamically Allocated Arrays. Structures and Unions. Sorting: Motivation, Quick sort, how fast can we sort, Merge sort, Heap sort		
UNIT – II		9 Hrs
Stack, Queue and Linked lists		
Stacks, Stacks using Dynamic Arrays, Queues, Circular Queues Using Dynamic Arrays, Evaluation of Expressions, Multiple Stacks and Queues. Linked lists: Singly Linked Lists and Chains, Representing Chains in C, Linked Stacks and Queues, Additional List Operations, Doubly Linked Lists.		
UNIT – III		9 Hrs
Trees		
Introduction, Binary Trees, Binary Tree Traversals, Additional Binary Tree Operations, Binary Search Trees, Counting Binary Trees, Optimal Binary search Trees, AVL Trees. B-Trees: B- Trees, B + Trees.		
UNIT – IV		9 Hrs
Graphs and Hashing		
The Graph Abstract Data Type, Elementary Graph Operations, Minimum Cost Spanning Trees, Shortest Paths and Transitive Closure Hashing: Introduction to Hash Table, Static Hashing, Dynamic Hashing.		
UNIT – V		9 Hrs
Files and Advanced sorting		
File Organization: Sequential File Organization, Direct File Organization, Indexed Sequential File Organization. Advanced sorting: Sorting on Several keys, List and Table sorts, Summary of Internal sorting, External sorting.		
Textbooks:		
1.Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd Edition, Galgotia Book Source, Pvt. Ltd., 2004. 2.Alan L. Tharp, "File Organization and Processing", Wiley and Sons, 1988.		
Reference Books:		
1.D. Samanta, "Classic Data Structures", 2nd Edition, Prentice-Hall of India, Pvt. Ltd., India, 2012. 2.Peter Bras, "Advanced Data Structures", Cambridge University Press, 2016		

3.Richard F.Gilberg, Behrouz A.Forouzan, "Data Structures A Pseudo code Approach with C", Second Edition, Cengage Learning 2005.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3											2	
CO2	3	3		3								2	2	1
CO3	3	3		3								2	2	1
CO4	1	2	3	3			3					3	2	2
CO5	3	3	3	2								3	2	2

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	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 PO12	PO1: Apply(L3) PO2: Review (L2) PO4: Develop (L3) PO12: Thumb rule	3 3 3 2
3	15	20%	2	CO3: Apply	L3	PO1 PO2 PO4 PO12	PO1: Apply(L3) PO2: Review (L2) PO4: Develop (L3) PO12: Thumb rule	3 3 3 2
4	13	18%	2	CO4: Evaluate	L5	PO1 PO2 PO3 PO4 PO7 PO12	PO1: Apply(L3) PO2: Formulate (L6) PO3: Develop (L3) PO4: Analyze(L4) PO7: Thumb rule PO12: Thumb rule	1 2 3 3 3 3
5	14	19%	2	CO5: Apply	L3	PO1 PO2 PO3 PO4 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO4: Analyze(L4) PO12: Thumb rule	3 3 3 2 3
	74	100 %						

Justification Statements :

CO1: Understand the basic concepts of an Algorithm to measure its performance
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)

CO2: Apply the Linear Data Structure to arrange the data in memory
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 less than PO2 verb by one level. Therefore, the correlation is medium (2)
PO4: Develop (L3)
CO2 Action verb is same level as PO4 verb. Therefore, the correlation is high (3)
PO12: Thumb rule
For some of Linear Data Structure applications, array and structure concepts are used to write programs. Therefore, the correlation is medium (2)

CO3: Apply the Non-Linear Data Structure to organize the data in hierarchical structure
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)
PO4: Develop (L3)
CO3 Action verb is same level as PO4 verb. Therefore, the correlation is high (3)
PO12: Thumb rule
For some of Non-Linear Data Structure applications, array and structure concepts are used to write programs. Therefore, the correlation is medium (2)

CO4: Evaluate the real time problems using graphs and hashing techniques
Action Verb: Evaluate (L5)

PO1: Apply(L3)
CO4 Action verb is less than PO1 verb by two levels. Therefore, the correlation is low (1)
PO2: Review (L2)
CO4 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO4 Action verb is greater than PO4 verb. Therefore, the correlation is high (3)
PO7: Thumb rule
For some of Real Time problems Data Structure applications, Graph concept is indirectly used to sustainable environment development. Therefore, the correlation is high (3)
PO12: Thumb rule
For some of Real Time problems Data Structure applications, Graph and Hash concepts are used to write programs and evaluation. Therefore, the correlation is high (3)

CO5: Apply the File handling and sorting methods to rearrange the data.
Action Verb: Apply (L3)

PO1: Apply(L3)
CO5 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L2)
CO5 Action verb is greater than 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: Analyze (L4)
CO5 Action verb is less than PO4 verb by one level. Therefore, the correlation is medium (2)
PO12: Thumb rule
For some of data manipulations Sorting and File Organization methods are used to solve storage problems. Therefore, the correlation is high (3)

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

Course Code	Year & Sem	Python Programming	L	T	P	C
20AES0509	I-II		1	0	4	3

Course Outcomes:

CO 1: Understand the basic Python environment data types, operators used to constructs simple programs

CO 2: Apply the concept of conditionals and loops in Python programs solving complex problems.

CO 3: Evaluate the Python programs by defining functions and calling them.

CO 4: Apply the concepts of Object-Oriented Programming for real time for applications.

CO 5: Create python programs to read and write data from/to files and apply exception Handling.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	basic concepts of Python environment	Data types and operators	for writing simple Programs	L2
CO2	**Apply**	Conditionals and loops		for solving complex problems	L3
CO3	**Evaluate**	Define functions	Numpy,pandas	For implement real time applications	L5
CO4	**Apply**	Object oriented programming	Class, objects	To evaluate the real time problems	L3
CO5	**Create**	Read and write operations and Exceptions	Use Exception Handling	To test bug free applications	L6

UNIT – I		9 Hrs

Basics of Python Programming: Features and applications of Python, Comparison with C, Literals, variables and identifiers, data types, comments, reserved words, indentation, operators, Input and Output Statements, type conversion.

- Write a program to demonstrate different representations of numbers in Python.
- Write a program to perform different Operations on operators in Python

UNIT – II		9 Hrs

Decision Control Statements: Introduction, selection/conditional branching statements, basic loop structures/iterative statements, nested loops, break, continue and pass statements, else statement used with loops.

Strings: operations and methods, Lists: accessing and updating values in list, nested and cloning lists, basic list operations, list methods, list comprehensions, looping in lists, Tuples, Sets, Dictionaries and Operations.

- Develop programs to demonstrate decision making and looping structures in python.
- Write a program to create, append, and remove lists in Python.
- Write a program to demonstrate working with tuples in python.
- Write a program to demonstrate working with dictionaries in python.

Case study on Loops:

- A perfect number is a number for which the sum of its proper divisors is exactly equal to the number. For example, the sum of the proper divisors of 28 would be 1 + 2 + 4 + 7 + 14 = 28, which means that 28 is a perfect number. A number n is called deficient if the sum of its proper divisors is less than n and it is called abundant if this sum exceeds n. Write a program for the

given large n, find the sum of all perfect numbers, sum of all deficient numbers and sum of abundant numbers separately. Print all perfect numbers along with its sum, deficient numbers along with its sum and abundant numbers along with its sum.

UNIT – III		9 Hrs

Functions: Introduction, Declaration and definition, calling a function, returning values from function, pass by object reference, arguments, Local and Global variables, recursive functions, lambda functions, fruitful functions.

Libraries: NumPy, pandas, Keras.

- Develop Python programs using recursive and non-recursive functions
- Write a program to demonstrate a) arrays b) array indexing such as slicing, integer array indexing and Boolean array indexing along with their basic operations in NumPy

Case study on Functions:

- Write a function mult_lists(a, b) that takes two lists of numbers of the same length, and returns the sum of the products of the corresponding elements of each.

UNIT – IV		9 Hrs

Classes and Objects: Introduction, classes and objects, constructor, encapsulation, Class method and self-argument, __init__() method, class variables and object variables, __del__() method, other special method, public and private data members, private methods, built-in class functions and attributes, overloading methods, overriding methods.

- Write a program to demonstrate how to create classes and objects in the application.

Case study on Classes

- Design a class named QuadraticEquation for a quadratic equation $ax^2+bx+c=0$. The class contains:
  • The private data fields a, b, c that represents three coefficients.
  • A constructor for the arguments for a, b and c
  • Three get methods for a, b and c
  • A method named getDiscriminant() that returns the discriminant, which is b^2-4ac.
  • The methods named getRoot1() and getRoot2() for returning the two roots of the equation using the formulas:
  $R_1 = -b + (\sqrt{b^2-4ac})/2a$ and $R_2 = -b - (\sqrt{b^2-4ac})/2a$.
  • These methods are useful only if the discriminant is non negative. Let these methods return 0 if the discriminant is negative.
  • Write a test program that prompts the user to enter values for a, b, c and displays the result based on discriminant.

UNIT – V		9 Hrs

Inheritance: Introduction, inheriting classes in python, types of inheritance, complex objects, abstract classes and interfaces. **Error and Exception Handing:** Types of Errors, Exceptions, Handling Exceptions, types of exceptions

Files & Database: Introduction to File Input and Output, Using Loops to Process Files, Introduction to database, standard methods, working with oracle database, case study (create employees table in the oracle database).

- Develop Python programs to exemplify the concepts of inheritance and overloading.
- Write a program to create user defined exception and handle the exception in the application.

Case study on Files

- Write a script named copyfile.py. This script should prompt the user for the names of two text files. The contents of the first file should be the input that to be written to the second file.

Textbooks:

1. Allen B. Downey, "Think Python", 2nd edition, SPD/O'Reilly, 2016.
2. Reema thareja, Python Programming using problem solving approach, Oxford University Press.

Reference Books:

1. Dietel and Dietel, Python How to Program.
2. Kenneth A. lambert, B.L. Juneja, Fundamentals of Python, Cengage Learning
3. James Payne, Beginning Python using Python2.6 and Python3

Mapping of course outcomes with program outcomes

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

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 PO12	PO1: Apply(L3) PO2: Review(L2) PO12: Thumb rule	3 3 2
2	CO2: Apply	L3	PO1 PO2 PO6 PO12	PO1: Apply(L3) PO2: Review(L2) PO6: Thumb rule PO12: Thumb rule	3 3 2 2
3	CO3: Evaluate	L5	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 2 3 3 3 2
4	CO4: Apply	L3	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review(L2) PO12: Thumb rule	3 2 2
5	CO5: Create	L6	PO1 PO2 PO3 PO4 PO5 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO12: Thumb rule	3 3 3 3 3 2

Justification Statements:

CO1: Understand the basic Python environment data types, operators used to construct simple programs

Action Verb: Understand (L2)

PO1 Verb: Apply(L3)

CO1 Action verb is same level of PO1 verb by one level. Therefore, the correlation is High (3)

PO2 Verb: Review(L2)

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

PO12: Thumb rule

To solve the different mathematical functions by using operators and need to remember all the basics. Therefore, the correlation is medium (2)

CO2: Apply the concept of conditionals and loops in Python programs solving complex problems.

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)

PO6: Thumb rule

By using Loops and conditional statements programming concepts were applied to solve complex problems to find solutions. Therefore, the correlation is medium (2)

PO12: Thumb rule

For usage of the loops and conditional statements of python using IDLE is medium. Therefore, the correlation is medium (2)

CO 3: Evaluate the Python programs by defining functions and calling them.

Action Verb: Evaluate **(L5)**

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

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

PO6: Thumb rule

To construct real time applications using functions can be lifelong learning. Therefore, the correlation is medium (2)

CO 4: Apply the concepts of Object-Oriented Programming for real time for applications.

Action Verb: Apply (L3)

PO1: Apply(L3)

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

PO2: Review(L2)

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

PO12: Thumb rule

The design application needs to upgrade for future specific requirement. Therefore the correlation is medium (2)

CO 5: Create python programs to read and write data from/to files and apply exception Handling.

Action Verb: Design (L6)

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 PO1 verb. Therefore, the correlation is High (3)

PO3: Develop (L3)

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

PO4: Analyze (L4)

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

PO5: Apply(L3)

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

PO12: Thumb rule

The team should be analyzing the several types of files (static & dynamic). Improve the knowledge towards storage concepts. Therefore, the correlation is medium (2)

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

Course Code	Year & Sem	Computer Science and Engineering Workshop	L	T	P	C
20AES0506	I-II		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO 1: Understand the Process of assembling and disassembling of a computer system.

CO 2: Analyze the Software Installation steps to trouble shoot the Hardware and software

CO 3: Apply the basic formulas and functions, formatting text & objects on a required content.

CO 4: Apply the designs and templates for creating effective presentations.

CO 5: Understand the fundamentals of the Internet of Things (IoT) and its real-world applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the Process of assembling and disassembling of a computer system			L2
CO2	**Analyze**	the Software Installation steps		to trouble shoot the Hardware and software	L4
CO3	**Apply**	the basic formulas and functions, formatting text & objects on a required content			L3
CO4	**Apply**	the designs and templates		for creating effective presentations	L3
CO5	**Understand**	the fundamentals of the Internet of Things (IoT) and its real-world applications			L2

Preparing your computer

Task 1: Assembling a Computer: Disassemble and assemble the PC back to working condition. Students should be able to trouble shoot the computer and identify working and non-working parts. Student should identify the problem correctly by various methods available (eg: beeps). Students should record the process of assembling and trouble shooting a computer. **(CO1)**

Task 2: Install Operating system: Student should install Linux on the computer. Student may install another operating system (including proprietary software) and make the system dual boot or multi boot. Students should record the entire installation process. **(CO2)**

Productivity tools

Task 3: Word Processor: Students should be able to create documents using the word processor tool. Some of the tasks that are to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, changing the font, changing the colour, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Students should be able to prepare project cover pages, content sheet and chapter pages at the end of the task using the features studied. Students should submit a user manual of the word processor considered. **(CO3)**

Task 4: Spreadsheet: Students should be able to create, open, save the application documents and format them as per the requirement. Some of the tasks that may be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells. Students should submit a user manual of the Spreadsheet application considered.**(CO3)**

Task 5: Presentations: creating, opening, saving and running the presentations, selecting the style for slides, formatting the slides with different fonts, colours, creating charts and tables, inserting and deleting text, graphics and animations, bulleting and numbering, hyperlinking, running the slide show, setting the timing for slide show. Students should submit a user manual of the Presentation tool considered.**(CO4)**

IoT

Task 6: Raspberry Pi

Study the architecture of Raspberry pi, configure software, Install SD card, Connect the cables, Install Raspbian (or any other) operating system, Configure Wi-Fi, Remotely connect to your Raspberry Pi.**(CO5)**

Story Telling

Task 7: Storytelling

Use Adobe spark or any other tool to create Graphics, Webpages, and Videos. **(CO5)**

Reference Books:

1. B. Govindarajulu, "IBM PC and Clones Hardware Trouble shooting and Maintenance", 2nd edition, Tata McGraw-Hill, 2002
2. "MOS study guide for word, Excel, Powerpoint & Outlook Exams", Joan Lambert, Joyce Cox, PHI.
3. "Introduction to Information Technology", ITL Education Solutions limited, Pearson Education.
4. Rusen, "Networking your computers and devices", PHI
5. Bigelows, "Trouble shooting, Maintaining & Repairing PCs", TMH.

Mapping of course outcomes with program outcomes

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

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 PO12	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO4: Analyze (L4) PO5: Apply (L3) PO12: Thumb rule	3 3 3 2 3 3
4	CO4: Apply	L3	PO1 PO3 PO4 PO5 PO12	PO1: Apply(L3) PO3: Develop(L3) PO4: Analyze (L4) PO5: Apply (L3) PO12: Thumb rule	3 3 2 3 3
5	CO5: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Identify (L3)	2 2

Justification Statements :

CO 1: Understand the Process of assembling and disassembling of a computer system.

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)

CO 2: Analyze the Software Installation steps to trouble shoot the Hardware and software

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 formulas and functions, formatting text & objects on a required content

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 less than as PO2 verb. Therefore, the correlation is medium(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 as PO4 verb. Therefore, the correlation is medium(2))

PO5: Apply (L3)

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

PO12: Thumb rule

Documentation and presentation is learning process to find the solution better manner the correlation is high (3)

CO 4: Apply the designs and templates for creating effective presentations.

Action Verb: Apply (L3)

PO1: Apply (L3)

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

PO2: idetify(L3)

CO4 Action verb is same 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 PO4 verb. Therefore, the correlation is medium (2)

PO5: Apply (L3)

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

PO12: Thumb rule

Spread sheets in Excel is the trending approach in the current days Therefore, the correlation is high (3)

CO 5: Understand the fundamentals of the Internet of Things (IoT) and its real-world 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)

PO2 Verb: Review(L2)

CO5 Action verb is less than PO2 verb. Therefore, the correlation is medium (2)

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

Course Code	Year & Sem	CHEMISTRY LAB	L	T	P	C
20ABS9909	I-II	**(Common to I Sem – CSE, CIC, II Sem ECE/EEE)**	**0**	**0**	**3**	**1.5**

Course Outcomes:

After studying the course, student will be able to

CO1: Analyze the hardness of ground water sample.
CO2: Apply the internal and external indicators in volumetric analysis.
CO3: Analyze the preparation and applications of advanced polymer materials.
CO4: Apply the electro analytical technique to measure the strength of acids.
CO5: Analyze the mixture of components by chromatographic techniques.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	The Hardness of ground water sample.			**L4**
CO2	Apply	The internal and external indicators		In volumetric analysis	**L3**
CO3	Analyze	The preparation and applications advanced polymer materials			**L4**
CO4	Apply	The electro analytical technique		to measure the strength of acids	**L3**
CO5	Analyze	The Mixture of components	By chromatographic techniques		**L4**

List of Experiments:

1. Determination of Hardness of a groundwater sample. (CO1)
2. Estimation of iron (II) using Diphenylamine indicator (Dichrometry – Internal indicator method) (CO2)
3. Determination of pH metric titration of strong acid vs. strong base (CO4)
4. Conductometric titration of strong acid vs. strong base (CO4)
5. Determination of Fe (II) in Mohr's salt by potentiometric method. (CO4)
6. Determination of percentage of Iron in Cement sample by colorimetry
7. Determination of Strength of an acid in Pb-Acid battery (CO2)
8. Preparation of phenol-formaldehyde resin (CO3)
9. Preparation of TIO_2/ZnO nano particles (Precipitation Method) (CO3)
10. Estimation of Calcium in port land Cement (CO2)
11. Adsorption of acetic acid by charcoal (CO2)
12. Thin layer chromatography (CO5)

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

Reference:

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

Mapping of COs to POs and PSOs

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

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

CO-PO mapping justification:

CO	CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Verb	BTL			
1	Analyze	**L4**	PO4	PO4: Analyze (L4)	3
2	Apply	**L3**	PO4	PO4: Analyze (L3)	2
3	Analyze	**L4**	PO4	PO4: Analyze (L4)	3
4	Apply	**L3**	PO4	PO4: Analyze (L3)	2
5	Analyze	**L4**	PO4	PO4: Analyze (L4)	3

CO1: Analyze the hardness of ground water sample.

