DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	Name of the Course	Course Code	Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development
A.Y 2022-23			
UG			
R-22 REGULATION			
SEM-1			
1	Linear Algebra & Calculus	22MTC01	Skill development
2	Optics and Semiconductor Physics	22PYC01	Skill development
3	Problem Solving and Programming	22CSC01	Skill development and Employability
4	English	22EGC01	Employability
5	Optics and Semiconductor Physics Lab	22PYC03	Skill development
6	English lab	22EGC02	Employability
7	Problem Solving and Programming Lab	22CSC02	Skill development and Employability
8	CAD AND DRAFTING	22MEC01	Skill development and Employability
9	Digital Fabrication Lab	22MEC38	Skill development
SEM-2			
10	Differential Equations & Numerical Methods	22MTC04	Skill development
11	Chemistry	22CYC01	Skill development
12	Basic Electrical Engineering	22EEC01	Skill development
13	Object Oriented Programming	22CSC03	Skill development and Employability
14	Chemistry Lab	22CYC02	Skill development
15	Community Engagement	22MBC02	Entrepreneurship

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	**Name of the Course**	**Course Code**	**Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development**
16	Object-Oriented Programming Lab	22CSC04	Skill development and Employability
17	Robotics & Drones Lab	22MEC37	Skill development
18	Basic Electrical Engineering Lab	22EEC02	Skill development
R-20 REGULATION			
SEM-3			
19	DC Circuits, Sensors and Transducers	20ECC34	Skill development
20	Probability and Statistics	20MTC09	Skill development
21	Database Management Systems	20ITC08	Skill development and Employability
22	Java Programming	20ADC01	Skill development and Employability
23	Digital Logic and Computer Architecture	20ITC05	Skill development
24	Indian Constitution and Fundamental Principles	20EGM01	Skill development
25	Indian Traditional Knowledge	20EGM02	Skill development
26	DBMS Lab	20ITC10	Skill development and Employability
27	Java Programming Lab	20ADC02	Skill development and Employability
28	Techniques and Applications	20ADC03	Skill development and Employability
29	Mini Project - I	20ITC12	Employability
30	MOOCs/Training/Internship	20ADI01	Employability
SEM-4			
31	Stochastic Process and Queueing Theory	20MTC10	Skill development

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	**Name of the Course**	**Course Code**	**Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development**
32	Discrete Mathematics and Applications	20ITC06	Skill development
33	Design and Analysis of Algorithms	20ITC15	Skill development and Employability
34	Machine Learning	20ADC 04	Skill development and Employability
35	Engineering Economics and Accountancy	20MBC01	Skill development
36	Environmental Science	20CEM01	Skill development
37	Stochastic Process and Queueing Theory Lab	20MTC11	Skill development
38	Design and Analysis of Algorithms Lab	20ITC17	Skill development and Employability
39	Machine Learning Lab	20ADC 05	Skill development and Employability
40	Mini Project – II	20ITC18	Employability
	Professional Elective – I		
41	Data Analysis and Visualization	20ADE01	Skill development and Employability
SEM-5			
42	Artificial Intelligence	20ADC06	Skill development and Employability
43	Embedded Systems and IoT	20ITC24	Skill development and Employability
44	Operating Systems	20ITC19	Skill development and Employability
45	Full Stack Development	20ADC07	Skill development and Employability
46	Computer Networks	20ITC20	Skill development and Employability
47	Artificial Intelligence Lab	20ADC08	Skill development and Employability
48	Embedded Systems and IoT Lab	20ITC26	Skill development and Employability

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	**Name of the Course**	**Course Code**	**Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development**
49	Minor Project - I (Full Stack Development)	20ADC09	Employability
50	Industrial / Rural Internship		Employability
	Professional Elective – 2		
51	Cyber Security	20ITE08	Skill development and Employability
SEM-6			
52	Software Engineering	20ITC13	Employability
53	Deep Learning	20ADC10	Skill development and Employability
54	Data Science with R	20ADC11	Skill development and Employability
55	Cloud Computing	20ITC25	Skill development and Employability
56	Software Engineering Lab	20ITC16	Employability
57	Deep Learning Lab	20ADC12	Skill development and Employability
58	Minor Project -II (Data Science)	20ADC13	Employability
59	Employability Skills	20EGC03	Employability
	Professional Elective – 3		
60	Applied Predictive Analytics	20ITE14	Skill development and Employability
61	Fundamentals of Block ChainTechnology	20ITE16	Skill development