Action Verb: Analyze **(L4)**

PO4 Verb: Analyze (L4)

CO1 Action Verb is equal to PO4 verb; Therefore correlation is high (3).

CO2: Apply the internal and external indicators in volumetric analysis.

Action Verb: Apply **(L3)**

PO4 Verb: Analyze (L3)

CO2 Action Verb is less than PO4 verb; therefore, correlation is less (2)

CO3: Analyze the preparation and applications of advanced polymer materials.

Action Verb: Analyze **(L4)**

PO4 Verb: Analyze (L4)

CO3 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).

CO4: Apply electro analytical technique to measure the strength of acids.

Action Verb: Apply **(L3)**

PO4 Verb: Analyze (L4)

CO4 Action Verb is less than PO4 verb; therefore, correlation is less (2)

CO5: Analyze mixture of components by chromatographic techniques**.**

Action Verb: Analyze **(L4)**

PO4 Verb: Analyze (L4)

CO5 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).

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

Course Code	Year & Sem	Data Structures Lab	L	T	P	C
20AES0504	I-II		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO 1: Apply the sorting and searching algorithms using suitable data structure

CO 2: Design the algorithms to solve real time problems using Linked lists

CO 3: Design the solutions for computational problems using stacks and queues

CO 4: Evaluate the operations of breadth first search using queues

CO 5: Design the algorithms to perform operations on trees and graphs

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Apply**	sorting and searching algorithm	using suitable data structure		L3
CO2	**Design**	the algorithms	using Linked lists	To solve real time problems	L6
CO3	**Design**	the solutions for computational problems	using stacks and queues		L6
CO4	**Evaluate**	the operations of breadth first search	using queues		L5
CO5	**Design**	the algorithms		to perform operations on trees and graphs	L6

List of Experiments

1. String operations using array of pointers **(CO1)**
2. Searching Algorithms (With the Number of Key Comparisons) Sequential, Binary and Fibonacci Search Algorithms. **(CO1)**
3. Sorting Algorithms: Insertion Sort, Selection Sort, Shell Sort, Bubble Sort, Quick Sort, Heap Sort, Merge Sort, and Radix Sort. Using the system clock, compute the time taken for sorting of elements. The time for other operations like I/O etc should not be considered while computing time. **(CO1)**
4. Implementation of Singly Linked List, Doubly Linked List, Circular Linked List**(CO2)**
5. Stack implementation using arrays**(CO3)**
6. Stack implementation using linked lists**(CO3)**
7. Queue implementation using arrays. Implement different forms of queue. While implementing you should be able to store elements equal to the size of the queue. No positions should be left blank. **(CO3)**
8. Queue implementation using linked lists**(CO3)**
9. Creation of binary search tree, performing operations insertion, deletion, and traversal. **(CO4)**
10. Breadth first search**(CO4)**
11. Depth first search**(CO4)**
12. Travelling sales man problem**(CO4)**
13. File operations**(CO4)**
14. Indexing of a file**(CO4)**
15. Reversing the links (not just displaying) of a linked list. **(CO4)**
16. Consider a linked list consisting of name of a person and gender as a node. Arrange the linked list using 'Ladies first' principle. You may create new linked lists if necessary. **(CO5)**
17. An expression can be represented in three ways: infix, prefix and postfix. All the forms are necessary in different contexts. Write modules to convert from one form to another form. **(CO5)**
18. A table can be defined as a collection of rows and columns. Each row and column may have a label. Different values are stored in the cells of the table. The values can be of different data types. Numerical operations like summation, average etc can be performed on rows/columns which contain numerical data. Such operations are to be prevented on data which is not numeric. User may like to insert row/columns in the already existing table. User may like to remove row/column. Create table data type and support different operations on it. **(CO5)**

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		3								2	
CO2	3	3	3	3	3							3	2	1
CO3	3	3	3	3	3							3	2	1
CO4	3	3	2	3	2		3					3	2	2
CO5	3	3	3	3	3							3	2	2

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 PO3 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO5:Apply(L3)	3 3 3 3
2	**CO2: Design**	L6	PO1 PO2 PO3 PO4 PO5 PO12	PO1: Apply(L3) PO2: Develop (L3) PO3: Design (L6) PO4: Design (L6) PO5:Create(L6) PO12: Thumb rule	3 3 3 3 3 3
3	**CO3: Design**	L6	PO1 PO2 PO3 PO4 PO5 PO12	PO1: Apply(L3) PO2: Develop (L3) PO3: Design (L6) PO4: Design (L6) PO5:Create(L6) PO12: Thumb rule	3 3 3 3 3 3
4	**CO4: Evaluate**	L5	PO1 PO2 PO3 PO4 PO5 PO7 PO12	PO1: Apply(L3) PO2: Review (L2) PO3: Design (L6) PO4: Analysis(L4) PO5:Create(L6) PO7: Thumb rule PO12: Thumb rule	3 3 3 2 2 3 3
5	**CO5: Design**	L6	PO1 PO2 PO3 PO4 PO5 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Design(L6) PO4: Analysis(L4) PO5:Create(L6) PO12: Thumb rule	3 3 3 3 3 3

Justification Statements :

CO1: Apply the sorting and searching algorithms using suitable data structure
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)
PO3 Verb: Develop(L3)
CO1 Action verb is greater than 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: Design the algorithms to solve real time problems using Linked lists

Action Verb: Design (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)
PO3 Verb: Design(L3)
CO2 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Design (L6)
CO2 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5 Verb: Create(L6)
CO1 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO12: 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: Design the solutions for computational problems using stacks and queues
Action Verb: Design (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)
PO3 Verb: Design(L6)
CO3 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Design (L6)
CO3 Action verb is same as PO4 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)
PO12: 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: Evaluate the operations of breadth first search using queues
Action Verb: Evaluate (L5)
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 less than PO3 verb by one level. Therefore, the correlation is medium (2)
PO4: Analysis (L4)
CO4 Action verb is greater than PO4 verb by one level. Therefore, the correlation is high (3)
PO5 Verb: Create(L6)
CO4 Action verb is greater than PO5 verb. Therefore, the correlation is medium (2)
PO7: Thumb rule
For some of Real Time problems Data Structure applications, queues concept is indirectly used to sustainable environment development. Therefore, the correlation is high (3)
PO12: 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: Design the algorithms to perform operations on trees and graphs
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 same level as PO2 verb. Therefore, the correlation is high (3)
PO3: Design (L6)
CO4 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO4: Analysis (L4)
CO5 Action verb is greater than PO4 verb. Therefore, the correlation is high (3)
PO5 Verb: Create(L6)
CO1 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

PO12: 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)
CSE(DATA SCIENCE)

Course Code	Year & Sem	ENVIRONMENTAL STUDIES	L	T	P	C
20AMC9903	I-II		3	0	0	0

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the multidisciplinary nature of environmental studies and various renewable and nonrenewable resources.

CO2: Understand the ecosystem and biodiversity to solve complex environmental problems

CO3: Apply various types of pollution and solid waste management and related preventive measures

CO4: Apply rainwater harvesting, watershed management, ozone layer depletion and wasteland reclamation.

CO5:Understand the population explosion

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	Multidisciplinary nature of environmental studies and various renewable and nonrenewable resources			**L2**
2	**Understand**	Ecosystem and biodiversity to solve complex environmental problems			**L2**
3	**Apply**	Various types of pollution and solid waste management and related preventive measures			**L3**
4	**Apply**	Rainwater harvesting, watershed management, ozone layer depletion and wasteland reclamation			**L3**
5	**Understand**	Population explosion			**L2**

UNIT – I		9 Hrs

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 over utilization 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		9 Hrs

Ecosystems: Concept of an ecosystem. – Structure and functions of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic

ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Biodiversity And Its Conservation: Introduction- Definition: genetic, species and ecosystem diversity – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III		9 Hrs

Environmental Pollution: Definition, Causes, effects and its control measures 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: floods, earthquake, cyclone, Tsunami and landslides.

UNIT – IV		9 Hrs

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water 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		9 Hrs

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmed. – 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 Erach Bharucha 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	PO12	PSO1	PSO2
CO1						2	2							
CO2							2					2		
CO3						2	2							
CO4						2	2							
CO5							2					2		

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)
	Register (Hrs)	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1	10	12	23	3	Understand	L2	PO6,PO7	PO6: PO7:	2,2
2	15	15	28	3	Understand	L2	PO7,PO12	PO7: PO12:	2,2
3	8	8	15	2	Apply	L3	PO6 PO7	PO6: PO7:	2,2
4	9	10	19	2	Apply	L3	PO6,PO7	PO6: PO7:	2,2

5	**8**	**8**	15	2	**Understand**	**L2**	PO7,PO12,	PO7: PO12:	2,2
	50	**53**	**100**						

Justification Statements:

CO1: Understand the multidisciplinary nature of environmental studies and various renewable and nonrenewable resources.

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 ecosystem and biodiversity to solve complex environmental problems

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 various types of pollution and solid waste management and related preventive measures

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: Apply rainwater harvesting, watershed management, ozone layer depletion and wasteland reclamation.

Action Verb: APPLY (L3)

CO4 Action Verb is **APPLY** of BTL 2.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)

CO5: Understand the population explosion

Action Verb: Understand (L2)

CO5 Action Verb is **Understand** of BTL 2.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(AUTONOMOUS)

B.Tech-CSE(DATA SCIENCE)

Semester III (Second year) – AK20

Sl.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P	C			
1	BS	20ABS9914	Discrete Mathematical Structures	3	0	0	3	30	70	100
2	PC	20APC0503	Digital Electronics & Microprocessors	3	0	0	3	30	70	100
3	PC	20APC3201	Database Management Systems	3	0	0	3	30	70	100
4	PC	20APC3202	Advanced Python Programming for Data Science	3	0	0	3	30	70	100
5	ES	20AES0205	Basics of Electrical and Electronics Engineering	3	0	0	3	30	70	100
6	PC Lab	20APC3203	Database Management Systems Lab	0	0	3	1.5	30	70	100
7	PC Lab	20APC3204	Advanced Python Programming for Data Science Lab	0	0	3	1.5	30	70	100
8	ES Lab	20AES0206	Basics of Electrical and Electronics Engineering Lab	0	0	3	1.5	30	70	100
9	SC	20ASC3201	Exploratory Data Analysis with R	1	0	2	2	100	0	100
10	MC	20AMC9902	Constitution of India	3	0	0	0	30	0	30
			Total credits				**21.5**	**370**	**560**	**930**

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

Course Code	Year & Sem	Discrete Mathematical Structures	L	T	P	C
20ABS9914	II-I		3	0	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 non-homogeneous 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
1	**Apply**	the concepts of mathematical logic	in various engineering fields		L3
2	**Understand**	the concepts related to set theory and algebraic structures.			L2
3	**Analyse**	the theory of elementary combinatorics	by using binomial and multinomial theorems		L4
4	**Evaluate**	the solutions of homogeneous and non homogeneous recurrence relations.			L5
5	**Apply**	the graph theory solving computer science problems.		and finite difference approximation.	L3

Unit I: Mathematical Logic: **9 hrs**

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: **9 hrs**

Basic Concepts of Set Theory, Relations and Ordering, 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 and Monoids, groups, sub groups, homomorphism, Isomorphism.

Unit III: Elementary Combinatorics: **9 hrs**

Basics of Counting, 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: **9 hrs**

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: **9 hrs**

Basic Concepts, Isomorphism and Subgraphs, Trees and their Properties, Spanning Trees, Directed Trees, Binary Trees, Planar Graphs, Euler's Formula, Multigraphs and Euler Circuits, Hamiltonian Graphs, Chromatic Numbers, The Four Color Problem equation using finite difference approximation.

Text books and Reference books:

1. Joe L. Mott, Abraham Kandel and Theodore P. Baker, Discrete Mathematics for Computer Scientists & Mathematicians, 2nd Edition, Pearson Education.
2. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 2002.,
3. Kenneth H. Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, 7th Edition, McGraw Hill Education (India) Private Limited
4. Graph Theory with Applications to Engineering and Computer Science by Narsingh Deo

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	PO12
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	**15**	21.7	3	**Apply**	**L3**	PO1	**Apply (L3)**	3
2	**11**	15.9	2	**Understand**	**L2**	PO1	**Apply (L3)**	2
3	**14**	20.2	**3**	**Analyze**	**L4**	PO2	**Analyze (L4)**	3
4	**14**	20.2	**3**	**Evaluate**	**L5**	PO2	**Analyze (L4)**	3
5	**15**	21.7	**3**	**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 non homogeneous recurrence relations.
Action Verb: Evaluate (L5)
PO2 Verb: Analyze (L4)
CO4 Action Verb level 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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CSE(DATA SCIENCE)

Course Code	Year & Sem		L	T	P	C
20APC0503	II-I	**Digital Electronics & Microprocessors**	**3**	**0**	**0**	**3**

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the different logic circuits using concepts of Boolean algebra.

CO2: Analyze the different logic circuit by combining sequential and combinational circuits.

CO3: Evaluate the different sequential logic circuits for construct complex circuits like counters and registers.

CO4: Apply the 8086 microprocessors to design application for real world issues.

CO5: Apply the 8051 micro controllers to construct complex microprocessor working model for real world problems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the different logic circuits	using concepts of Boolean algebra		L2
CO2	**Analyze**	the different logic circuit	by combining sequential and combinational circuits		L4
CO3	**Evaluate**	the different sequential logic circuits		for construct complex circuits like counters and registers.	L5
CO4	**Apply**	the 8086 microprocessors		to design application for real world issues	L3
CO5	**Apply**	the 8051 micro controller		to construct complex microprocessor working model for real world problems.	L3

Syllabus:

UNIT - I Number Systems & Code Conversion

Number Systems & Code conversion, Boolean Algebra & Logic Gates, Truth Tables, Universal Gates, Simplification of Boolean functions, SOP and POS methods – Simplification of Boolean functions using K-maps, Signed and Unsigned Binary Numbers.

UNIT - II Combinational Circuits

Combinational Logic Circuits: Adders & Subtractors, Multiplexers, Demultiplexers, Encoders, Decoders, Programmable Logic Devices.

UNIT - III Sequential Circuits

Sequential Logic Circuits: RS, Clocked RS, D, JK, Master Slave JK, T Flip-Flops, Shift Registers, Types of Shift Registers, Counters, Ripple Counter, Synchronous Counters, Asynchronous Counters, Up-Down Counter.

UNIT - IV Microprocessors - I

8085 microprocessor Review (brief details only), 8086 microprocessor, Functional Diagram, register organization 8086, Flag register of 8086 and its functions, Addressing modes of 8086, Pin diagram of 8086, Minimum mode & Maximum mode operation of 8086, Interrupts in 8086.

UNIT – V Microprocessors - II

Instruction set of 8086, Assembler directives, Procedures and Macros, Simple programs involving arithmetic,

logical, branch instructions, Ascending, Descending and Block move programs, String Manipulation Instructions. Overview of 8051 microcontroller, Architecture, I/O ports and Memory organization, addressing modes and instruction set of 8051(Brief details only), Simple Programs.

Text Books:

1. M. Morris Mano, Michael D. Ciletti, Digital Design, Pearson Education, 5th Edition, 2013
2. Anil K. Maini, Digital Electronics: Principles, Devices and Applications, John Wiley & Sons, Ltd., 2007.
3. N. Senthil Kumar, M. Saravanan, S. Jeevanathan, Microprocessor and Microcontrollers, Oxford Publishers, 2010.
4. Advanced microprocessors and peripherals-A.K Ray and K.M. Bhurchandani, TMH, 2nd edition, 2006.

Reference Books:

1. Thomas L. Floyd, Digital Fundamentals – A Systems Approach, Pearson, 2013.
2. Charles H. Roth, Fundamentals of Logic Design, Cengage Learning, 5th, Edition, 2004.
3. D.V.Hall, Microprocessors and Interfacing. TMGH, 2nd edition, 2006.

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

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	14	23%	3	CO1: Understand	L2	PO1 PO3 PO9	PO1: Apply(L3) PO2: Identify(L3) PO9: Thumb Rule	2 2 2
2	10	17%	2	CO2: Analyze	L4	PO1 PO3 PO9	PO1: Apply(L3) PO2: Identify(L3) PO9: Thumb Rule	3 3 2
3	12	20%	2	CO3: Evaluate	L3	PO1 PO2 PO9 PO10	PO1: Apply(L3) PO2: Identify(L3) PO9: Thumb Rule PO10: Thumb Rule	3 3 2 2
4	10	17%	2	CO4: Apply	L3	PO1 PO3 PO9 PO10	PO1: Apply(L3) PO3: Develop(L3) PO9: Thumb Rule PO10: Thumb Rule	3 3 2 2
5	14	23%	3	CO5: Analyze	L4	PO1 PO3 PO4 PO10	PO1: Apply(L3) PO3: Develop(L3) PO4: Apply(L3) PO10: Thumb Rule	2 2 2 2
	60	100 %						

Justification Statements:

CO 1: Understand the different logic circuits using concepts of Boolean algebra.

Action Verb : Understand (L2)

PO1 Verb : Apply(L3)

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

PO2 Verb : Identify(L3)

CO1 Action verb is less than PO2 verb by one. Therefore, the correlation is medium (2)

PO9: Thumb rule

To involvement of individual must know all the basic concept to understand team work outcomes. Therefore the correlation is medium (2)

CO 2: Analyze the different logic circuit by combining sequential and combinational circuits

Action Verb : Analyze (L4)

PO1: Apply(L3)

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

PO2: Identify(L3)

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

PO9: Thumb rule

At the time of design sequential and combinational circuits were need to form the team and develop required circuits in long period. Therefore the correlation is medium (2)

CO 3: Evaluate the different sequential logic circuits for construct complex circuits like counters and registers.

Action Verb : Evaluate (L5)

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)

PO9: Develop (L3)

Need to analyze real time application from the whole team for construct complex circuits. Therefore, the correlation is high(3)

PO10: Thumb rule

For resolving solutions to complex problem required a strong engineering concepts. Therefore, the correlation is high(3)

CO 4: Apply the 8086 microprocessors to design application for real world issues.

Action Verb :Apply (L3)

PO1: Apply(L3)

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

PO3: Develop(L3)

CO4 Action verb is same as PO3 verb. Therefore the correlation is high(3)

PO9: Thumb rule

To implement real world application, the individual should have deep knowledge about 8086 microprocessors. Therefore, the correlation is medium. Therefore the correlation is medium(2)

PO10: Thumb rule

Once the model ready with 8086 microprocessors, need to narrate about model with understandable manner Therefore the correlation is medium (2)

CO 5: Analyze the 8051 micro controller to construct complex microprocessor working model for real world problems.

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 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)

PO9: Thumb rule

Once the model ready with 8085 micro controllers, need to narrate about model with understandable manner Therefore the correlation is high(3)

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CSE(DATA SCIENCE)

Course Code	Year & Sem	Database Management Systems	L	T	P	C
20APC3201	II-I	(common to CSE,CIC,AIDS,AIML,CSE(DS))	3	0	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 SQL and PL/SQL concepts to formulate queries.
CO3: Apply the E-R model for data base design of real world applications.
CO4: Analyze the query processing and optimization for data manipulation.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The fundamentals of databases		To design relational models.	L2
CO2	Apply	the SQL and PL/SQL concepts		To formulate queries.	L3
CO3	Apply	the E-R model		for data base design of real world applications	L3
CO4	Analyze	the query processing and optimization		For data manipulation.	L4
CO5	Analyze	the concurrent transactions and recover systems		to prevent data loss in system crash.	L4

CO5: Analyze the concurrent transactions and recover systems to prevent data loss in system crash.

UNIT - I	**Introduction, Introduction to Relational Model**	9Hrs
Introduction: Database systems applications, Purpose of Database Systems, view of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Information Retrieval, Specialty Databases, Database users and Administrators, Introduction to Relational Model: Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, Relational Operations		
UNIT - II	**Introduction to SQL, Advanced SQL**	9 Hrs
Introduction to SQL: Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Sub-queries, Modification of the Database. Intermediate SQL: Joint Expressions, Views, Transactions, Integrity Constraints, SQL Data types and schemas, Authorization. Advanced SQL: Accessing SQL from a Programming Language, Functions and Procedures, Triggers, Recursive Queries, OLAP, Formal relational query languages.		
UNIT - III	**Database Design and the E-R Model, Relational Database Design**	9 Hrs
Database Design and the E-R Model: Overview of the Design Process, The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams, Reduction to Relational Schemas, Entity-Relationship Design Issues. Relational Database Design:Features of Good Relational Designs, Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies, Functional-Dependency Theory, Algorithms for Decomposition, Decomposition Using Multivalued Dependencies, More Normal Forms.		
UNIT - IV	**Query Processing, Query optimization**	9 Hrs
Query Processing: Overview, Measures of Query cost, Selection operation, sorting, Join Operation, other operations, Evaluation of Expressions. Query optimization: Overview, Transformation of Relational Expressions, Estimating statistics of Expression results, Choice of Evaluation Plans, Materialized views, Advanced Topics in Query Optimization.		
UNIT - V	**Transaction Management, Concurrency control and Recovery System**	10Hrs
Transaction Management: Transactions: Concept, A Simple Transactional Model, Storage Structures, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Isolation and Atomicity,		

Transaction Isolation Levels, Implementation of Isolation Levels, Transactions as SQL Statements. Concurrency Control: Lock-based Protocols, Deadlock Handling, Multiple granularity, Timestamp-based Protocols, and Validation-based Protocols. Recovery System: Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with Loss of Nonvolatile Storage, Early Lock Release and Logical Undo Operations.
Textbooks:
1. A. Silberschatz, H.F.Korth, S.Sudarshan, "Database System Concepts",6/e, TMH 2019
Reference Books:
1. Database Management System, 6/e Ramez Elmasri, Shamkant B. Navathe, PEA 2. Database Principles Fundamentals of Design Implementation and Management, Carlos Coronel, StevenMorris, Peter Robb, Cengage Learning. 3. Database Management Systems, 3/e, Raghurama Krishnan, Johannes Gehrke,TMH
Online Learning Resources:
https://onlinecourses.nptel.ac.in/noc21_cs04/preview

Mapping of course outcomes with program outcomes

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	13	14%	2	CO1 :Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	19	20%	2	CO2 :Apply	L3	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review(L2) PO12: Thumb rule	3 3 2
3	18	19%	2	CO3 :Apply	L3	PO1 PO2 PO3 PO4 PO5 PO8 PO9 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO8: Thumb rule PO9: Thumb rule PO12: Thumb rule	3 3 3 2 3 2 2 2
4	18	19%	2	CO4 :Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO8	PO1: Apply(L3) PO2: Analyze(L4) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO8: Thumb rule	3 3 3 3 3 3
5	25	27%	3	CO5 :Analyze	L4	PO2 PO3 PO4 PO5 PO8 PO9 PO12	PO2: Analyze(L4) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO8: Thumb rule PO9: Thumb rule PO12: Thumb rule	3 3 3 3 2 2 2
	93	100 %						

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

Correlation matrix

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 medium (2)
PO2 Verb : Review(L2)
CO1 Action verb is same level as PO2 verb. Therefore the correlation is high (3)

CO2: Apply the SQL and PL/SQL concepts to formulate queries.
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)
PO12: Thumb rule
For some of DB applications, PL/SQL concepts are used to formulate queries. Therefore the correlation is medium (2)

CO3: Apply the E-R model for data base design of real world applications.
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 medium (2)
PO5: Apply(L3)
CO3 Action verb is same level as PO5 verb. Therefore the correlation is high (3)
PO8 : Thumb rule
Since ethical principles should be followed to create a database. Therefore the correlation is medium(2)
PO9 : Thumb rule
Team work is required between DBA and Database designer to create a database. Hence the correlation is medium (2)
PO12: Thumb rule
For some of DB applications, ER model concepts are used to create designs. Therefore the correlation is medium(2)

CO4: Analyze the query processing and optimization for data manipulation.
Action Verb : Analyze(L4)
PO1: Apply(L3)
CO4 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
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)
PO8: 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)

PO8 : Thumb rule

Since ethical principles should be followed for transaction management. Therefore the correlation is medium(2)

PO9 : Thumb rule

Team work is required for transaction management and recovery of failure transactions. Hence the correlation is medium (2)

PO12: Thumb rule

In real time transaction management is continuously updating. Therefore the correlation is medium (2)

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

Course Code	Year & Sem	Advanced Python Programming for Data Science	L	T	P	C
20APC3202	II-I		3	0	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: **Understand** the working knowledge of the Python IDE and proficiency in Python programming for data science pipeline.

CO2: **Apply** the mathematical principles to the analysis of very large data sets in the context of real world problems.

CO3: **Evaluate** the various problems using Numpy, arrays, and pandas to effectively manage various types of data

CO4: **Apply** the Use various data visualization tools for effective interpretations and insights of data using Matplotlib**.**

CO5: **Analyze** the data wrangling with Scikit-learn applying exploratory data analysis.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The Working Knowledge of Python IDE	Using Data Science Pipeline	to solve various problems	L2
CO2	Apply	the mathematical principles to the analysis of data		the context of real world Problems	L3
CO3	Evaluate	The various problems of data sets	Using Numpy and Pandas	to effectively manage various types of data	L5
CO4	Apply	The Use various data visualization	Matplotlib Package	to effective interpretations and insights of data	L3
CO5	Analyze	The data Wrangling concepts		To apply Scikit learn Concept for data analysis problems	L4

UNIT - I	**The Role of Python in Data Science**	9Hrs
Introduction- Creating the Data Science Pipeline, Understanding Python's Role in Data Science, Learning to Use Python Fast, Setting Up Python for Data Science, Reviewing Basic Python		
UNIT - II	**Conditioning and Working with Real Data**	9 Hrs
Uploading, Streaming, and Sampling Data, Accessing Data in Structured Flat-File Form, Sending Data in Unstructured File Form, Managing Data from Relational Databases, Interacting with Data from NoSQL Databases, Accessing Data from the Web,NumPy and pandas, Validating Your Data, Manipulating Categorical Variables, Dealing with Dates in Your Data, Slicing and Dicing: Filtering and Selecting Data, Aggregating Data at Any Level.		
UNIT - III	**Shaping and Performing Action on Data**	9 Hrs
Working with HTML Pages, Working with Raw Text, Using the Bag of Words Model and Beyond, Working with Graph Data, Contextualizing Problems and Data, Considering the Art of Feature Creation, Performing Operations on Arrays.		
UNIT - IV	**MatPlotLib and Visualization of Data**	9 Hrs
Starting with a Graph, Setting the Axis, Ticks, Grids, Defining the Line Appearance, Using Labels, Annotations, and Legends, Choosing the Right Graph, Creating Advanced Scatterplots, Plotting Time Series, Plotting Geographical Data, Visualizing Graphs.		
UNIT - V	**Wrangling Data**	10Hrs
Playing with Scikit-learn, Performing the Hashing Trick, Considering Timing and Performance, Running in Parallel, Counting for Categorical Data, Understanding Correlation, Modifying Data Distributions, Reducing Dimensionality, Clustering, Detecting Outliers in Data.		

Textbooks:

1. Python for Data Science for Dummies, 2ed, Luca Massaron John Paul Mueller, by ISBN: 978-1-118-84418-2

Reference Books:

1. Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Pearson; 2 edition (January 26, 2003), ISBN 978-0201648652

2. Big Data: Principles and best practices of scalable realtime data systems, 1st Edition, Nathan Marz,

James Warren, ISBN 978-1617290343

Mapping of course outcomes with program outcomes

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

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	13	19	3	CO1: Understand	L2	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review(L2) PO12: Thumb rule	3 3 2
2	14	20	3	CO2: Apply	L3	PO1 PO2 PO6	PO1: Apply(L3) PO2: Review(L2) PO6: Thumb rule	3 3 2
3	15	23	3	CO3: Evaluate	L5	PO1 PO2 PO3 PO4 PO5 PO6	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule	3 3 3 3 3 2
4	14	20	3	CO4: Apply	L3	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review(L2) PO12: Thumb rule	3 3 2
5	12	18	3	CO5: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO12: Thumb rule	3 3 3 3 3 2
	68	100%						

Justification Statements:

CO1: Understand the working knowledge of the Python IDE and proficiency in Python programming for data science pipeline.

Action Verb: Understand (L2)

PO1 Verb: Apply(L3)

CO1 Action verb is same level of PO1 verb by one level. Therefore, the correlation is High (3)

PO2 Verb: Review(L2)

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

PO12: Thumb rule

To solve the different numeric applications and manipulate data sets . Therefore, the correlation is medium (2)

CO2: Apply the mathematical principles to the analysis of very large data sets in the context of real world problems.

Action Verb : Apply (L3)

PO1: Apply(L3)

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

PO2: Review(L2)
CO2 Action verb is greater than PO2 verb. Therefore, the correlation is high(3)
PO6: Thumb rule
To Perform data loading, cleaning, transformation and merging and optimizing data performance .Therefore, the correlation is medium (2)

CO3: Evaluate the various problems using Numpy, arrays, and pandas to effectively manage various types of data
Action Verb : Evaluate (L5)
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)
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 PO5 verb. Therefore the correlation is high(3)
PO6: Thumb rule
To Finding context and vector space problem solutions to real world problems and natural processing applications Therefore the correlation is medium (2)

CO4: Apply Use various data visualization tools for effective interpretations and insights of data using Matplotlib.

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)
PO12: Thumb rule
Graphical visualization of data using Matplotlib of finding best data visualization project. Therefore the correlation is medium (2)

CO5: Analyze the data wrangling with Scikit-learn applying exploratory data analysis.
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)
PO12: Thumb rule
Gain familiarity with principles and techniques for optimizing the performance of GUI and parallel applications and business statistical analysis .Therefore the correlation is medium (2)

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

Course Code	Year & Sem	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
20AES0205	II-I		3	0	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Apply the concepts of Kirchhoff Laws and the basic theorems for Electrical Circuits.

CO2: Analyze the operational characteristics of D.C motor, generator, induction motor and transformer.

CO3: Understand the basic operation of Electrical Power generation and transmission systems.

CO4: Understand the operations of different diodes, transistors and op-amps.

CO5: Analyze the characteristics of BJT, FET and OPAMP applications.

CO6: Understand various modulation concepts and examples of Communication Systems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	The Concepts of Kirchhoff Laws and basic theorems for Electrical circuits			L3
CO2	Analyze	The operational characteristics of D.C motor, generator, induction motor and transformer.			L4
CO3	Understand	The Basic operation of electrical power generation and transmission systems			L2
CO4	Understand	The operations of different diodes, transistors and op-amps.			L2
CO5	Analyze	The characteristics		of BJT, FET and OPAMP applications.	L4
CO6	Understand	Various modulation concepts and examples of Communication Systems.			L2

PART-A
BASIC ELECTRICAL ENGINEERING

UNIT - I	**DC & AC Circuits**	9Hrs

Electrical circuit elements (R - L and C) - Kirchhoff laws - Series and parallel connection of resistances with DC excitation. Superposition Theorem - Representation of sinusoidal waveforms - peak and rms values - phasor representation - real power - reactive power - apparent power - power factor - Analysis of single-phase ac circuits consisting of RL - RC - RLC series circuits.

UNIT - II	**DC & AC Machines**	9 Hrs

Principle and operation of DC Generator - EMF equations - OCC characteristics of DC generator – principle and operation of DC Motor – Performance Characteristics of DC Motor - Speed control of DC Motor – Principle and operation of Single Phase Transformer - OC and SC test on transformer - principle and operation of Induction Motor [Elementary treatment only]

UNIT - III	**Basics of Power Systems**	9 Hrs

Layout & operation of Hydro, Thermal, Nuclear Stations - Solar & wind generating stations – Typical AC Power Supply scheme – Elements of Transmission line – Types of Distribution systems: Primary & Secondary distribution systems.

TEXTBOOKS:

1. D. P. Kothari and I. J. Nagrath - "Basic Electrical Engineering" - Tata McGraw Hill -2010.
2. V.K. Mehta & Rohit Mehta, "Principles of Power System" – S.Chand – 2018.

REFERENCE BOOKS:

1. L. S. Bobrow - "Fundamentals of Electrical Engineering" - Oxford University Press - 2011.
2. E. Hughes - "Electrical and Electronics Technology" - Pearson - 2010.
3. C.L. Wadhwa – "Generation Distribution and Utilization of Electrical Energy", 3rd Edition, New Age International Publications.

PART-B
(Electronics Engineering)

UNIT – I		12Hrs

PN JUNCTION DIODE AND SPECIAL DIODE CHARACTERISTICS: Overview of Semiconductors, PN junction diode, Zener diode, Applications of diode as switch and rectifier, Zener diode as regulator, special purpose diodes: schottky diode, tunnel diode, varactor diode, photodiode, phototransistor and LED. BJT construction, operation, configuration and characteristics, JFET and MOSFET construction, operation, characteristics (CS configuration), applications Operational Amplifiers: Introduction, block diagram, basic op-amp circuits: Inverting, Non Inverting, summer, subtractor, voltage follower.

UNIT – II		12Hrs

TRANSISTOR CHARACTERISTICS: BJT construction, operation, configuration and characteristics, JFET and MOSFET construction, operation, characteristics (CS configuration), applications Operational Amplifiers: Introduction, block diagram, basic op-amp circuits: Inverting, Non Inverting, summer, subtractor, voltage follower.

UNIT – III		10Hrs

COMMUNICATION SYSTEMS: Introduction, Elements of Communication Systems, EM spectrum, basics of electronic communication, Amplitude and Frequency modulation, Pulse modulation, Communication receivers, Examples of communication systems: Microwave & Satellite, Fibre optic, Television, mobile communication (block diagram approach).

Textbooks:

1. D.P. Kothari, I.J.Nagrath, Basic Electronics, 2nd edition, McGraw Hill Education(India)Private Limited
2. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, 2nd edition, Pearson India Private Limited.

Reference Books:

1. R. Muthu subramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw Hill Education, Reprint 2012.
2. David Bell, Electronic Devices and Circuits: Oxford University Press, 5th edition. 2008.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2				1							2	
CO2	3	3				1							1	
CO3	2	1				1							1	
CO4	2	3												
CO5	3	3		3										
CO6	2	3												

Correlation matrix

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	15	33.33	3	Apply	L3	PO1, PO2 , PO6	PO1:Apply(L3) PO2:Analyze(L4) PO6:Thumb Rule	3 2 1
2	17	37.77	3	Analyze	L4	PO1, PO2 , PO6	PO1:Apply(L3) PO2:Analyze(L4) PO6:Thumb Rule	3 3 1
3	13	28.88	3	Understand	L2	PO1, PO2 , PO6	PO1:Apply(L3) PO2:Analyze(L4) PO6:Thumb Rule	2 1 1
	45							

CO1: Apply the concepts of Kirchhoff Laws and the basic theorems for Electrical Circuits.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO1 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
PO2: Analyze (L4)
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: Analyze the operational characteristics of D.C motor, generator, induction motor and transformer.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO2 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).

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	**16**	42	3	Understand	**L2**	PO1, PO2	PO1: Apply (L3) PO2:	2 3
2	**12**	32	3	Analyze	**L4**	PO1, PO2,PO4	PO1: Apply (L3) PO2: Review(L2) PO4: Analyze(L4)	3 3 3
3	**10**	26	3	Understand	**L2**	PO1, PO2	PO1:Apply(L3) PO2:Review (L2)	2 3
	38	**100%**						

Justification Statements:
CO 4: Understand the fundamental concepts of diodes, transistors and op-amps.
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).
CO 5: Analyze the characteristics of BJT and MOSFET devices
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 greater than PO2 verb by two level; Therefore correlation is high (3).
PO4 Verbs: Analyze (L4**)**
CO5 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
CO 6: Understand the basic concepts and examples of Communication Systems.
Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)
CO6 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (2).
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)
CSE(DATA SCIENCE)

Course Code	Year & Sem	Database Management System Lab	L	T	P	C
20APC3203	II-I		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO 1: Apply the DDL, DML Commands for manipulating the data.
CO 2: Evaluate the simple mathematical operations using PL/SQL.
CO 3: Apply the Triggers to automate the actions on database
CO 4: Apply the cursors to access system memory in PL/SQL Programs
CO 5: Apply the Entity-Relationship for real time applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Apply**	the DDL, DML Commands		for manipulating the data.	L3
CO2	**Evaluate**	the simple mathematical operations	using PL/SQL		L5
CO3	**Apply**	the Triggers		to automate the actions on database	L3
CO4	**Apply**	the cursors		to access system memory in PL/SQL Programs.	L3
CO5	**Apply**	the Entity-Relationship		for real time applications	L3

List of Experiments:

Week-1: CREATION OF TABLES

1. Create a table called Employee with the following structure.

Name	Type
Empno	Number
Ename	Varchar2(20)
Job	Varchar2(20)
Mgr	Number
Sal	Number

- Add a column commission with domain to the Employee table.
- Insert any five records into the table.
- Update the column details of job
- Rename the column of Employ table using alter command.
- Delete the employee whose empno is19. **(CO1)**

2. Create department table with the following structure.

Name	Type
Deptno	Number
Deptname	Varchar2(20)
location	Varchar2(20)

a. Add column designation to the department table.
b. Insert values into the table.
c. List the records of emp table grouped by deptno.
d. Update the record where deptno is 9.
e. Delete any column data from the table **(CO1)**

3. Create a table called Customer table

Name	Type

Cust name	Varchar2(20)
Cust street	Varchar2(20)
Cust city	Varchar2(20)

a. Insert records into the table.
b. Add salary column to the table.
c. Alter the table column domain.
d. Drop salary column of the customer table.
e. Delete the rows of customer table whose ust_city is 'hyd'. **(CO1)**

4. Create a table called branch table. **(CO1)**

Name	Type
Branch name	Varchar2(20)
Branch city	Varchar2(20)
asserts	Number

5. Increase the size of data type for asserts to the branch.
   a. Add and drop a column to the branch table.
   b. Insert values to the table.
   c. Update the branch name column
   d. Delete any two columns from the table **(CO1)**

6. Create a table called sailor table

Name	Type
Sid	Number
Sname	Varchar2(20)
rating	Varchar2(20)

a. Add column age to the sailor table.
b. Insert values into the sailor table.
c. Delete the row with rating>8.
d. Update the column details of sailor.
e. Insert null values into the table. **(CO1)**

7. Create a table called reserves table

Name	Type
Boat id	Integer
sid	Integer
day	Integer

a. Insert values into the reserves table.
b. Add column time to the reserves table.
c. Alter the column day data type to date.
d. Drop the column time in the table.
e. Delete the row of the table with some condition. **(CO1)**

Week-2: QUERIES USING DDL AND DML

1. a. Create a user and grant all permissions to the user.
   b. Insert the any three records in the employee table and use rollback. Check the result.
   c. Add primary key constraint and not null constraint to the employee table.
   d. Insert null values to the employee table and verify the result. **(CO1)**
2. a. Create a user and grant all permissions to the user.
   b. Insert the any three records in the employee table and use rollback. Check the result.
   c. Add primary key constraint and not null constraint to the employee table.
   d. Insert null values to the employee table and verify the result. **(CO1)**
3. a. Create a user and grant all permissions to the user.
   b. Insert values in the department table and use commit.
   c. Add constraints like unique and not null to the department table.
   d. Insert repeated values and null values into the table. **(CO1)**
4. a. Create a user and grant all permissions to the user.
   b. Insert values into the table and use commit.

c. Delete any three records in the department table and use rollback.
d. Add constraint primary key and foreign key to the table.