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	Name of the Course	Course Code	Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development
PG			
R-20 REGULATION			
SEM-1			
	Professional Core		
62	Mathematical Foundations of Data	20MTC101	Skill development and Employability
63	Artificial Intelligence	20ITC101	Skill development and Employability
	Professional Elective – I		
64	Information Retrieval Systems	20ITE103	Skill development
	Professional Elective – 2		
65	Predictive Analytics with R	20ITE116	Skill development and Employability
	Mandatory Course		
66	Research Methodology and IPR	20MEM103	Skill development
	Audit Course – I		
67	English for Research Paper Writing	20EGA101	Employability
	Laboratory		
68	Mathematical Foundations of Data Science Lab	20MTC102	Skill development and Employability
69	Artificial Intelligence Lab	20ITC104	Skill development and Employability
70	Predictive Analytics in R Lab	20ITE126	Skill development and Employability

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	Name of the Course	Course Code	Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development
SEM-2			
	Professional Core		
71	Introduction to Data Science	20ITC102	Skill development and Employability
72	Machine Learning	20ITC103	Skill development and Employability
	Professional Elective – 3		
73	Social Network Analysis	20ITE105	Skill development
	Professional Elective – 4		
74	Big Data Analytics	20ITE114	Skill development and Employability
	Laboratory		
75	Machine Learning Lab	20ITC106	Skill development and Employability
76	Big Data Analytics Lab	20ITE124	Skill development and Employability
77	Introduction to Data Science Lab	20ITC105	Skill development and Employability
78	Mini Project with Seminar	20ITC107	Employability
SEM-3			
	Professional Elective – 5		
79	Recommender Systems	20ITE108	Skill development
	Open Elective		
80	Business Analytics	20CSO101	Skill development and Employability
	Core		

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	**Name of the Course**	**Course Code**	**Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development**
81	Dissertation/Phase-I	20ITC108	Employability
	SEM-4		
82	Dissertation/Phase-II	20ITC109	Employability
A.Y 2023-24			
UG			
R-22 REGULATION			
SEM-1			
83	Linear Algebra & Calculus	22MTC01	Skill development
84	Optics and Semiconductor Physics	22PYC01	Skill development
85	Problem Solving and Programming	22CSC01	Skill development and Employability
86	English	22EGC01	Employability
87	Optics and Semiconductor Physics Lab	22PYC03	Skill development
88	English lab	22EGC02	Employability
89	Problem Solving and Programming Lab	22CSC02	Skill development and Employability
90	CAD AND DRAFTING	22MEC01	Skill development and Employability
91	Digital Fabrication Lab	22MEC38	Skill development

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	**Name of the Course**	**Course Code**	**Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development**
		SEM-2	
92	Differential Equations & Numerical Methods	22MTC04	Skill development
93	Chemistry	22CYC01	Skill development
94	Basic Electrical Engineering	22EEC01	Skill development
95	Object Oriented Programming	22CSC03	Skill development and Employability
96	Chemistry Lab	22CYC02	Skill development
97	Community Engagement	22MBC02	Entrepreneurship
98	Object-Oriented Programming Lab	22CSC04	Skill development and Employability
99	Robotics & Drones Lab	22MEC37	Skill development
100	Basic Electrical Engineering Lab	22EEC02	Skill development
		SEM-3	
101	Mathematical and Statistical Foundations	22MTC07	Skill development
102	Operating Systems	22CSC15	Skill development and Employability
103	Database Management Systems	22CSC11	Skill development and Employability
104	Java Programming	22ITC02	Skill development and Employability
105	Digital Logic and Computer Architecture	22ITC01	Skill development
106	Data Structures	22CSC05	Skill development and Employability
107	Indian Constitution and Fundamental Principles	22EGM01	Skill development
108	Database Management Systems Lab	22CSC33	Skill development and Employability