5. a. Create a user and grant all permissions to the user. **(CO1)**
   b. Insert records in the sailor table and use commit.
   c. Add save point after insertion of records and verify save point.
   d. Add constraints not null and primary key to the sailor table.
   e. Create a user and grant all permissions to the user.
   f. Use revoke command to remove user permissions.
   g. Change password of the user created.
   h. Add constraint foreign key and not null. **(CO1)**
6. a. Create a user and grant all permissions to the user.
   b. Update the table reserves and use savepoint and rollback.
   c. Add constraint primary key , foreign key and not null to the reserves table
   d. Delete constraint not null to the table column **(CO1)**

Week-3:QUERIES USING AGGREGATE FUNCTIONS

1. a. By using the group by clause, display the enames who belongs to deptno 10 along with average salary.
   b. Display lowest paid employee details under each department.
   c. Display number of employees working in each department and their department number.
   d. Using built-in functions, display number of employees working in each department and their department name from dept table. Insert deptname to dept table and insert deptname foreach row, do the required thing specified above.
   e. List all employees which start with either B or C.
   f. Display only these ename of employees where the maximum salary is greater than or equal to 5000. **(CO1)**
2. a. Calculate the average salary for each different job.
   b. Show the average salary of each job excluding manager.
   c. Show the average salary for all departments employing more than three people.
   d. Display employees who earn more than the lowest salary in department 30
   e. Show that value returned by sign (n)function.
   f. How many days between day of birth to current date **(CO1)**
3. a. Show that two substring as single string.
   b. List all employee names, salary and 15% rise in salary.
   c. Display lowest paid emp details under each manager
   d. Display the average monthly salary bill for each deptno.
   e. Show the average salary for all departments employing more than two people.
   f. By using the group by clause, display the eid who belongs to deptno 05 alongwith average salary. **(CO1)**
4. a. Count the number of employees in department20 **(CO1)**

b. Find the minimum salary earned by clerk.

a. Find minimum, maximum, average salary of all employees.
b. List the minimum and maximum salaries for each job type.
c. List the employee names in descending order.
d. List the employee id, names in ascending order by empid. **(CO1)**

5. a.Find the sids ,names of sailors who have reserved all boats called"INTERLAKE
   b. Find the age of youngest sailor who is eligible to vote for each rating level with at least twosuch sailors.
   c. Find the sname, bid and reservation date for each reservation.
   d. Find the ages of sailors whose name begin and end with B and has at least 3characters.
   e. List in alphabetic order all sailors who have reserved redboat.
   f. Find the age of youngest sailor for each rating level. **(CO1)**
6. a. List the Vendors who have delivered products within 6 months from order date.
   b. Display the Vendor details who have supplied both Assembled and Subparts.
   c. Display the Sub parts by grouping the Vendor type (Local or Nonlocal).
   d. Display the Vendor details in ascending order.
   e. Display the Sub part which costs more than any of the Assembled parts.
   f. Display the second maximum cost Assembled part**(CO1)**

Week-4: PROGRAMS ON PL/SQL

1. a. Write a PL/SQL program to swap two numbers. **(CO2)**
   b. Write a PL/SQL program to find the largest of three numbers.
2. a. Write a PL/SQL program to find the total and average of 6 subjects and display the grade.
   b. Write a PL/SQL program to find the sum of digits in a given number. **(CO2)**
3. a. Write a PL/SQL program to display the number in reverse order.
   b. Write a PL/SQL program to check whether the given number is prime or not. **(CO2)**
4. a. Write a PL/SQL program to find the factorial of a given number.

b. Write a PL/SQL code block to calculate the area of a circle for a value of radius varying from 3 to 7. Store the radius and the corresponding values of calculated area in an empty table named areas, consisting of two columns radius and area. **(CO2)**

5. a. Write a PL/SQL program to accept a string and remove the vowels from the string. (When 'hello' passed to the program it should display 'Hll' removing e and o from the world Hello).
   b. Write a PL/SQL program to accept a number and a divisor. Make sure the divisor is less thanor equal to 10. Else display an error message. Otherwise Display the remainder in words. **(CO2)**

Week-5: PROCEDURES AND FUNCTIONS

1. Write a function to accept employee number as parameter and return Basic +HRA together assingle column. **(CO2)**
2. Accept year as parameter and write a Function to return the total net salary spent for a given year. **(CO2)**
3. Create a function to find the factorial of a given number and hence find NCR. **(CO2)**
4. Write a PL/SQL block o pint prime Fibonacci series using local functions. **(CO2)**
5. Create a procedure to find the lucky number of a given birth date. **(CO2)**
6. Create function to the reverse of given number**(CO2)**

Week-6: TRIGGERS

1. Create a row level trigger for the customers table that would fire for INSERT or UPDATE orDELETE operations performed on the CUSTOMERS table. This trigger will display the salary difference between the old values and new values **(CO3)**

CUSTOMERS table:

ID	NAME	AGE	ADDRESS	SALARY
1	Alive	24	Khammam	2000
2	Bob	27	Kadappa	3000
3	Catri	25	Guntur	4000
4	Dena	28	Hyderabad	5000
5	Eeshwar	27	Kurnool	6000
6	Farooq	28	Nellore	7000

2. Creation of insert trigger, delete trigger, update trigger practice triggers using the passenger database. Passenger(Passport_ id INTEGER PRIMARY KEY, Name VARCHAR (50)Not NULL, Age Integer Not NULL, Sex Char, Address VARCHAR (50) Not NULL);
   a. Write a Insert Trigger to check the Passport_id is exactly six digits or not.
   b. Write a trigger on passenger to display messages '1 Record is inserted', '1 record is deleted', '1 record is updated' when insertion, deletion and updation are done on passenger respectively. **(CO3)**
3. Insert row in employee table using Triggers. Every trigger is created with name any trigger have same name must be replaced by new name. These triggers can raised before insert, updateor delete rows on data base. The main difference between a trigger and a stored procedure is that the former is attached to a table and is only fired when an INSERT, UPDATE or DELETE occurs. **(CO3)**
4. Convert employee name into uppercase whenever an employee record is inserted or updated.Trigger to fire before the insert or update. **(CO3)**
5. Trigger before deleting a record from emp table. Trigger will insert the row to be deleted into table called delete _emp and also record user who has deleted the record and date and time of delete. **(CO3)**
6. Create a transparent audit system for a table CUST_MSTR. The system must keep track of therecords that are being deleted or updated**(CO3)**

Week-7:PROCEDURES

1. Create the procedure for palindrome of given number. **(CO3)**
2. Create the procedure for GCD: Program should load two registers with two Numbers and thenapply the logic for GCD of two numbers. GCD of two numbers is performed by dividing the greater number by the smaller number till the remainder is zero. If it is zero, the divisor is theGCD if not the remainder and the divisors of the previous division are the new set of two numbers. The process is repeated by dividing greater of the two numbers by the smaller number till the remainder is zero and GCD is found.
3. Write the PL/SQL programs to create the procedure for factorial of given number. **(CO3)**
4. Write the PL/SQL programs to create the procedure to find sum of N natural number. **(CO3)**
5. Write the PL/SQL programs to create the procedure to find Fibonacci series. **(CO3)**
6. Write the PL/SQL programs to create the procedure to check the given number is perfect or not**(CO3)**

Week-8: CURSORS

1. Write a PL/SQL block that will display the name, dept no, salary of fist highest paid employees**.**

Update the balance stock in the item master table each time a transaction takes place in the item transaction table. The change in item master table depends on the item id is already present in the item master then update operation is performed to decrease the balance stock bythe quantity specified in the item transaction in case the item id is not present in the item master table then the record is inserted in the item master table. **(CO4)**

2. Write a PL/SQL block that will display the employee details along with salary using cursors. **(CO4)**

3. To write a Cursor to display the list of employees who are working as a Managers or Analyst. **(CO4)**

4. To write a Cursor to find employee with given job and deptno. **(CO4)**

5. Write a PL/SQL block using implicit cursor that will display message, the salaries of all the employees in the 'employee' table are updated. If none of the employee's salary is updated we get a message 'None of the salaries were updated'. Else we get a message like for example, 'Salaries for 1000 employees are updated' if there are 1000 rows in 'employee' table**(CO4)**

Week-9: CASE STUDY: BOOK PUBLISHING COMPANY

A publishing company produces scientific books on various subjects. The books are written by authors who specialize in one particular subject. The company employs editors who, not necessarily being specialists in a particular area, each take sole responsibility for editing one or more publications.

A publication covers essentially one of the specialist subjects and is normally written by a singleauthor. When writing a particular book, each author works with on editor, but may submit another work for publication to be supervised by other editors. To improve their competitiveness, the company tries to employ a variety of authors, more than one author being a specialist in a particularsubject for the above case study, do the following:

1. Analyze the data required.
2. Normalize the attributes.

Create the logical data model using E-R diagrams**(CO5)**

Week-10: **CASE STUDY GENERAL HOSPITAL**

A General Hospital consists of a number of specialized wards (such as Maternity, Pediatric, Oncology, etc.). Each ward hosts a number of patients, who were admitted on the recommendation of their own GP and confirmed by a consultant employed by the Hospital. On admission, the personaldetails of every patient are recorded. A separate register is to be held to store the information ofthe tests undertaken and the results of a prescribed treatment. A number of tests may be conductedfor each patient. Each patient is assigned to one leading consultant but may be examined byanother doctor, if required. Doctors are specialists in some branch of medicine and may be leadingconsultants for a number of patients, not necessarily from the same ward. For the above case study,do the following.

1. Analyze the data required.
2. Normalize the attributes.

Create the logical data model using E-R diagrams**(CO5)**

Week-11: **CASE STUDY: CAR RENTAL COMPANY**

A database is to be designed for a car rental company. The information required includes a description of cars, subcontractors (i.e. garages), company expenditures, company revenues and customers. Cars are to be described by such data as: make, model, year of production, engine size,fuel type, number of passengers, registration number, purchase price, purchase date, rent price andinsurance details. It is the company policy not to keep any car for a period exceeding one year. Allmajor repairs and maintenance are done by subcontractors (i.e. franchised garages), with whom CRC has long-term agreements. Therefore the data about garages to be kept in the database includes garage names, addresses, range of services and the like. Some garages require payments immediately after a repair has been made; with others CRC has made arrangements for credit facilities. Company expenditures are to be registered for all outgoings connected with purchases,repairs, maintenance, insurance etc. Similarly the cash inflow coming from all sources: Car hire, car sales, insurance claims must be kept of file. CRC maintains a reasonably stable client base. For this privileged category of customers special credit card facilities are provided. These customers may also book in advance a particular car. These reservations can be made for any period of time up to one month. Casual customers must pay a deposit for an estimated time of rental, unless they wish to pay by credit card. All major credit cards are accepted. Personal detailssuch as name, address, telephone number, driving license, number about each customer are kept in the database. For the above case study, do the following:

1. Analyze the data required.
2. Normalize the attributes.

Create the logical data model using E-R diagrams**(CO5)**

Week-12: **CASE STUDY: STUDENT PROGRESS MONITORING SYSTEM**

A database is to be designed for a college to monitor students' progress throughout their course ofstudy. The students are reading for a degree (such as BA, BA (Hons.) M.Sc., etc) within the framework of the modular system. The college provides a number of modules, each being characterized by its code, title, credit value, module leader, teaching staff and the department theycome from. A module is coordinated by a module leader who shares teaching duties with one or more lecturers. A lecturer may teach (and be a module leader for) more than one module. Studentsare free to choose any module they wish but the following rules must be observed: Some modulesrequire pre- requisites modules and some degree programs have compulsory modules. The database is also to contain some information aboutstudents including their numbers, names, addresses, degrees they read for, and their past performance i.e. modules taken and examination results.

For the above case study, do the following: **(CO5)**

1. Analyze the data required.
2. Normalize the attributes.
3. Create the logical data model i.e., ER diagrams.
4. Comprehend the data given in the case study by creating respective tables with primarykeys and foreign keys wherever required.
5. Insert values into the tables created (Be vigilant about Master- Slave tables).
6. Display the Students who have taken M.Sc course
7. Display the Module code and Number of Modules taught by each Lecturer.
8. Retrieve the Lecturer names who are not Module Leaders.
9. Display the Department name which offers 'English 'module.

10. Retrieve the Prerequisite Courses offered by every Department (with Department names).
11. Present the Lecturer ID and Name who teaches 'Mathematics'.
12. Discover the number of years a Module is aught.
13. List out all the Faculties who work for 'Statistics' Department.
14. List out the number of Modules taught by each Module Leader.
15. List out the number of Modules taught by a particular Lecturer.
16. Create a view which contains the fields of both Department and Module tables.(Hint- The fields like Module code, title, credit, Department code and its name).

Update the credits of all the prerequisite courses to 5. Delete the Module 'History' from the Module table.

References:

1. Ramez Elmasri, Shamkant, B. Navathe, "Database Systems", Pearson Education, 6th Edition, 2013.
2. Peter Rob, Carles Coronel, "Database System Concepts", Cengage Learning, 7th Edition, 2008.

Online Learning Resources/Virtual Labs:

http://www.scoopworld.in http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/index.php

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3		3								1	
CO2	1	3			3								1	
CO3	3	2		3	3								2	2
CO4	3	2		3	3									
CO5			3		3	2						2		

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 PO3 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO5: Apply(L3)	3 2 3 3
2	CO2: Evalute	L5	PO1 PO2 PO5	PO1:Apply(L3) PO3:Formulate(L6) PO5:Create(L6)	1 3 3
3	CO3: Apply	L3	PO1 PO2 PO4 PO5	PO1:Apply(L3) PO2:Review(L2) PO4:Design(L6) PO5:Create(L6)	3 2 3 3
4	CO4: Apply	L3	PO1 PO2 PO4 PO5	PO1:Apply(L3) PO2:Review(L2) PO4:Design(L6) PO5:Create(L6)	3 2 3 3
5	CO5: Apply	L3	PO3 PO5 PO6 PO12	PO3:Design(L6) PO5:Create(L6) PO6:Thumb rule PO12:Thumb rule	3 3 3 3

Justification Statements :

CO1: Apply the DDL,DML 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 medium (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: Evaluate the simple mathematical operations using PL/SQL.

Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3)
CO2 Action verb is is less than PO2 verb by two levels. Therefore, the correlation is low (1)
PO2 Verb : Formulate(L6)
CO2 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: Create(L6)
CO2 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)

CO3: Apply the Triggers to automate the actions on database

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 is less than PO2 verb by one level. Therefore, the correlation is Medium(2)
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: Apply the cursors to access system memory in PL/SQL Programs.

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 is less than PO2 verb by one level. Therefore, the correlation is Medium(2)
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: Apply the Entity-Relationship for real time applications

Action Verb: Apply (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)
PO6 Verb:Thumb rule
By designing a solution for a problem it is easy to provide solution for any problem. So the correlation is medium(2)
PO12: Verb:Thumb rule
Modeling is a continuous learning activity for the user, the correlation is medium(2)

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

Course Code	Year & Sem	Advanced Python Programming for Data Science Lab	L	T	P	C
20APC3204	II-I		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO 1: Understand the basic Python libraries for data science to optimizing numeric applications

CO 2: Apply the concept of Data frames, pandas and NumPy in Python programming solving complex problems.

CO 3: Evaluate the python libraries for basic statistical and descriptive analytics on the data sets.

CO 4: Apply corelation and regression analytics and standard data sets.

CO 5: Create python programs to present and interpret data using visualization packages in python.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	Python libraries		for numerical application	L2
CO2	**Apply**	Data frames	NumPy, pandas	For solving complex problems	L3
CO3	**Evaluate**	Basic statistical analysis	Seaborn and SciPy	To analysis real time applications	L5
CO4	**Apply**	Perform corelation and regression on data set	Either linear and logistic regression	To get optimistic accuracy	L3
CO5	**Create**	Present and interpret data visualization	Packages like matplotlib, plotly	Visualizing geographic data with different Techniques	L6

List of Experiments:

WEEK1:

The number of birds banded at a series of sampling sites has been counted by your field crew and entered into the following list. The first item in each sublist is an alphanumeric code for the site and the second value is the number of birds banded. Cut and paste the list into your assignment and then answer the following questions by printing them to the screen. **(CO1)**

```
data = [['A1', 28], ['A2', 32], ['A3', 1], ['A4', 0],
['A5', 10], ['A6', 22], ['A7', 30], ['A8', 19],
['B1', 145], ['B2', 27], ['B3', 36], ['B4', 25],
['B5', 9], ['B6', 38], ['B7', 21], ['B8', 12],
['C1', 122], ['C2', 87], ['C3', 36], ['C4', 3],
['D1', 0], ['D2', 5], ['D3', 55], ['D4', 62],
['D5', 98], ['D6', 32]]
```

1. How many sites are there?
2. How many birds were counted at the 7th site?
3. How many birds were counted at the last site?
4. What is the total number of birds counted across all sites?
5. What is the average number of birds seen on a site?
6. What is the total number of birds counted on sites with codes beginning with C? (don't just identify this site by eye, in the real world there could be hundreds or thousands of sites)

WEEK2:

1. Multiplication of two Matrices in Single line using Numpy in Python**(CO2)**

2. Transpose a matrix in Single line using Python**(CO2)**
3. Python program to print checkerboard pattern of nxn using numpy**(CO2)**

WEEK3:
Reading different types of data sets (.txt, .csv) fromWeb and disk and writing in file in specific disk location. **(CO2)**
Reading Excel data sheet**(CO2)**
Reading XML dataset**(CO2)**

WEEK4:

1. Find the data distributions using box and scatter plot. **(CO2)**
2. Find the outliers using plot. **(CO2)**
3. Plot the histogram, bar chart and pie chart on sample data**(CO2)**

WEEK5:

1. Find the correlation matrix. **(CO3)**
2. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data. **(CO3)**
3. Analysis of covariance: variance (ANOVA), if data have categoricalvariables on iris data. **(CO3)**

WEEK6:

Import a data from web storage. Name the dataset and now do LogisticRegression to find out relation between variables that are affecting theadmission of a student in a institute based on his or her GRE score,GPA obtained and rank of the student. Also check the model is fit ornot. Require (foreign), require (MASS). **(CO4)**

WEEK7:

Decision Tree Classification, attribute selection measures, and how to build and optimize Decision Tree Classifier using Python Scikit-learn. **(CO4)**

WEEK8:

Apply multiple regressions, if data have a continuousindependent variable. Apply on above dataset. **(CO4)**

WEEK9:

Apply regression Model techniques to predict the data**(CO4)**

WEEK10:

1. Install relevant package for classification. **(CO5)**
2. Choose classifier for classification problem. **(CO5)**
3. Evaluate the performance of classifier. **(CO5)**

WEEK11:

Clustering algorithms for unsupervised classification. **(CO5)**
Plot the cluster data using python with Matplotlib visualizations. **(CO5)**

WEEK12:

Case Study: Data Science in Education
Data Science has also changed the way in which students interact with teachers and evaluate their performance. Instructors can use data science to analyse the feedback received from the students and use it to improve their teaching. Use Predictive modeling Data Science that can predict the drop-out rate of students based on their performance and inform the instructors to take necessary precautions. **(CO5)**

References:

1. https://www.w3schools.com/datascience/
2. https://data-flair.training/blogs/data-science-tutorials-home/
3. https://www.javatpoint.com/data-science
4. https://www.tutorialspoint.com/python_data_science/index.htm
5. https://intellipaat.com/blog/tutorial/data-science-tutorial/

Mapping of course outcomes with program outcomes

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

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO12)	Level of Correlation (0-3)
1	CO1: Understand	L2	PO1 PO2 PO5 PO12	PO1: Apply(L3) PO2: Review(L2) PO5 : Apply(L3) PO12: Thumb rule	3 3 2 2
2	CO2: Apply	L3	PO1 PO2 PO4 PO6 PO12	PO1: Apply(L3) PO2: Review(L2) PO4: Analyze (L4) PO6: Apply(L3) PO12: Thumb rule	3 3 2 2 2
3	CO3: Evaluate	L5	PO1 PO2 PO3 PO4 PO5 PO10	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO10: Thumb rule	3 2 3 3 3 2
4	CO4: Apply	L3	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review(L2) PO12: Thumb rule	3 2 2
5	CO5: Create	L6	PO1 PO2 PO3 PO4 PO5 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO12: Thumb rule	3 3 3 3 3 2

Justification Statements:

CO 1: Understand the basic Python libraries for data science to optimizing numeric applications

Action Verb: Understand (L2)

PO1 Verb: Apply(L3)

CO1 Action verb is same level of PO1 verb by one level. Therefore, the correlation is High (3)

PO2 Verb: Review(L2)

CO1 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)

PO5 Verb: Apply(L3)

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

PO12: Thumb rule
To solve the different mathematical functions by using python data science predefine libraries to writing simple programs. Therefore, the correlation is medium (2)

CO 2: Apply the concept of Data frames, pandas and NumPy in Python programming solving complex problems.

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 medium (2)
PO6: Thumb rule
By using NumPy open-source library for python programing is used for scientific computing applications. Therefore, the correlation is medium (2)
PO12: Thumb rule
For usage of multi-dimensional array object of python programing provides high level functional tools for working with arrays. Therefore, the correlation is medium (2)

CO 3: Evaluate the python libraries for basic statistical and descriptive analytics on the data sets.

Action Verb: Evaluate (L5)
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 less than level as PO2 verb by one. Therefore, the correlation is medium (2)
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 same level as PO5 verb. Therefore, the correlation is high (3)
PO10: Thumb rule
The fundamental tools of data analysis and statistics to solve difficult problems in different data sets Therefore, the correlation is medium (2)

CO 4: Apply corelation and regression analytics and 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 less than PO2 verb. Therefore the correlation is medium (2)
PO12: Thumb rule
The probability density functions and distribution functions used in statistics because of its advantages in real time scenarios. Therefore, the correlation is medium (2)

CO 5: Create python programs to present and interpret data using visualization packages in python.

Action Verb: Create (L6)
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 greater level of 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)
PO12: 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
(AUTONOMOUS)
CSE(DATA SCIENCE)

Course Code	Year & Sem	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB	L	T	P	C
20AES0206	II-I		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: Apply the Kirchhoff's Laws and Superposition theorem for DC Circuits.
CO2: Analyze the performance of AC and DC Machines by various testing methods.
CO3: Analyze the speed of DC shunt motor using armature and field control methods.
CO4: Analyze the V-I Characteristics of PN and Zener diodes.
CO5: Evaluate the parameters of rectifiers with & without filters
CO6: Analyze the input and output characteristics of BJT and FET.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Apply**	The Kirchhoff's Laws & Superposition theorem for dc circuits			L3
CO2	**Analyze**	The performance of AC and DC Machines	by various testing methods.		L4
CO3	**Analyze**	the speed of DC shunt motor	using armature and field control methods.		L4
CO4	**Analyze**	the V-I Characteristics of PN and Zener diodes			L4
CO5	**Evaluate**	the parameters of rectifiers with & without filters			L5
CO6	**Analyze**	the input and output characteristics of BJT and FET.			L4

List of Experiments:

Part A: Electrical Engineering Lab

1. Verification of Kirchhoff laws-(CO1).
2. Verification of Superposition Theorem-(CO1).
3. Open circuit characteristics of a DC Shunt Generator-(CO2).
4. Speed control of DC Shunt Motor-(CO3).
5. OC & SC test of 1 – Phase Transformer-(CO2).
6. Brake test on 3 - Phase Induction Motor-(CO2).
7. Brake test on DC Shunt Motor-(CO2).

Part B: Electronics Engineering Lab

1. PN Junction Diode Characteristics.
2. Zener Diode Characteristics.
3. Rectifiers (With and Without Filter).
4. BJT Characteristics (CB Configuration).
5. BJT Characteristics (CE Configuration).
6. FET Characteristics (CS Configuration).

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

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	PO12	PSO1	PSO2
BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING LAB	CO1	3			2					1				2	
	CO2	3			3					1				1	
	CO3	3			3					1				1	
	CO4	3	3												
	CO5	3	3		3										
	CO6	3	3		3										

Justification Table:

CO	CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Verb	BTL			
1	**Apply**	L3	PO1, PO4, PO9	PO1:Apply(L3) PO2:Analyze(L4) PO9:Thumb Rule	3 2 1
2	**Analyze**	L4	PO1, PO4, PO9	PO1:Apply(L3) PO2:Analyze(L4) PO9:Thumb Rule	3 3 1
3	**Analyze**	L4	PO1, PO4, PO9	PO1:Apply(L3) PO2:Analyze(L4) PO9:Thumb Rule	3 3 1
4	**Analyze**	L4	PO1, PO2	PO1: Apply (L3) PO2: Review (L2)	3 3
5	**Evaluate**	L5	PO1, PO2, P04	PO1: Apply (L3) PO2: Review (L2) P04: Analyze(L4)	3 3 3
6	**Analyze**	L4	PO1, PO2, P04	PO1: Apply (L3) PO2: Review (L2) P04: Analyze(L4)	3 3 3

CO1: Apply the Kirchhoff's Laws and Superposition theorem for DC Circuits.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO1 Action Verb is same as PO1 verb; Therefore correlation is high (3).
PO4: Analyze (L4)
CO1 Action Verb is less than PO2 verb by one level; Therefore correlation is moderate (2).
PO9: Using Thumb Rule, CO1 correlates to PO9 as low (1).
CO2: Analyze the performance of AC and DC Machines by various testing methods.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO2 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
PO4: Analyze (L4)
CO2 Action Verb is same as PO4 verb; Therefore correlation is high (3).
PO9: Using Thumb Rule, CO2 correlates to PO9 as low (1).
CO3: Analyze the speed control of DC shunt motor.
Action Verb: Analyze (L4)
PO1: Apply (L3)
C3 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
PO4: Analyze (L4)
CO3 Action Verb is same as PO4 verb; Therefore correlation is high (3).

PO9: Using Thumb Rule, CO3 correlates to PO9 as low (1).

CO 4: Analyze the V-I Characteristics of PN and Zener diodes.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO4 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3)

PO2 Verbs: Review (L2)

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

CO 5: Evaluate the parameters of rectifiers without & with filters

Action Verb: Evaluate (L5)

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 greater than PO2 verb by one level; Therefore correlation is high (3).

PO4 Verbs: Analyze (L4)

CO5 Action Verb is equal to PO4 verb Therefore correlation is high (3).

CO 6: Evaluate the parameters of BJT and FET from their characteristics

Action Verb: Evaluate (L5)

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 greater than PO2 verb by one level; Therefore correlation is high (3).

PO4 Verbs: Analyze (L4)

CO6 Action Verb is equal to PO4 verb Therefore correlation is high (3).

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

Course Code	Year & Sem	Exploratory Data Analysis with R	L	T	P	C
20ASC3201	II-I		1	0	2	2

Course Outcomes:

After studying the course, student will be able to

CO 1: Understand the basics and extended functionality of R by using add-on packages

CO 2: Apply the Probability Distributions to gather the data from sampling

CO 3: Analyze the testing hypothesis to decide the sufficiency of the data in the real-life applications

CO 4: Apply the R Graphics and Tables to visualize results of various statistical operations

CO 5: Apply the statistical functions to explore the data using R

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	**Understand**	The basics and extended functionality of R	by using add-on packages		L2
CO2	**Apply**	the Probability Distributions		to gather the data from sampling	L4
CO3	**Evaluate**	the testing hypothesis		to decide the sufficiency of the data in the real-life applications	L5
CO4	**Apply**	the R Graphics and Tables		to visualize results of various statistical operations	L3
CO5	**Apply**	the statistical functions		to explore the data using R	L3

List of Experiments:

1: INTRODUCTION TO COMPUTING (CO1)

a. Installation of R

b. The basics of R syntax, workspace

c. Matrices and lists

d. Subsetting

e. System-defined functions; the help system

f. Errors and warnings; coherence of the workspace

2: GETTING USED TO R: DESCRIBING DATA (CO1)

a. Viewing and manipulating Data

b. Plotting data

c. Reading the data from console, file (.csv) local disk and web

d. Working with larger datasets

3: SHAPE OF DATA AND DESCRIBING RELATIONSHIPS (CO2)

a. Tables, charts and plots.

b. Univariate data, measures of central tendency, frequency distributions, variation, and Shape.

c. Multivariate data, relationships between a categorical and a continuous variable,

d. Relationship between two continuous variables – covariance, correlation coefficients, comparing multiple correlations.

e. Visualization methods – categorical and continuous variables, two categorical variables, two continuous variables.

4: PROBABILITY DISTRIBUTIONS (CO2)

a. Sampling from distributions – Binomial distribution, normal distribution

b. tTest, zTest, Chi Square test
c. Density functions
d. Data Visualization using ggplot – Box plot, histograms, scatter plotter, line chart, bar chart, heat maps

5: EXPLORATORY DATA ANALYSIS Demonstrate the range, summary, mean, variance, median, standard deviation, histogram, box plot, scatter plot using population dataset. **(CO3)**

6: TESTING HYPOTHESES (CO3)
a. Null hypothesis significance testing
b. Testing the mean of one sample
c. Testing two means

7: PREDICTING CONTINUOUS VARIABLES (CO3)
a. Linear models
b. Simple linear regression
c. Multiple regression
d. Bias-variance trade-off – cross-validation

8: CORRELATION (CO4)
a. How to calculate the correlation between two variables.
b. How to make scatter plots.
c. Use the scatter plot to investigate the relationship between two variables

9: TESTS OF HYPOTHESES (CO4)
a. Perform tests of hypotheses about the mean when the variance is known.
b. Compute the p-value.
c. Explore the connection between the critical region, the test statistic, and the p-value

10: ESTIMATING A LINEAR RELATIONSHIP Demonstration on a Statistical Model for a Linear Relationship
a. Least Squares Estimates
b. The R Function lm
c. Scrutinizing the Residuals**(CO5)**

11: APPLY-TYPE FUNCTIONS(CO5)
a. Defining user defined classes and operations, Models and methods in R
b. Customizing the user's environment
c. Conditional statements
d. Loops and iterations

12: STATISTICAL FUNCTIONS IN R(CO5)
a. Write Demonstrate Statistical functions in R
b. Statistical inference, contingency tables, chi-square goodness of fit, regression, generalized linear models, advanced modeling methods.

References:

1. SandipRakshit, "Statistics with R Programming", McGraw Hill Education, 2018.
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, "AN Introduction to Statistical Learning: with Applications in R", Springer Texts in Statistics, 2017.
3. Joseph Schmuller, "Statistical Analysis with R for Dummies", Wiley, 2017.
4. K G Srinivasa, G M Siddesh, ChetanShetty, Sowmya B J, "Statistical Programming in R", Oxford Higher Education, 2017.

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			3									
CO2	3	3	3	3	3									
CO3		3	3		3						3			
CO4	3	3	3	3	3				3		3	3		

CO5	**3**	**3**	**3**	**3**	**3**				**3**		**3**	**3**		

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** **PO5**	**PO1: Apply(L3)** **PO2: Identify(L3)** **PO5:Interpret(L2)**	**2** **2** **3**
2	**CO2: Apply**	**L3**	**PO1** **PO2** **PO3** **PO4** **PO5**	**PO1: Apply(L3)** **PO2: experiment with(L3)** **PO3: Choose(L3)** **PO4: Utilize(l3)** **PO5: Solve(L3)**	**3** **3** **3** **3** **3**
3	**CO3: Evaluate**	**L5**	**PO2** **PO3** **PO5** **P011**	**PO2: Compare(L5)** **PO3: Conclude(L5)** **PO5: Assess(L5)** **PO11: Thumb Rule**	**3** **3** **3** **3**
4	**CO4: Apply**	**L3**	**PO1** **PO2** **PO3** **PO4** **PO5** **PO9** **PO11** **PO12**	**PO1: Apply(L3)** **PO2:Examine(L3)** **PO3:Make Use Of(L3)** **PO4:Solve(L3)** **PO5:Utilize(L3)** **PO9: Thumb Rule** **PO11: Thumb Rule** **PO12: Thumb Rule**	**3** **3** **3** **3** **3** **3** **3** **3**
5	**CO5: Apply**	**L3**	**PO1** **PO2** **PO3** **PO4** **PO5** **PO9** **PO11** **PO12**	**PO1: Apply(L3)** **PO2:ClassifyL3)** **PO3: Identify(L3)** **PO4:Solve(L3)** **PO5:Utilize(L3)** **PO9: Thumb Rule** **PO11: Thumb Rule** **PO12: Thumb Rule**	**3** **3** **3** **3** **3** **3** **3** **3**

Justification Statements:

CO 1: Understand the basics and extended functionality of R by using add-on packages
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is lesser than PO1 verb. Therefore, the correlation is medium (2)
PO2: Identify (L3)
CO1 Action verb is lesser than PO3 verb. Therefore, the correlation is medium (2)
PO5: Interpret(L2)
CO1 Action verb is same as PO3 verb. Therefore, the correlation is high (3)

CO 2: Apply the probability and Probability Distributions in the relevant application areas
Action Verb: Apply
PO1: Apply(L3)
CO2 Action verb is same as PO2 verb. Therefore, the correlation is high (3)
PO2: experiment with (L3)
CO2 Action verb is same as PO2 verb. Therefore, the correlation is high (3)
PO3: Choose(L3)
CO2 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Utilize(l3)
CO2 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Solve(L3)

O2 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

CO 3: Evaluate the different testing tools like t-Test, z-Test, Chi square test to analyze the real-life problems

Action Verb: Evaluate (L5)

PO2: Compare(L5)

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

PO3: Conclude(L5)

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

PO5: Assess(L5)

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

PO11: Thumb Rule

T- test, Z- test both are used for continuous data and chi square test is used for categorical data. So, the correlation is high (3)

CO 4: Apply the R Graphics and Tables to visualize results of various statistical operations on data

Action Verb: Apply(L3)

PO1: Apply(L3)

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

PO2: Examine(L3)

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

PO3: Make Use Of(L3)

CO4 Action verb is same as PO3 verb. Therefore, the correlation is high (3)

PO4: Solve(L3)

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

PO5: Utilize(L3)

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

PO9: Thumb Rule

C04 Data analytics plays a crucial role in day-to-day life and any individual, a member or a leader can work on different fields.

PO11: Thumb rule

CO4 Data analytics can be applied in business in various ways. It can be used to analyze customer behavior, optimize marketing campaigns, improve supply chain management, So the correlation is high (3)

PO12: Thumb Rule

CO4: Organizations can assess risks, develop mitigation strategies, and make informed decisions by analyzing historical data, market trends, and external factors. So, the analyst can upgrade their knowledge and improve their skills. So, the correlation is high (3)

CO5: Apply the knowledge gained on R using exploratory data analytics

Action Verb: Apply(L3)

PO1: Apply(L3)

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

PO2: Examine(L3)

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

PO3: Make Use Of(L3)

CO4 Action verb is same as PO3 verb. Therefore, the correlation is high (3)

PO4: Solve(L3)

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

PO5: Utilize(L3)

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

PO9: Thumb Rule

C04 Data analytics plays a crucial role in day-to-day life and any individual, a member or a leader can work on different fields.

PO11: Thumb rule

CO4 Data analytics can be applied in business in various ways. It can be used to analyze customer behavior, optimize marketing campaigns, improve supply chain management, So the correlation is high (3)

PO12: Thumb Rule

Organizations can assess risks, develop mitigation strategies, and make informed decisions by analyzing historical data, market trends, and external factors. So, the analyst can upgrade their knowledge and improve their skills. So, the correlation is high (3)

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

Course Code	Year & Sem	CONSTITUTION OF INDIA	L	T	P	C
20AMC9902	II-I		3	0	0	0

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the historical background of the Constitution making and its importance for building a democratic India.

CO2: Remember the basic features of Indian Constitution

CO3: Understand the fundamental rights and duties for becoming a good citizen of India.

CO4: Understand the Powers and functions of Governor, President, and Judiciary.

CO5: Understand the functions of local administration bodies.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the historical background of the Constitution making and its importance	for building a democratic India.		**L2**
CO2	**Remember**	the basic features of Indian Constitution			**L1**
CO3	**Understand**	the fundamental rights and duties	for becoming a good citizen of India.		**L2**
CO4	**Understand**	the Powers and functions	of Governor, President, and Judiciary.		**L2**
CO5	**Understand**	the functions of local administration bodies			**L2**

UNIT – I		
History of Making of the Indian Constitution - History Drafting Committee, (Composition & Working)		
UNIT – II		
Philosophy of the Indian Constitution - Preamble Salient Features		
UNIT – III		
Contours of Constitutional Rights & Duties - Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation - Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies - Directive Principles of State Policy - Fundamental Duties.		
UNIT – IV		
Organs of Governance - Parliament – Composition - Qualifications and Disqualifications - Powers and Functions - Executive, President, Governor - Council of Ministers -Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions.		
UNIT – V		
Local Administration - District's Administration head: Role and Importance - Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation - Panchayati raj: Introduction, PRI: Zilla Panchayat - Elected officials and their roles, CEO Zilla Panchayat: Position and role - Block level: Organizational Hierarchy (Different departments) - Village level: Role of Elected and Appointed officials - Importance of grass root democracy.		