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	**Name of the Course**	**Course Code**	**Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development**
109	Java Programming Lab	22ITC03	Skill development and Employability
110	Data Structures Lab	22CSC31	Skill development and Employability
111	MOOCs/Training/Internship	22ADI01	Employability
	SEM-4		
112	Stochastic Process and Queueing Theory	22MTC16	Skill development
113	Systems and Signal Processing	22ECC39	Skill development
114	Design and Analysis of Algorithms	22CSC14	Skill development and Employability
115	Fundamentals of Machine Learning	22ADC01	Skill development and Employability
116	Engineering Economics and Accountancy	22MBC01	Skill development
117	Environmental Science	22CEM01	Skill development
118	Stochastic Process and Queueing Theory Lab	22MTC17	Skill development
119	Design and Analysis of Algorithms Lab	22CSC34	Skill development and Employability
120	Machine Learning Lab	22ADC02	Skill development and Employability
121	Linux and Latex Lab	22ADC04	Skill development and Employability
	Professional Elective – I		
122	Data Analysis and Visualization	22ADE01	Skill development and Employability

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	Name of the Course	Course Code	Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development
R-20 REGULATION			
SEM-5			
123	Artificial Intelligence	20ADC06	Skill development and Employability
124	Embedded Systems and IoT	20ITC24	Skill development and Employability
125	Operating Systems	20ITC19	Skill development and Employability
126	Full Stack Development	20ADC07	Skill development and Employability
127	Computer Networks	20ITC20	Skill development and Employability
128	Artificial Intelligence Lab	20ADC08	Skill development and Employability
129	Embedded Systems and IoT Lab	20ITC26	Skill development and Employability
130	Minor Project - I (Full Stack Development)	20ADC09	Employability
131	Industrial / Rural Internship		Employability
	Professional Elective – 2		
132	Natural Language Processing	20ADE03	Skill development and Employability
133	Cyber Security	20ITE08	Skill development and Employability
SEM-6			
134	Software Engineering	20ITC13	Employability
135	Deep Learning	20ADC10	Skill development and Employability
136	Data Science with R	20ADC11	Skill development and Employability

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	**Name of the Course**	**Course Code**	**Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development**
137	Cloud Computing	20ITC25	Skill development and Employability
138	Software Engineering Lab	20ITC16	Employability
139	Deep Learning Lab	20ADC12	Skill development and Employability
140	Minor Project -II (Data Science)	20ADC13	Employability
141	Employability Skills	20EGC03	Employability
	Professional Elective – 3		
142	Fundamentals of Block Chain Technology	20ITE16	Skill development
SEM-7			
143	Big Data Analytics	20ADC14	Skill development and Employability
144	Universal Human Values II: Understanding Harmony	20EGM03	Skill development
145	Gender Sensitization	20EGMO4	Skill development
146	Big Data Analytics Lab	20ADC15	Skill development and Employability
147	Project Part – 1	20ADC16	Employability
148	Internship		Employability
	Professional Elective – 4		
149	Business Intelligence	20ADE11	Entrepreneurship
	Open Elective – 1		
150	Neural Networks and Fuzzy Logic	20ECO14	Skill development

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	**Name of the Course**	**Course Code**	**Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development**
151	Technical Writing Skills	20EGO01	Skill development
SEM-8			
152	Technical Seminar	20ADC17	Employability
153	Project Part -2	20ADC18	Employability
	Open Elective – 2		
154	Principles of Entrepreneurship	20MEO04	Entreprenuership
155	Energy Conservation	20EEO04	Skill development
	Open Elective – 3		
156	Disaster Risk Reduction and Management	20CEO02	Skill development
PG			
R-23 REGULATION			
SEM-1			
	Professional Core		
157	Mathematical Foundations of Data Science	23MTC101	Skill development
158	Artificial Intelligence	23ADC101	Skill development and Employability
	Professional Elective-1		
159	Cloud Computing	23ADE102	Skill development and Employability

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	Name of the Course	Course Code	Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development
	Professional Elective-2		
160	Big Data Analytics	23ADE119	Skill development and Employability
	Mandatory Course		
161	Research Methodology and IPR	23MEM103	Skill development
	Audit Course-1		
162	English for Research Paper Writing	23EGA101	Employability
	Laboratory		
163	Mathematical Foundations of Data Science Lab	23MTC102	Skill development and Employability
164	Big Data Analytics Lab	23ADE129	Skill development and Employability
165	Artificial Intelligence Lab	23ADC105	Skill development and Employability
SEM-2			
	Not yet started		
R-20 REGULATION			
SEM-3			
	CORE		
166	Dissertation/ Phase-1	20ITC108	Employability
	Professional Elective-5		
167	Intelligent Bio Informatics	20ITE107	Skill development

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

1.1.3 Details of courses offered by the institution that focus on employability/ entrepreneurship/ skill development during the year.