Textbooks:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

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	**4**	14	2	**Understand**	**L2**	PO6, PO12	Thumb Rule Thumb Rule	2 2
2	**4**	14	1	**Remember**	**L1**	PO6, PO7	Thumb Rule Thumb Rule	1 1
3	**8**	**26**	**2**	**Understand**	**L2**	PO8, PO12	Thumb Rule Thumb Rule	2 2
4	**8**	**26**	**2**	**Understand**	**L2**	PO6, PO12	Thumb Rule Thumb Rule	2 2
5	**6**	**20**	**2**	**Understand**	**L2**	PO6, PO12	Thumb Rule Thumb Rule	2 2
	30							

CO1: Understand the historical background of the Constitution making and its importance for building a democratic India.

Action Verb: Understand (L2)

CO1 Action Verb is Understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).

CO2: Remember the basic features of Indian Constitution

Action Verb: Remember (L1)

CO2 Action Verb is Remember of BTL 1. Using Thumb rule, L1 correlates PO6 to PO12 as low (1).

CO3: Understand the fundamental rights and duties for becoming a good citizen of India.

Action Verb: Understand (L2)

CO3 Action Verb is Understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).

CO4: Understand the Powers and functions of Governor, President, and Judiciary.

Action Verb: Understand (L2)

CO4 Action Verb is Understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).

CO5: Understand the functions of local administration bodies.

Action Verb: Understand (L2)

CO5 Action Verb is Understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(AUTONOMOUS)

B.Tech-CSE(DATA SCIENCE)

Semester IV (Second year) – AK20

Sl.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	TOTAL
				L	T	P	C			
1	PC	20APC3205	Computer Organization	3	0	0	3	30	70	100
2	PC	20APC3206	Design And Analysis Of Algorithms	3	0	0	3	30	70	100
3	PC	20APC3207	Object Oriented Programming through Java	3	0	0	3	30	70	100
4	PC	20APC3208	Operating Systems	3	0	0	3	30	70	100
5	HS	20AHSMB01	Managerial Economics and Financial Analysis	3	0	0	3	30	70	100
6	HS	20AHS9905	Universal Human Values	2	1	0	3	30	70	100
7	PC Lab	20APC3209	Design And Analysis Of Algorithms Lab	0	0	3	1.5	30	70	100
8	PC Lab	20APC3210	Object Oriented Programming through Java Lab	0	0	3	1.5	30	70	100
9	PC Lab	20APC3211	Operating Systems Lab	0	0	3	1.5	30	70	100
10	SC	20ASC3202	Digital and Social Media Marketing	1	0	2	2	100	0	100
			Total credits				**24.5**	**370**	**630**	**1000**

Community service Project with credits

(To visit the selected community to conduct survey (Socio-economic & domain survey) and conduct sensitization/awareness program/activities at the end of IV- semester before commencement of V-semester and complete immersion programme also during V-Semester and submit report in V - semester. Assessment will be done at the end of V-Semester).

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

Course Code	Year & Sem	Computer Organization	L	T	P	C
20APC3205	II-II	(common to CSE,CIC,CSE(DS))	3	0	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the operational concepts and instruction set related to modern processors.

CO2: Evaluate the Arithmetic operations for understanding execution process.

CO3: Understand the hardware requirements of primary and secondary memories to store the data.

CO4: Analyze the Input/Output interfaces to connect multiple devices.

CO5: Apply the pipeline concepts to execute parallel tasks.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the Operational concepts and instruction set related		to modern processors.	L2
CO2	Evaluate	the Arithmetic operations		for understanding execution process.	L5
CO3	Understand	The hardware requirements of primary and secondary memories		to store the data.	L2
CO4	Analyze	the Input/Output interfaces		to connect multiple devices.	L4
CO5	Apply	the pipeline concepts		to execute parallel tasks.	L3

UNIT - I	**Basic Structure of Computer, Machine Instructions and Programs**	9 Hrs

Basic Structure of Computer: Computer Types, Functional Units, Basic operational Concepts, Bus Structure, Software, Performance, Multiprocessors and Multicomputer.

Machine Instructions and Programs: Numbers, Arithmetic Operations and Programs, Instructions and Instruction Sequencing, Addressing Modes, Basic Input/output Operations, Stacks and Queues, Subroutines, Additional Instructions.

UNIT - II	**Arithmetic, Basic Processing Unit**	9Hrs

Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed-operand Multiplication, Fast Multiplication, Integer Division, Floating-Point Numbers and Operations.

Basic Processing Unit: Fundamental Concepts, Execution of a Complete Instruction, Multiple-Bus Organization, Hardwired Control, and Multi programmed Control.

UNIT - III	**The Memory System**	9 Hrs

The Memory System: Basic Concepts, Semiconductor RAM Memories, Read-Only Memories, Speed, Size and Cost, Cache Memories, Performance Considerations, Virtual Memories, Memory Management Requirements, Secondary Storage.

UNIT - IV	**Input/Output Organization**	9 Hrs

Input/Output Organization: Accessing I/O Devices, Interrupts, Processor Examples, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces.

UNIT - V	**Pipelining, Large Computer Systems**	9 Hrs

Pipelining: Basic Concepts, Data Hazards, Instruction Hazards, Influence on Instruction Sets.

Large Computer Systems: Forms of Parallel Processing, Array Processors, The Structure of General-Purpose multiprocessors, Interconnection Networks.

Textbooks:

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, “Computer Organization”, 5th Edition, McGraw Hill Education, 2013.

Reference Books:

1. M.Morris Mano, “Computer System Architecture”, 3rd Edition, Pearson Education.
2. Themes and Variations, Alan Clements, “Computer Organization and Architecture”, CENGAGE Learning.
3. SmrutiRanjanSarangi, “Computer Organization and Architecture”, McGraw Hill Education.

John P.Hayes, “Computer Architecture and Organization”, McGraw Hill Education

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	PO12	PSO1	PSO2
CO1	2	3										2		
CO2	3	3	3			2						2	2	
CO3	2	3						2	2					
CO4	3	3	3	3	3			2				2		1
CO5	3	3						2	2				2	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	09	20%	2	CO1 :Understand	L2	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review(L2) PO12: Thumb rule	2 3 2
2	09	20%	2	CO2 : Evaluate	L5	PO1 PO2 PO3 PO6 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO6: Thumb rule PO12: Thumb rule	3 3 3 2 2
3	09	20%	2	CO3 : Understand	L2	PO1 PO2 PO8 PO9	PO1: Apply(L3) PO2: Review(L2) PO8: Thumb rule PO9: Thumb rule	2 3 2 2
4	09	20%	2	CO4 : Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO8 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO8: Thumb rule PO12: Thumb rule	3 3 3 3 3 2 2
5	09	20%	2	CO5 : Apply	L3	PO1 PO2 PO8 PO9	PO1: Apply(L3) PO2: Review (L2) PO8: Thumb rule PO9: Thumb rule	3 3 2 2
	45	100 %						

Justification Statements :

CO1: Understand the operational concepts and instruction set related to modern processors.
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)
PO12: Thumb rule
Identify the deficiencies and demonstrate the need of updating the computer components to meet desired requirements. Therefore the correlation is medium (2)

CO2: Evaluate the Arithmetic operations for understanding execution process
Action Verb : Evaluate (L5)
PO1: Apply(L3)
CO2 Action verb is greater than level PO1 verb by two level. 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)
PO6: Thumb rule
For some of computer applications, Various arithmetic operations are evaluated for understanding execution process of computer systems. Therefore, the correlation is Medium (2)

PO12: Thumb rule
Identify the deficiencies and demonstrate the need of updating the computer instruction set to meet desired requirements. Therefore the correlation is medium(2)

CO3: Understand the hardware requirements of primary and secondary memories to store the data.
Action Verb : Understand (L2)
PO1: Apply(L3)
CO3 Action verb is less than PO1 verb level 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)
PO8 : Thumb rule
Since ethical principles should be followed to while creating the primary and secondary memories. Therefore the correlation is medium(2)
PO9 : Thumb rule
Team work is required to understand and demonstrate the secondary memories in computer system. Hence the correlation is medium (2)

CO4: Analyze the Input/Output interfaces to connect multiple devices.Action Verb : Analyze(L4)
Action Verb : Analyze (L4)
PO1: Apply(L3)
CO4 Action verb is greater 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 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
Since ethical principles shall be followed in creating quality input and output interfaces. Therefore the correlation is medium(2)
PO12: Thumb rule
Identify the deficiencies and demonstrate the need of updating the input and output interfaces to meet desired requirements. Therefore the correlation is medium(2)

CO5: Apply the pipeline concepts to execute parallel tasks.
Action Verb : Apply (L3)
PO1: Apply(L3)
CO5 Action verb is same as PO1. Therefore the correlation is high (3)
PO2: Review (L2)
CO5 Action verb is greater than PO2 verb. Therefore the correlation is high(3)
PO8 : Thumb rule
Since ethical principles should be followed in solving problems caused in pipeline hazards. Therefore the correlation is medium(2)
PO9 : Thumb rule
Team work is required to provide the solutions caused due to pipeline hazards. Hence the correlation is medium (2)

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

Course Code	Year & Sem	Design And Analysis Of Algorithms	L	T	P	C
20APC3206	II-II	(common to CSE,CSE(DS))	3	0	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: **Apply** the Divide and conquer method to solve various problems.
CO2: **Apply** the greedy and dynamic programming methods to solve real time problems.
CO3: **Evaluate** the various problems using traversal, backtracking and searching techniques.
CO4: **Apply** the 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	Apply	The Divide and conquer method		to solve various problems	L3
CO2	Apply	The greedy and dynamic programming methods		to solve real time problems.	L3
CO3	Evaluate	The various problems	Using traversal, backtracking and searching techniques.		L5
CO4	Apply	The branch and bound methods		to solve minimization problems	L3
CO5	Analyze	The P, NP, NP hard , NP complete problems		for solving reduction problems	L4

UNIT - I		9Hrs
Introduction: What is an Algorithm, Algorithm specification, Performance analysis. **Divide and Conquer:** General method, Binary Search, Finding the maximum and minimum, Merge sort, Quick Sort, Selection sort, Stressen's matrix multiplication.		
UNIT - II		9 Hrs
Greedy Method: General method, Knapsack problem, Job Scheduling with Deadlines, Minimum cost Spanning Trees, Optimal storage on tapes, Single-source shortest paths. **Dynamic programming:** General Method, Multistage graphs, All-pairs shortest paths, Optimal binary search trees, 0/1 knapsack, The traveling sales person problem.		
UNIT - III		9 Hrs
Basic Traversal and Search Techniques: Techniques for binary trees, Techniques for Graphs, Connected components and Spanning trees, Bi-connected components and DFS **Back tracking:** General Method, 8 – queens problem, Sum of subsets problem, Graph coloring and Hamiltonian cycles, Knapsack Problem.		
UNIT - IV		8 Hrs
Branch and Bound: The method, Travelling salesperson, 0/1 Knapsack problem, Efficiency Considerations. **Lower Bound Theory:** Comparison trees, Lower bounds through reductions – Multiplying triangular matrices, inverting a lower triangular matrix, computing the transitive closure.		
UNIT - V		10Hrs
NP – Hard and NP – Complete Problems: NP Hardness, NP Completeness, Consequences of beingin P, Cook's Theorem, Reduction Source Problems, Reductions: Reductions for some known problems		
Textbooks:		
1. "Fundamentals of Computer Algorithms", Ellis Horowitz, S. Satraj Sahani and Rajasekhran, 2nd edition, University Press.2014, 2. "Design and Analysis of Algorithms", Parag Himanshu Dave, Himanshu Bhalchandra Dave, Pearson Education, Second Edition, 2009.		
Reference Books:		

1. "Introduction to Algorithms", second edition, T.H.Cormen, C.E.Leiserson, R.L.Rivest and C.Stein, PHI Pvt. Ltd./ Pearson Education. 2. "Introduction to Design and Analysis of Algorithms A strategic approach", R.C.T.Lee, S.S.Tseng, R.C.Chang and T.Tsai, Mc Graw Hill. 3. "Design and Analysis of algorithms", Aho, Ullman and Hopcroft, Pearson education.
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	3	3										2	3	
CO2	3	3				2						2	2	
CO3	3	3	3	3	3	2						2	2	
CO4	3	3										2	2	
CO5	3	3	3	3	3							2	2	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	17	23%	3	CO1: Apply	L3	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review(L2) PO12: Thumb rule	3 3 2
2	16	22%	3	CO2: Apply	L3	PO1 PO2 PO6 PO12	PO1: Apply(L3) PO2: Review(L2) PO6: Thumb rule PO12: Thumb rule	3 3 2 2
3	16	22%	3	CO3: Evaluate	L5	PO1 PO2 PO3 PO4 PO5 PO6 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule PO12: Thumb rule	3 3 3 3 3 2 2
4	13	18%	2	CO4: Apply	L3	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review(L2) PO12: Thumb rule	3 3 2
5	12	15%	2	CO5: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO12: Thumb rule	3 3 3 3 3 2
	74	100 %						

Justification Statements :

CO1: Apply the Divide and conquer method to solve various problems.

Action Verb : Apply (L3)
PO1 Verb : Apply(L3)
CO1 Action verb is same level of PO1 verb by one level. Therefore, the correlation is High (3)
PO2 Verb : Review(L2)
CO1 Action verb is greater than PO2 verb. Therefore the correlation is high(3)
PO12: Thumb rule
Divide and conquer strategy is applied to solve various problems, where the work is distributed to many members to complete that task. Therefore the correlation is medium (2)

CO2: Apply the greedy and dynamic programming methods to solve real time problems.
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)
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 medium (2)
PO12: Thumb rule
Finding optimal solution to a real world problems is a continuous activity. Therefore the correlation is medium (2)

CO3: Evaluate the various problems using traversal, backtracking and searching techniques.
Action Verb : Evaluate (L5)
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)
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 PO5 verb. Therefore the correlation is high(3)
PO6 : Thumb rule
backtracking and searching techniques were applied for GPS. Therefore, the correlation is medium (2)
PO12: Thumb rule
backtracking and searching techniques will give optimal solutions to various problems. Therefore, the correlation is medium (2)

CO4: Apply the branch and bound methods to solve minimization problems.
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)
PO12: Thumb rule
Lower bound techniques were applied to minimize cost of finding best routes. Therefore the correlation is medium(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 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)
PO12: Thumb rule
In research oriented purpose P, NP concepts can be applied. Therefore the correlation is medium (2)

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

Course Code	Year & Sem	Object Oriented Programming through Java	L	T	P	C
20APC3207	II-II	(common to CSE,CIC,CSE(DS))	3	0	0	3

Course Outcomes:

After studying the course, student will be able to

CO1: **Understand** the OOP concepts to apply basic java programming.

CO2: **Apply** the inheritance, packages, and interfaces to organize various java resources.

CO3: **Analyze** the exception handling to develop efficient and error free codes.

CO4: **Apply** the concepts of multithreading and collection frameworks to solve real world scenarios

CO5: **Apply** the concepts of applets and swings for making web and GUI based applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The fundamentals of OOP concepts		to design java programs.	L2
CO2	Apply	the inheritance, packages, and interfaces		to organize various java resources	L3
CO3	Analyze	the exception handling		to develop efficient and error free codes	L4
CO4	Apply	the concepts of multithreading and collection frameworks		to solve real world scenarios.	L3
CO5	Apply	the concepts of applets and swings		for making web and GUI based applications.	L3

UNIT - I		9Hrs
Object Oriented Thinking: History of Java, Java Buzzwords, Overview of OOP CLASSES AND Objects: Classes, Objects, Simple Java Program, Methods, Constructors, this Keyword, Garbage Collection, Data Types, Variables, Arrays, Operators, Control Statements Overloading of Methods and Constructors, Parameter Passing, Recursion, String Class and String handling methods.		
UNIT - II		9 Hrs
Inheritance: Inheritance Basics, Using Super, Multilevel Hierarchy, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Using final with Inheritance, Object Class. **Packages:** Packages, Access Protection, Importing Packages. **Interfaces:** Defining an Interface, Implementing Interface, Applying Interface, Variables in Interfaces, Interfaces can be extended.		
UNIT - III		8Hrs
Exception Handling: Exception Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built in Exceptions, Creating Own Exception Sub Classes. **Input and Output Operations**: I/O basics, reading console input, writing console output, the PrintWriter class, reading and writing files, automatically closing a file. **Generic Programming** : Generic classes, generic methods, Bounded Types, Restrictions and Limitations.		
UNIT - IV		8 Hrs
Multithreading: Java Thread Model, The Main Thread, Thread Life Cycle, Creating Thread and Multiple Threads, isAlive() and join(), Thread Priorities, Synchronization, Inter thread Communication, Suspending, Resuming and Stopping Threads. **Collection Framework**: Collection Overview, Collection Interfaces: The Collection Interface, the List Interface, the Queue Interface, Collection Classes: Array List Class, Linked List Class, String Tokenizer, Scanner.		
UNIT - V		10Hrs
Applets: Applet Basics, Life Cycle of an Applet, Simple Applet Display Methods, The HTML APPLET tag, Passing Parameters to Applets. **Swing:** Introduction to Swing Model-View, Controller design pattern button, layout management, Swing Components.		
Textbooks:		

Herbert Schildt, Java. The complete reference, TMH. 9thEdition, 2014 Cay. S. Horstmann and Gary Cornell Core Java 2, Vol 2, Advanced Features, Pearson Education, 7thEdition, 2004
Reference Books:
1. J.Nino and F.A. Hosch, An Introduction to programming and OO design using Java, John Wiley & sons. 2. Y. Daniel Liang, Introduction to Java programming, Pearson Education 6th Edition 3. R.A. Johnson- Thomson, An introduction to Java programming and object oriented application development. 4. P. Radha Krishna, Object Oriented Programming through Java, University Press.
Online Learning Resources:
www.javatpoint.com

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3											1	1
CO2		3	3	2	3						3	3	1	1
CO3	2	3	3	3	3								1	1
CO4	3	3		2	3		2						1	1
CO5		3	3		3						3	3	1	1

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	16	19%	2	CO1 :Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	18	21%	3	CO2 :Apply	L3	PO2 PO3 PO4 PO5 PO11 PO12	PO2: Review (L2) PO3: Develop (L3) PO4: Analyze(L4) PO5: Apply(L3) PO11: Thumb Rule PO12: Thumb Rule	3 3 2 3 3 3
3	19	22%	3	CO3 :Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Analyze(L4) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3)	2 3 3 3 3
4	18	21%	3	CO4 :Apply	L3	PO1 PO2 PO4 PO5 PO7	PO1: Apply(L3) PO2: Review (L2) PO4: Analyze(L4) PO5: Apply(L3) PO7: Thumb Rule	3 3 2 3 2
5	15	17%	2	CO5 :Apply	L3	PO2 PO3 PO5 PO11 PO12	PO2: Review (L2) PO3: Develop (L3) PO5: Apply(L3) PO11: Thumb Rule PO12: Thumb Rule	3 3 3 3 3
	85	100%						

Justification Statements :

CO1: Understand the OOP concepts to apply basic java programming.
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 inheritance, packages, and interfaces to organize various java resources

Action Verb : Apply (L3)

PO2: Review (L2)
CO2 Action verb is greater than 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 medium (2)
PO5: Apply (L3)
CO2 Action verb is same level as PO5 verb. Therefore the correlation is high (3)
PO11: Thumb rule
Create some Java programs to solve real world problems. Therefore the correlation is high (3)
PO12: Thumb rule
Learn java programs to solve. Therefore the correlation is high (3)

CO3: Analyze the exception handling to develop efficient and error free codes
Action Verb : Analyze(L4)
PO1: Apply(L3)
CO3: CO3 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
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)

CO4: Apply the concepts of multithreading and collection frameworks to solve real world scenarios.
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 by one level. 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 same level as PO5 verb. Therefore the correlation is high (3)
PO7: Thumb rule
To solve some problems we use multithreading and collection frame works. Therefore the correlation is medium(2)

CO5: Apply the concepts of applets and swings for making web and GUI based applications.
Action Verb :Apply (L3)
PO2: Review (L2)
CO5 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO5 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO5 Action verb is same level as PO5 verb. Therefore the correlation is high (3)
PO11: Thumb rule
Java is used to design simple and enterprise applications so need for project management. Therefore the correlation is high(3)
PO12: 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)

CSE(DATA SCIENCE)

Course Code	Year & Sem	Operating Systems	L	T	P	C
20APC3208	II-II	**(common to CSE,CIC,AIDS,AIML,CSE(DS))**	**3**	**0**	**0**	**3**

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 methods to handle deadlock and memory management
CO4: **Evaluate** the various disk scheduling algorithms and file system interfaces
CO5: **Understand** the issues and goals of protection various security

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 & CPU scheduling	by drawing Gantt chart		L3
CO3	Analyze	the methods to handle deadlock and memory management			L4
CO4	Evaluate	the various disk scheduling algorithms and file system interfaces			L5
CO5	Understand	the various security issues and goals of protection			L2

UNIT - I		9 Hrs
Operating Systems Overview: Operating system functions, Operating system structure, operating systems Operations, protection and security, 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 structure, operating system debugging, System Boot. **Processes:** Process concept, process Scheduling, Operations on processes, Inter process Communication, Examples of IPC systems.		
UNIT - II		10Hrs
Threads: overview, Multi-core Programming, Multithreading Models, Thread Libraries, Implicit Threading, Threading Issues. **Process Synchronization:** The critical-section problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic problems of synchronization, Monitors, Synchronization examples, Alternative approaches. **CPU Scheduling:** Scheduling-Criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling, Real-Time CPU Scheduling, Algorithm Evaluation.		
UNIT - III		8Hrs
Memory Management: Swapping, contiguous memory allocation, segmentation, paging, structure of the page table. **Virtual memory:** demand paging, page-replacement, Allocation of frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory **Deadlocks:** System Model, deadlock characterization, Methods of handling Deadlocks, Deadlock prevention, Detection and Avoidance, Recovery from deadlock.		
UNIT - IV		9Hrs
Mass-storage structure: Overview of Mass-storage structure, Disk structure, Disk attachment, Disk scheduling, Swap-space management, RAID structure, Stable-storage implementation. **File system Interface:** The concept of a file, Access Methods, Directory and Disk structure, File system mounting, File sharing, Protection. **File system Implementation:** File-system structure, File-system Implementation, Directory Implementation, Allocation Methods, Free-Space management.		
UNIT - V		8Hrs
I/O systems: I/O Hardware, Application I/O interface, Kernel I/O subsystem, Transforming I/O requests to Hardware operations.		

Protection: Goals of Protection, Principles of Protection, Domain of protection, Access Matrix, Implementation of Access Matrix, Access control, Revocation of Access Rights, Capability- Based systems, Language – Based Protection

Security: The Security problem, Program threats, System and Network threats, Cryptography as a security tool, User authentication, Implementing security defenses, Firewalling to protect systems and networks, Computer–security classifications.

Textbooks:

3. Operating System Concepts, Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Wiley, Eight Edition, 2018

Reference Books:

1. Operating systems by A K Sharma, Universities Press,
2. Operating Systems, S.Haldar, A.A.Aravind, Pearson Education.
3. Operating Systems, A.S.Godbole, Second Edition, TMH.
4. Operating Systems, G.Nutt, N.Chaki and S.Neogy, Third Edition, Pearson Education.
5. Operating Systems, R.Elmasri, A,G.Carrick and D.Levine, Mc Graw Hill.
6. Principles of Operating Systems, B.L.Stuart, Cengage learning, India Edition.

Online Learning Resources:

https://nptel.ac.in/courses/106/106/106106144/ http://peterindia.net/OperatingSystems.html

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3										2	1	1
CO2	3	3				2						3	1	1
CO3	3	3	3	3	3								2	2
CO4	3	3	3	3	3	2		3				2	2	2
CO5	2	3						3				2	2	2

Unit No.	CO				BTL	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	16	19%	2	CO1 : Understand	L2	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review(L2) PO12: Thumb rule	2 3 2
2	19	22%	3	CO2 :Apply	L3	PO1 PO2 PO6 PO12	PO1: Apply(L3) PO2: Review(L2) PO6: Thumb rule PO12: Thumb rule	3 3 2 3
3	16	19%	2	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	18	21%	3	CO4 : Evaluate	L5	PO1 PO2 PO3 PO4 PO5 PO6 PO8 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule PO8: Thumb rule PO12: Thumb rule	3 3 3 3 3 2 3 2
5	17	19%	2	CO5 : Understand	L2	PO1 PO2 PO8 PO12	PO1: Apply(L3) PO2: Review(L2) PO8: Thumb rule PO12: Thumb rule	2 3 3 2
	86	100 %						

Correlation matrix

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)
PO12: 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 & CPU scheduling by drawing gantt chart
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)
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)
PO12: Thumb rule
Scheduling is the one of the daily activity done in many sectors. Therefore the correlation is High(3)

CO3: Analyze the methods to handle deadlock and memory management
Action Verb : 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)

CO4: Evaluate the various disk scheduling algorithms and file system interfaces.
Action Verb : Evaluate (L5)
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)
PO3: Develop (L3)
CO4 Action verb is greater than PO3 verb. Therefore the correlation is high(3)
PO4: Analyze (L4)
CO4 Action verb is greater than PO4 verb by one level. 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
Disk scheduling and file system interfaces are applied to provide solutions for E-Commerce database access . Therefore the correlation is medium (2)
PO8: Thumb rule
Since ethical principles shall be followed in file manipulations and data storage. Therefore the correlation is high(3)
PO12: 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 security issues and goals of protection
Action Verb : 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 asPO2 verb. Therefore, the correlation is high(3)
PO8 : Thumb rule
Ethical principles should be followed for various security issues. Therefore the correlation is high(3)

PO12: Thumb rule
Security services and principles are keep on updating in the today's world. Therefore, the correlation is medium (2)

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

Course Code	Year & Sem	MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS	L	T	P	C
20AHSMB01	II-II		3	0	0	3

Course Outcomes (CO):

After studying the course, student will be able to

CO1: Understand the fundamentals of managerial economics and demand concept.

CO2: Understand the production and cost concepts to optimize the output

CO3: Analyze the price output relationship in different markets.

CO4: Evaluate the capital budgeting techniques to invest in various projects.

CO5: Analyze the accounting statements to evaluate the financial performance of business entity.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	fundamentals of managerial economics			**L2**
CO2	**Understand**	production and cost concepts		To optimize the output	**L2**
CO3	**Analyze**	price output relationship in various markets			**L4**
CO4	**Evaluate**	capital budgeting techniques		To invest in various projects	**L5**
CO5	**Analyze**	accounting statements		to evaluate the financial performance of business entity	**L4**

UNIT - I	**Managerial economics**
Introduction – meaning, nature, significance, functions, and advantages, ME and its role in other fields. Demand - Concept, Function, Law of Demand - Demand Elasticity- Types – Measurement. Demand Forecasting- Factors governing forecasting, Methods.	
UNIT - II	**Production and Cost Analysis**
Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least-cost combination– Short run and Long run Production Function- Isoquants and Isocosts, MRTS - Cobb-Douglas Production Function - Laws of Returns - Internal and External Economies of scale. Cost& Break-Even Analysis - Cost concepts and Cost behavior- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems)-Managerial significance and limitations of Break-Even Analysis.	
UNIT - III	**Business Organizations and Markets**
Introduction – Nature, meaning, significance, functions and advantages. Forms of Business Organizations- Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises. Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly- Monopolistic Competition–Oligopoly-Price-Output Determination - Pricing Methods and Strategies.	
UNIT - IV	**Capital Budgeting**
Introduction to Capital, Sources of Capital. Short-term and Long-term Capital: Working capital, types, Estimating Working capital requirements. Capital Budgeting – Features, Proposals, Time value of money. Methods and Evaluation of Projects – Pay Back Method, Accounting Rate of Return (ARR), Net Present Value (NPV), and Internal Rate Return (IRR) Method (simple problems).	
UNIT - V	**Financial Accounting and Analysis**
Introduction – Nature, meaning, significance, functions and advantages. Concepts and Conventions-Double-Entry Book Keeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profitand Loss Account and Balance Sheet with simple adjustments). ***Financial Analysis*** - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability.	

Textbooks:

1. Varshney&Maheswari: Managerial Economics, Sultan Chand, 2013.
2. Aryasri: Business Economics and Financial Analysis, 4/e, MGH, 2019

Reference Books:

1.	Ahuja Hl Managerial economics Schand,3/e,2013
2.	S.A. Siddiqui and A.S. Siddiqui: Managerial Economics and Financial Analysis, New Age International, 2013.
3.	Joseph G. Nellis and David Parker: Principles of Business Economics, Pearson, 2/e, New Delhi.
4.	Domnick Salvatore: Managerial Economics in a Global Economy, Cengage, 2013.

Online Learning Resources:

https://www.slideshare.net/123ps/managerial-economics-ppt
https://www.slideshare.net/rossanz/production-and-cost-45827016
https://www.slideshare.net/darkyla/business-organizations-19917607

COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2													
CO2		1												
CO3	3													
CO4		3												
CO5		3												

Course Outcome (CO)	Percentage of contact hours over the total planned contact hours	CO: Action verb and BTL	Program Outcome(PO)	PO: Action verb and BTL	Level of correlation (0-3)
CO1	16%	understand	PO1	Apply	2
CO2	22%	understand	PO2	Analyse	1
CO3	22%	Analyse	PO1	Apply	3
CO4	16%	Evaluate	PO2	Analyse	3
CO5	22%	Analyse	PO2	Analyse	3

Justification Statements:

CO1: Understand the fundamentals of Managerial economics and demand concept.
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: Understand the Concept of Production and cost analysis.
Action Verb: Understand (L2)
PO2: Analyze (L4)
CO2 Action verb is less than PO1 verb by two levels. Therefore, the correlation is low (1)

CO3: Analyze the price output in various markets.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO3 Action verb is more than PO1 verb by one level. Therefore, the correlation is high (3)
CO4: Evaluate the capital budgeting techniques.
Action Verb : Evaluate (L5)
PO2: Analyse
CO3 Action verb is more than PO1 verb by one level. Therefore, the correlation is high (3)
CO5: Analyse the Accounting statements and evaluate the financial performance of business entity.
Action Verb: Analyze (L4)
PO2: Analyze (L4)
CO5 Action verb is same as PO2 verb. Therefore, the correlation is high (3)

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

Course Code	Year & Sem	Universal Human Values	L	T	P	C
20AHS9905	II-II		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
CO1	**Understand**	the essentials of human values, self-exploration, happiness and prosperity for value added education			**L2**
CO2	**Analyze**	the harmony in the human being as sentient 'I' and the material 'Body' in various aspects.			**L4**
CO3	**Apply**	the nine universal human values in relationships for harmony in the family and orderliness in the society			**L3**
CO4	**Evaluate**	the interconnectedness of four orders of nature and holistic perception of harmony at all levels of existence			**L5**
CO5	**Apply**	the holistic understanding of harmony on professional ethics through augmenting universal human order.			**L3**

UNIT – 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current. scenario
- Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT II: Understanding Harmony in the Human Being - Harmony in Myself!

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)

- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

UNIT III: **Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship**.

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
- Understanding the meaning of Trust; Difference between intention and competence
- Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

UNIT IV: **Understanding Harmony in the Nature and Existence - Whole existence as Coexistence**

- Understanding the harmony in the Nature
- Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature
- Understanding Existence as Co-existence of mutually interacting units in all- pervasive space
- Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT- V: Implications of the above Holistic Understanding of Harmony on Professional Ethics.

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions Eg. To discuss the conduct as an engineer or scientist etc.

TEXT BOOKS

1. 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

2. 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

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

Articulation matrix

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	PO 12	PSO 1	PSO 2
Universal Human Values	CO1								2				12		
	CO2							3	3						
	CO3						2	2	2						
	CO4						3	3	3				3		
	CO5						2	2	2				2		

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,PO12	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,PO12	Thumb Rule	3,3,3,3
5	7	19.4	2	Apply	3	PO6,PO7,PO8,PO12	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 PO12 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 PO12 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 PO12 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 PO12 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 PO12 as moderate (2).

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

Course Code	Year & Sem	Design And Analysis of Algorithms Lab	L	T	P	C
20APC3209	II-II		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO 1: **Understand** the sorting and searching concepts in a given set of elements to measure its time complexity

CO 2: **Analyze** the greedy method to derive best solution for a given data

CO 3: **Analyze** the dynamic programming strategy for solving the 0/1 Knapsack problem

CO 4: **Apply** the backtracking method to implement N-Queen's Problem

CO 5: **Apply** branch and bound method to solve Travelling Salesman Problem

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	**Understand**	the sorting and searching concepts in a given set of elements		to measure its time complexity	L2
CO2	**Analyze**	the greedy method		to derive best solution for a given data	L4
CO3	**Analyze**	the dynamic programming strategy		for solving the 0/1 Knapsack problem	L4
CO4	**Apply**	the backtracking method		to implement N-Queen's Problem	L3
CO5	**Apply**	branch and bound method		to solve Travelling Salesman Problem	L3

List of Experiments:

1. Implement Selection sort and find how many steps are required to sort 10 elements.**(CO1)**
2. Implement and Analysis factorial of a number program using iterative and recursive methods. **(CO1)**
3. Sort a given set of elements using the quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n (the number of elements in the list to be sorted) and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. **(CO1)**
4. Write a program to check whether a given graph is connected or not using the DFS method. **(CO1)**
5. Apply Greedy method to compress the given data using Huffman encoding. **(CO2)**
6. Implement fractional knapsack problem using Greedy Strategy. **(CO2)**
7. Implement minimum spanning tree using Prim's algorithm and analyse its time complexity. **(CO2)**
8. Apply dynamic programming methodology to implement 0/1 Knapsack problem. **(CO3)**
9. Solve the longest common subsequence problem using dynamic programming. **(CO3)**
10. Find the length of the longest subsequence in a given array of integers such that all elements of the subsequence are sorted in strictly ascending order. **(CO4)**
11. Implement N-Queens problem using backtracking. **(CO4)**
12. Implement graph coloring problem using backtracking. **(CO4)**
13. Find the solution of the 0/1 Knapsack Problem using LC Branch and Bound. **(CO4)**
14. Find the solution to the Travelling Salesman Problem. Repeat the experiment for a graph having total number of nodes (n) = 4, 8, 12, 16, 20 and note the time required to find the solution. Plot the graph taking n on the x-axis and time on y-axis and analyze the graph to determine whether it is exponential or not. **(CO5)**

References:

1. https://onlinecourses.nptel.ac.in/noc19_cs47/preview
2. https://ocw.mit.edu/courses/6-046j-design-and-analysis-of-algorithms-spring-2015/
3. https://vignanits.ac.in/design-and-analysis-of-algorithms-lab/
4. https://www.ahirlabs.com/practicals/design-analysis-of-algorithms-lab-practical/

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3										3	2
CO2	3	3	3		3								2	2
CO3	3	3	3	3	1								2	2
CO4	3	3	3	3							3		2	2
CO5	3	3	3	3					3		3		2	2

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 PO3 PO5	PO1: Apply(L3) PO2:Analyze(L4) PO5:Solve(L3)	2 1 3
2	CO2: Analyze	L4	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Analyze(L4) PO3: Construct(L3) PO5: Identify(L3)	3 3 3 3
3	CO3: Analyze	L4	PO1 PO2 PO3 PO4 P05	PO1: Apply(L3) PO2: Identify(L3) PO3: Divide(L4) PO4: Discover(L4) P05: Develop(L6)	3 3 3 3 1
4	CO4: Apply	L3	PO1 PO3 PO4 PO11	PO1: Apply(L3) PO2:Make use of(L3) PO3: Construct(L3) PO4:Develop(L3) PO11:Thumbrule	3 3 3 3
5	CO5: Apply	L3	PO1 PO3 PO4 PO9 PO11	PO1: Apply(L3) PO2: Make use of(L3) PO3: solve(L3) PO4: Identify(L3) PO9: Thumb Rule PO11: Thumb Rule	3 3 3 3 3

Justification Statements:

CO 1: Understand the sorting and searching concepts in a given set of elements to measure its time complexity

Action Verb: Understand (L2)

PO1 Verb: Apply (L3)

CO1 Action verb is lesser than PO1 verb. Therefore, the correlation is medium (2)

PO3: Analyze(L4)

CO1 Action verb is lesser than PO3 verb. Therefore, the correlation is low (1)

PO5: Solve (L3)

CO1 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

CO 2: Analyze the greedy method to derive best solution for a given data

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

PO3: Construct(L3)
CO2 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO5: Identify(L3)
CO2 Action verb is greater than PO5 verb. Therefore, the correlation is high (3)

CO 3: Analyze the dynamic programming strategy for solving the 0/1 Knapsack problem
Action Verb: Analyze (L3)
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: Divide(L4)
CO3 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Discover(L4)
CO3 Action verb is same as PO4 verb. Therefore, the correlation is high (3)

P05: Develop(L6)
CO3 Action verb is two less than PO5 verb. Therefore, the correlation is low (1)

CO 4: Apply the backtracking method to implement N-Queen's Problem
Action Verb: Apply(L3)
PO1: PO1: Apply(L3)
CO4 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2: Make use of(L3)
CO4 Action verb is same as PO2 verb. Therefore, the correlation is high (3)
PO3: Construct(L3)
CO4 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Develop(L3)
CO4 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO11: Thumbrule
CO4 Backtracking technique used in many real-world applications, including solving puzzles, finding paths in a maze, scheduling tasks, and optimizing decisions in areas such as logistics and resource allocation. It is also commonly used in artificial intelligence.so the correlation is high (3)

CO 5: Apply branch and bound method to solve Travelling Salesman Problem
Action Verb: Apply (L3)
PO1: Apply (L3)
CO5 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2: Make use of(L3)
CO5 Action verb is same as PO2 verb. Therefore, the correlation is high (3)
PO3: solve(L3)
CO5 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO4: Identify(L3)
CO5 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO9: Thumb Rule
CO5 Branch and Bound can efficiently handle constraint satisfaction problems by systematically exploring the search space and pruning branches based on constraints.so the correlation is high (3)
PO11: Thumb Rule
CO5 Branch and bound techniques can apply in scenarios like resource allocation where resources need to be distributed optimally among competing demands.so the correlation is high (3)

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

Course Code	Year & Sem	OBJECT ORIENTED PROGRAMMING THROUGH JAVA	L	T	P	C
20APC3210	II-II	LAB	0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO1: Understand the java compiler and learn how to use eclipse or net beans IDE.