1.2.1 Details of courses introduced across all programmes offered during the year

Sl. No	**Name of the Course**	**Course Code**	**Activities/Content with a direct bearing on Employability/ Entrepreneurship/ Skill development**
	Open Elective		
168	Business Analytics	20CSO101	Skill development and Employability
SEM-4			
	CORE		
169	Dissertation/ Phase-2	20ITC109	Employability

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Scheme of Instructions of I Semester of B.E. – Artificial Intelligence and Data Science
(Inline with AICTE Model Curriculum with effect from AY 2022-23)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER – I

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MTC01	Linear Algebra & Calculus	3	1	0	3	40	60	4
2	22PYC01	Optics and Semiconductor Physics	3	0	0	3	40	60	3
3	22CSC01	Problem Solving and Programming	2	1	0	3	40	60	3
4	22EGC01	English	2	0	0	3	40	60	2
PRACTICAL									
5	22PYC03	Optics and Semiconductor Physics Lab	0	0	3	3	50	50	1.5
6	22EGC02	English lab	0	0	2	3	50	50	1
7	22CSC02	Problem Solving and Programming Lab	0	0	3	3	50	50	1.5
8	22MEC01	CAD AND DRAFTING	0	1	3	3	50	50	2.5
9	22MEC38	Digital Fabrication Lab	0	0	3	3	50	50	1.5
TOTAL			**10**	**3**	**14**	**27**	**410**	**490**	**20**

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

22MTC01

LINEAR ALGEBRA & CALCULUS
(AI&DS)

Instruction	3 L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

COURSE OBJECTIVES: This course aims to

1. To discuss Physical interpretations of scalar and vector functions.
2. To discuss vector line, surface and volume integrals.
3. To explain the concepts of basis, dimension of vector space and matrix representation of a linear transformation.
4. To explain the solution of system of linear equations by Matrix Methods.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Determine the extreme values of functions of two variables.
2. Apply the vector differential operator to scalar and vector functions
3. Solve line, surface & volume integrals by Greens, Gauss and Stoke's theorems.
4. Determine the basis and dimension of a vector space, compute linear transformation.
5. Apply the Matrix Methods to solve the system of linear equations

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2
CO 4	3	3	3	3	-	-	-	-	-	-	-	1
CO 5	3	3	3	3	-	-	-	-	-	-	-	1

UNIT-I

Partial Differentiation and Its Applications: Functions of two or more variables, Partial derivatives, Higher order partial derivatives, Total derivative, Differentiation of implicit functions, Jacobians, Taylor's expansion of functions of two variables, Maxima and minima of functions of two variables.

UNIT-II

Vector Differential Calculus and multiple Integrals: Scalar and Vector point functions, vector operator Del, Gradient, Directional derivative, Divergence, Curl, Del applied twice to point functions, Del applied to product of point functions (vector identities), Irrotational fields and Solenoidal fields, Double integral, Change of order of Integration and Triple integrals.

UNIT-III

Vector Integral Calculus: Line integral, Surface integral and Volume integral. Verification of Green's theorem in a plane (without proof), verification of Stroke's theorem (without proof) and Gauss's divergence theorem (without proof).

UNIT-IV:

Vector space: Vector space, Subspace, linear combination of vectors, linear span, row and column spaces, linear dependent, independent vectors, basis, dimension, linear transformation, invertible transformation, matrix of linear transformation, kernel and range of LT, rank and nullity of LT-rank nullity theorem(without proof), change of basis.

UNIT-V

Matrices: Rank of a matrix, Echelon form, consistency of linear System of equations, Eigen values, Eigenvectors, Properties of Eigen values, Cayley-Hamilton theorem, Quadratic forms, Reduction of quadratic form to canonical form by linear transformation, Nature of quadratic form.

TEXT BOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. Seymour Lipschutz, "Schaum's Outline of Linear Algebra", 5th Edition, McGraw Hill, 2013.
4. Gilbert Strang, "Introduction to linear algebra", 5th Edition, Wellesley - Cambridge press, 2016.

SUGGESTED READING:

1. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw- Hill, New Delhi, 2008.
2. R.K. Jain, S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publications, 5th edition, 2016.
3. D. Poole, "Linear Algebra: A Modern Introduction, 2nd Edition", Brooks/ Cole, 2005.
4. Kuldeep Singh, "Linear algebra: step by step". OUP Oxford, 2013.

22PYC01

OPTICS AND SEMICONDUCTOR PHYSICS
(CSE, IT, CSE (AI&ML), CSE (IoT & Cyber Security including Block Chain Technology), AI&ML, AI&DS)

Instruction	3L Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Understand the fundamentals of wave nature of light
2. Acquire knowledge of lasers, holography and fiber optics
3. Familiarize with quantum mechanics
4. Learn the fundamental concepts of solids

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Demonstrate the physical properties of light.
2. Explain characteristic properties of lasers and fiber optics
3. Find the applications of quantum mechanics
4. Classify the solids depending upon electrical conductivity
5. Identify different types of semiconductors

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	2	2	2	3	2	2	2	1	1	2	1	2
C02	3	3	3	3	3	3	3	3	2	2	3	2
C03	3	3	3	3	3	2	3	2	1	2	1	2
C04	2	2	2	1	2	2	2	2	1	2	2	2
C05	3	2	2	2	2	2	3	3	2	2	3	2

UNIT-I

Wave Optics: Huygen's principle –Super position of waves –Interference of light by wave front splitting and amplitude splitting–Fresnel's biprism – Interference in thin films in reflected light– Newton's rings– Fraunhofer diffraction from a single slit –Double slit diffraction – Rayleigh criterion for limit of resolution– Concept of N-slits–Diffraction grating and its resolving power.

UNIT-II

Lasers & Holography: Characteristics of lasers – Einstein's coefficients –Amplification of light by population inversion –Different types of lasers: solid-state lasers: Ruby & Nd:YAG; gas lasers: He-Ne & CO_2; semiconductor laser – Applications of lasers in engineering and medicine. Holography: Principle – Recording and reconstruction–Applications.

Fiber Optics: Introduction – Construction – Principle – Propagation of light through an optical fiber – Numerical aperture and acceptance angle –Step-index and graded-index fibers –Pulse dispersion – Fiberlosses--Fiber optic communication system –Applications.

UNIT-III

Principles of Quantum Mechanics: Introduction – Wave nature of particles – de-Broglie hypothesis – Physical significance of ψ – Time-dependent and time-independent Schrodinger equations – Born interpretation – Probability current –Wave packets –Uncertainty principle –Particle in infinite square well potential –Scattering from potential step – Potential barrier and tunneling.

UNIT-IV

Band Theory of Solids: Salient features of free electron theory of metals (Classical and Quantum) – Fermi level –Density of states – Bloch's theorem for particles in a periodic potential – Kronig-Penney model – Classification of solids: metals, semiconductors and insulators.

UNIT-V

Semiconductors: Intrinsic and extrinsic semiconductors – Charge carrier concentration in intrinsic semiconductors – Dependence of Fermi level on carrier concentration and temperature in extrinsic semiconductors (qualitative) – Carrier generation and recombination – Carrier transport: diffusion and drift – P-N junction – Thermistor – Hall effect – LED – Solar cell.

TEXT BOOKS:

1. B. K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications, 2012.
2. M. N. Avadhanulu and P. G. Kshirsagar, *A Text Book of Engineering Physics*, S. Chand Publications, 2014.
3. M. Arumugam, *Materials Science*, Anuradha Publications, 2015.
4. S. L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications, 2011.

SUGGESTD READING:

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications, 2014.
2. V. Rajendran, *Engineering Physics*, Mc Graw-Hill Education Publications, 2013.
3. P. K. Palanisamy, *Engineering Physics*, Scitech Publications, 2012.
4. V. Raghavan, *Materials Science and Engineering*, Prentice Hall India Learning Private Limited; 6th Revised edition, 2015.