CO2: Apply the class concepts for developing simple java applications.

CO3: Apply the oops concepts for implementing java programs.

CO4: Analyze the concepts of multithreading and collection frameworks for writing simple programs.

CO5: Create the applets and GUI based applications using swings.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the java compiler and learn how to use eclipse or net beans IDE.			L2
CO2	Apply	the class concepts		for developing simple java applications.	L3
CO3	Apply	the oops concepts		for implementing java programs.	L3
CO4	Analyze	the concepts of multithreading and collection frameworks		for writing simple programs.	L4
CO5	Create	the applets and GUI based applications	using swings.		L6

List of Experiments

Week-1: (Unit-1)

Installation of Java software, study of any integrated development environment, Use Eclipse or Net bean platform and acquaint with the various menus. Create a test project, add a test class and run it.

Practice Java Basic Programs on Classes and Objects.**(CO1)**

Week-2: (Unit-1)

Develop a Java application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Commute the bill amount using the following tariff.
If the type of the EB connection is domestic, calculate the amount to be paid as follows:

First 100 units - Rs. 1 per unit; 101-200 units - Rs. 2.50 per unit; 201 -500 units - Rs. 4 per unit;

501 units - Rs. 6 per unit. If the type of the EB connection is commercial, calculate the amount to be paid as follows: First 100 units - Rs. 2 per unit; 101-200 units - Rs. 4.50 per unit; 201 -500 units - Rs. 6 per unit; > 501 units - Rs. 7 per unit.

Write a java program to illustrate the concept of class with method overloading. C) Write a java program to illustrate the concept of class with Constructors overloading. **(CO2)**

Week-3:(Unit-2)

a) Write a program to create a class named shape. It should contain 2 methods, draw() and erase() that prints “Drawing Shape” and “Erasing Shape” respectively. For this class, create three sub classes,

Circle, Triangle and Square and each class should override the parent class functions - draw () and erase (). The draw() method should print "Drawing Circle", "Drawing Triangle" and "Drawing Square" respectively. The erase() method should print "Erasing Circle", "Erasing Triangle" and "Erasing Square" respectively. Create objects of Circle, Triangle and Square in the following way and observe the polymorphic nature of the class by calling draw() and erase() method using each object. Shape c=new Circle(); Shape t=new Triangle(); Shape s=new Square();

b) Write a Java Program to demonstrate inheritance &usage of super**(CO2)**

Week-4:(Unit-2)

Write a Java Program to implement multilevel inheritance. **(CO3)**
Write a Java program to implement the method overriding**(CO3)**
Write a Java program to implement dynamic method dispatch. **(CO3)**
Week-5:(Unit-2)

Write a Java program to implement abstract class. **(CO3)**
Write a Java Program to implement Packages. **(CO3)**
Write a Java Program to implement Access Protection in Packages. **(CO3)**
Week-6:(Unit-2)

Write a Java program to demonstrate interfaces. **(CO3)**
Write a Java program to implement the multiple inheritance using interfaces. **(CO3)**
Week-7:(Unit-3)

Write a Java program to implement the exception handling mechanism. **(CO3)**
Write a Java program to implement the nested try statement. **(CO3)**
Write a Java program to implement your own exception class. **(CO3)**
Week-8:(Unit-3)

Write a Java Program to demonstrate the following String Handlings. **(CO3)**
String Length& Concatenation.
Character Extraction.
String Comparison.
Searching and modifying String.
Write a Java Program to demonstrate String Buffer Class.
Week-9:(Unit-4)

Write a Java program for multi-thread implementation. **(CO4)**
Write a Java program to implement producer consumer problem using inter-thread communication mechanism. **(CO4)**
Week-10:(Unit-4)

Practice any two Programs on Collections. **(CO4)**
Practice any two Programs on String Tokenizer & Scanner. **(CO4)**
Week-11:(Unit-5)

Write a Java Program to develop an applet that displays a simple message. **(CO5)**
Develop an applet that receives an integer in one text field, and computes its factorial Value and returns it in another text field, when the button named ―Compute‖ is clicked. **(CO5)**
Write a java program to handle keyboard events. **(CO5)**
Write a java program to handle Mouse events**(CO5)**
Week-12:(Unit-5)

Write a Java Program to demonstrate AWT Label & Button. **(CO5)**
Write a Java Program to demonstrate JLabel, JTextField & JButton. **(CO5)**
Write a program to design a calculator using event driven programming paradigm of java**(CO5)**

Reference Books:

5. Herbert Schildt.Java. The complete reference, TMH. 9thEdition.
6. H.M.Dietel and P.J.Dietel, Java How to Program 6thEdition,PearsonEducation/PHI
7. Y.Daniel Liang, Introduction to Java programming, Pearson Education, 6thEdition.

8. Cay Horstmann, Big Java, 2nd edition, Wiley Student Edition, Wiley India Private Limited.
Online Learning Resources/Virtual Labs:
http://www.javatpoint.com

Mapping of course outcomes with program outcomes

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

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	PO2: Analyze (L4) PO3: Develop(L3) PO4: Analyze(L4) PO5: Apply(L3)	3 3 3 3
5	CO5 :Create	L6	PO3 PO5	PO3: Design (L6) PO5: Create(L6)	3 3

Justification Statements :

CO1: Understand the java compiler and learn how to use eclipse or net beans IDE.

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 medium (2)

CO2: Apply the class concepts for developing simple java applications.

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 medium (2)

PO5: Apply (L3)

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

CO3: Apply the oops concepts for implementing java programs.

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 medium(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 writing simple 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)

CO5: Create the applets and GUI based applications using swings.
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)

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

Course Code	Year & Sem	Operating Systems Lab	L	T	P	C
20APC3211	II-II		0	0	3	1.5

Course Outcomes:

After studying the course, student will be able to

CO 1: Understand the basic commands in UNIX operating systems.

CO 2: Apply the concepts of CPU scheduling algorithms to solve real time problems.

CO 3: Apply the concepts of process synchronization methods.

CO 4: Analyze the solutions for virtual memory and Deadlocks.

CO 5: 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 solutions		for virtual memory and Deadlocks	L4
CO5	**Analyze**	various file system interfaces			L4

List of Experiments to be implemented in C/Java

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. Simulate all file allocation strategies: a) Sequential b) Indexed c) Linked**(CO2)**
6. Simulate MVT and MFT**(CO2)**
7. Simulate all File Organization Techniques a) Single level directory b) Two level c) Hierarchical d) DAG**(CO2)**
8. Simulate Bankers Algorithm for Deadlock Avoidance**(CO3)**
9. Simulate Bankers Algorithm for Deadlock Prevention**(CO3)**
10. Simulate all page replacement algorithms a) FIFO b) LRU c) LFU Etc. …**(CO4)**
11. Simulate Paging Technique of memory management**(CO4)**
12. Control the number of ports opened by the operating system with a) Semaphore b) monitors**(CO4)**
13. Simulate how parent and child processes use shared memory and address space**(CO4)**
14. Simulate sleeping barber problem**(CO4)**
15. Simulate dining philosopher's problem**(CO4)**
16. Simulate producer and consumer problem using threads (use java) **(CO4)**
17. Simulate little's formula to predict next burst time of a process for SJF scheduling algorithm. **(CO4)**
18. Develop a code to detect a cycle in wait-for graph**(CO5)**
19. Develop a code to convert virtual address to physical address**(CO5)**
20. Simulate how operating system allocates frame to process**(CO5)**
21. Simulate the prediction of deadlock in operating system when all the processes announce their resource requirement in advance. **(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	PO12	PSO1	PSO2
CO1	3				3								2	
CO2	3	3	3		3							3	2	
CO3	3	3	3		3									
CO4	2	2		3	3									
CO5	2				3									

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	PO5	PO1: Apply(L3) PO5: Create (L6)	3 3
2	CO2: Apply	L3	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Formulate (L6) PO3: Develop(L6) PO5: Create (L6) PO12:Thumb Rule	3 3 3 3 3
3	CO3: Apply	L3	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Formulate (L6) PO3: Develop(L6) PO5: Create (L6)	3 3 3 3
4	CO4: Analyze	L4	PO1 PO2 PO4 PO5	PO1:Apply(L3) PO2: Identify (L3) PO4: Analyze (L4) PO5: Create (L6)	2 2 3 3
5	CO5: Analyze	L4	PO1 PO5	PO1: Apply(L3) PO5: Create (L6)	2 3

Justification Statements :

CO1: Understand the basic commands in UNIX operating systems.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO5 Verb: Create (L3)
CO1 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)

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: Formulate(L6)
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: Create (L6)
CO2 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)

PO12 Verb: Thumb rule
Algorithms analysis is learning process to find the solution better manner the correlation is high (3)

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: Formulate(L6)
CO3 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Develop (L6)
CO3 Action verb is greater than as PO3 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 the solutions for virtual memory and Deadlocks.
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO4 Action verb is less than as PO1 verb by one level. Therefore, the correlation is medium (2)
PO2 Verb: Idetify(L3)
CO4 Action verb is less than as PO2 verb by one level. Therefore, the correlation is medium (2)
PO4 Verb: Analyze (L4)
CO4 Action verb is same 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 various file system interfaces.
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO5 Action verb is less than as PO1 verb by one level. Therefore, the correlation is medium (2)
PO5 Verb: Create (L6)
CO5 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)

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

Course Code	Year & Sem	DIGITAL AND SOCIAL MEDIA MARKETING	L	T	P	C
20ASC3202	II-II		1	0	2	2

Course Outcomes:

After studying the course, student will be able to

CO 1: Understand the concepts of digital marketing and its real-world applications
CO 2: Create a website to develop social media content and deploy using a domain name
CO 3: Analyze E-commerce fundamentals and business models for affiliate marketing
CO 4: Apply email marketing for sending promotional newsletters a list of subscribers
CO 5: Apply social media marketing strategies to build community for the businesses

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	**Understand**	the concepts of digital marketing and its real-world applications			L2
CO2	**Create**	a website		to develop social media content and deploy using a domain name	L3
CO3	**Analyze**	E-commerce fundamentals and business models		for affiliate marketing	L3
CO4	**Apply**	email marketing		for sending promotional newsletters a list of subscribers	L3
CO5	**Apply**	social media marketing strategies		to build community for the businesses	L6

UNIT I	Introduction, Search Engine optimization	9Hrs

Marketing Goes Digital: Introduction, Digital isn't the only option, Non-Marketing digital marketers, Personalization, Viral Marketing, Paid, earned and owned, Content marketing, Influencers, Affiliate marketing, Attribution, Public relations and reputation management, Integrated marketing communications, Gaming, Legal Considerations, Strategic digital marketing, Digital marketing Objectives

Search Engine optimization: Introduction, How search engines work, Keyword selection, On-site optimization, Off-site optimization, Strategic search engine optimization, Third-party search engine ranking

Activity 1:(Search Engine Optimization)

Perform the following activities in relation to On Page -Search Engine Optimization.

1. Submit your site to Google Search Console: Take a screenshot of successful message.
2. Create XML Map. Submit to Google Search Console: Take a screenshot of successful message.
3. Install Yoast SEO Plug-in. Perform SEO Analysis. Take screenshot of the report
4. Perform Readability Analysis of the post that you created in Activity 1 Website Review:
   Part:1. Question 1 using Yoast SEO. Take a screenshot of the report
5. Use keyword Planner tool. Select 10 Important Keyword for your website. Takescreen shot of this list.

UNIT II	Website Development	8Hrs

Website Development: Introduction, Web presence ownership, management and development, Usability, The basics, Content development, The B2B website, The global web presence.

Activity 2: Buy Domain Name and WebHosting

You need to buy a domain name and webhosting to build your own websites which is very important.

to have hands-on experience with SEO and other digital marketing techniques.

UNIT III	E-commerce	9Hr

E-commerce: Introduction, Multi-channel retailing, Fulfilment, Comparison shopping engines, emarketplaces and third-party shopping websites, The e-commerce website

Advertising online: Introduction, Programmatic advertising, Objectives and management, Online ad formats, Search advertising, Network advertising, Landing pages.

Activity-3: (Website Review)

1. Crete a Website of your own
2. Add a new post to your website, a topic should be related to your Website.
3. Add a contact us form in the website (Use Contact Form 7 Plug-in).
4. Create Home page of your Website using Elementor Plug-in.
5. Add Slider to any page of your website
6. Create top Menu of your website

UNIT IV	Email marketing	8Hr

Email marketing: Introduction, Email as a medium for direct marketing, Email as a medium for marketing messages, Email newsletters

Activity 4: Email Marketing

All these questions are with respect to MailChimp

1. Create a new Audience. Add 10 Dummy Subscribers to the audience list using any of the following methods

1. Manual
2. Copy Paste from the file
3. CSV or tab-delimited text file

2. Make sure your list includes, First Name, Last name, Phone (Dummy), Tag, Address and Gender. Please also mention which method you have used. Take a screenshot of the list. Upload to your website. Send the URL of Page.
3. Create a signup form using "Form Builder Option". Objective should be collecting the emails for your Digital Marketing Training Institute. Share the URL of Signup form
4. Create an embedded form. Embed this form in any page of your website. Share the link of the page. Objective should be collecting the emails only.
5. Suppose you are offering Training on Digital Marketing. Create a 1 Column – Full Width Template by using at least five Blocks in the template. Share the URL of that template
6. Select "Art Newsletter" and customize it a newsletter from digital marketing training institute. You may include the text/ message as per your wish.

Activity 5: Email Marketing

All these questions are with respect to Mail Chimp

1. Take the audience list. Create Two segments based on gender. Take the screenshot of each segment and Upload to your website. Send the URL of Page.
2. Create a group based on interest in your audience. It should be visible in Signup form. Take the screenshot and Upload to your website. Send the URL of Page.
3. Create a dummy campaign using mail chimp to promote Digital marketing services. Share the URLs of the Campaign. Use may use any template as per your wish.
4. Create a dummy 'plain text campaign' on any subject. Take a screenshot of Desktop and Mobile preview. Upload to your website. Send the URL of Page.
5. Create a pop-up form for your website. Share the URL of your website

UNIT V	Marketing on Social media	9Hr

Marketing on social media: Introduction, Blogging, Consumer reviews and ratings, Social networking, Social sharing, Social media service and support, Strategic marketing on social media, Measure and monitor.

Activity 6: Social Media Marketing

Assume a product. You want to advertise it. Prepare the advertisement and do the marketing on Facebook.

Activity 7: Twitter and LinkedIn

Experiment with Twitter and LinkedIn

Activity 8: YouTube

All the students put together create a YouTube Chanel. Upload videos. Optimize it.

Activity 9: Logo, Banner, Video

Prepare logo, banner, and Video for assumed product/organization.

Activity 10: WhatsApp

Prepare a publicity video and market it on WhatsApp

Textbooks:

1.Alan Charlesworth, "Digital Marketing: A Practical Approach", 3rd Edition,2018

References:

1. Digital and Social Media Marketing: Emerging Applications and Theoretical Development,Nripendra P. Rana 2019
2. Digital Marketing Paperback – 6 August 2020by Seema Gupta

Mapping of course outcomes with program outcomes

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

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: Demonstrate(L2)	3
2	CO2: Create	L6	PO1 PO2	PO1: Build(L6) PO2: Develop(L6)	3 3
3	CO3: Analyze	L4	PO1 PO2 PO9 PO10 PO11 PO12	PO1: Compare(L4) PO2: Examine(L4) PO9: Thumb Rule PO10: Thumb Rule PO11: Thumb Rule PO12: Thumb Rule	3 3 3 3 3 3
4	CO4: Apply	L3	PO1 PO3 PO9 PO10 PO11	PO1: Apply(L3) PO3: Develop(L3) PO9: Thumb Rule PO10: Thumb Rule PO11: Thumb Rule	3 3 3 3 3
5	CO5: Apply	L3	PO1 PO3 PO9 PO10 PO11 PO12	PO1: Apply(L3) PO3: Make use of(L3) PO9: Thumb Rule PO10: Thumb Rule PO11: Thumb Rule PO12: Thumb Rule	3 3 3 3 3 3

Justification Statements:

CO1: : Understand Digital marketing to reimagine marketing in the digital age to create change and sustain growth.

Action Verb: Understand (L2)

PO1 Verb: Demonstrate(L2)
CO1 Action verb is same as PO1 verb. Therefore, the correlation is high (3)

CO2: Create a website to develop social media content management and development system

Action Verb: Apply (L6)
PO1: Build(L6)
CO2 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2: Develop(L6)
CO2 Action verb is same as PO3 verb. Therefore, the correlation is high (3)

CO3: Analyze E-commerce fundamentals and business models for affiliate marketing

Action Verb: Analyze(L4)
PO1: Compare (L4)
CO3 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2: Examine(L4)
CO3 Action verb is sames as PO2 verb. Therefore, the correlation is high (3)
PO9: Thumbrule
CO3 To create third party websites and additional functionalities, therefore the correlation is high (3)
PO10: Thumbrule
CO3 Affiliate marketing is a performance-based marketing where it promotes business products or services through content and ads, therefore the correlation is high (3)
PO11: Thumbrule
CO3 financial services industry, affiliates focus on referring people to products such as credit cards loans, insurance or investment platforms, therefore the correlation is high (3)
PO12: Thumbrule
CO3 Improve familiarity with current challenges and issues in E-Commerce, therefore the correlation is high (3)

CO4: Apply email marketing for effective email strategy

Action Verb: Apply(L3)
PO1: Apply (L3)
CO4 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO3: Develop(L3)
CO4 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)
PO9: Thumbrule
CO4 Effective understanding of consumer behaviour in digital forms, therefore the correlation is high (3)
PO10: Thumbrule
CO4 Email as a medium for digital marketing, therefore the correlation is high (3)
PO11: Thumbrule
CO4 creation of awareness on marketing activities of a business organization through social media in a cost-effective manner, therefore the correlation is high (3)

CO5: Apply social media marketing strategies

Action Verb: Apply(L3)
PO1: Apply (L3)
CO5 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO3: Make use of(L3)
CO5 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO9: Thumbrule
CO5 identify social media marketing problems and ways to solve, therefore the correlation is high (3)
PO10: Thumbrule
CO5 Asses the role of branding social advertising and other communication in achieving behavioural change, therefore the correlation is high (3)
PO11: Thumbrule
CO5 Exploring marketing concepts and techniques applied to commercial marketing, therefore the correlation is high (3)
PO12: Thumbrule
CO5 Social Media marketing has grown to include several techniques and strategies to engage users and market products and services, therefore the correlation is (3)