22CSC01

PROBLEM SOLVING AND PROGRAMMING

Instruction	2L + 1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to:

1. Develop logical skills and basic technical skills so that students should be able to solve basic computational problems.
2. Learn any basic programming language.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand real world problems and develop computer solutions for those problems.
2. Understand the basics of Python.
3. Apply Python for solving basic programming solutions.
4. Create algorithms/flowcharts for solving real-time problems.
5. Build and manage dictionaries to manage data.
6. Handle data using files.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	3	1	1	-	1	-	-	-	-	-	-	1
2	3	1	1	-	1	-	-	-	-	-	-	1
3	3	1	1	-	1	-	-	-	-	-	-	1
4	3	1	1	-	1	-	-	-	-	-	-	1
5	3	1	1	-	1	-	-	-	-	-	-	1
6	3	1	1	-	1	-	-	-	-	-	-	1

UNIT I

Introduction to Programming - *Evolution of languages*: Machine, Assembly and High-level languages. *Software requirements for programming*: OS, compiler, linker, loader, editor. Design specification: Algorithms and Flowcharts.

UNIT II

Data Types and Operators, Variable, Sequences and Iteration - Data types, Expressions, Precedence Rules, Operators: arithmetic, relational, logical, bit-wise and miscellaneous operators; local variable, global variables, List, String, Tuples, Sequence mutation and accumulating patterns.

UNIT III

Conditional Statement, Loops, Arrays and Strings, user-defined Data Types – if, else, for, while, nested iteration, Concept and use of arrays, declaration and usage of arrays, 2-dimensional arrays, different types of user defined data types.

UNIT IV

Dictionaries and Dictionary Accumulation, Functions/Methods - Dictionary basics, operations, methods, accumulation, advantages of modularizing program into functions, function definition and function invocation. Positional parameters passing arrays to functions, recursion, library functions.

UNIT V

File Handling and Memory Management - Concepts of files and basic file operations, writing/reading data to/from a .csv file, Memory Management Operations.

TEXT BOOKS AND REFERENCES:

1. R.S. Salaria, "Programming for Problem Solving", First Edition, Khanna Book Publishing Co., Delhi.
2. Jeeva Jose, "Taming Python by Programming", Revised Edition, Khanna Book Publishing Co., Delhi.
3. Mark Lutz, "Learning Python", 5th Edition, O'Reilly Media, Inc.
4. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes, No Starch Press.
5. "Programming in Python", R.S. Salaria, Khanna Book Publishing Co., Delhi.

NPTEL/SWAYAM Course:

1. Introduction to Problem Solving and Programming, Video Lectures, Prof. D Gupta, IIT Delhi.
2. Problem Solving Aspects and Python Programming, Dr. S Malinga, Dr Thangarajan, Dr. S V Kogilavani, Kongu Engineering College.
3. https://www.coursera.org/specializations/python-3-programming.

22EGC01

ENGLISH

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Prerequisite: Basic knowledge of English grammar and vocabulary.

COURSE OBJECTIVES: This course aims to

1. To the role and importance of communication while developing their basic communication skills in English.
2. To basics of writing coherent paragraphs and formal Emails.
3. To techniques of writing a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. To description, definition and classification of processes while enabling them to draft formal reports following a proper structure.
5. To gaining adequate reading comprehension techniques.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Illustrate the nature, process and types of communication and communicate effectively without barriers.
2. Construct and compose coherent paragraphs, emails and adhering to appropriate mobile etiquette.
3. Apply techniques of precision to write a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. Distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.
5. Critique passages by applying effective reading techniques.

CO-PO-PSO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	1	1	1	1	1	2	3	3	2	3
CO 2	1	1	1	1	-	1	1	1	2	2	1	2
CO 3	-	2	1	1	-	2	1	1	2	2	1	2
CO 4	1	2	1	2	1	2	2	1	2	2	1	2
CO 5	1	2	1	2	1	1	1	1	1	2	1	2

UNIT-I

Understanding Communication in English: Introduction, nature and importance of communication; Process of communication; Types of communication - verbal and non-verbal; Barriers to communication; Intrapersonal and interpersonal communication; Understanding Johari Window.

Vocabulary &Grammar: The concept of Word Formation; Use of appropriate prepositions and articles.

UNIT-II

Developing Writing Skills I: Paragraph writing. – Structure and features of a paragraph; Cohesion and coherence. Rearranging jumbled sentences. Email and Mobile etiquette.

Vocabulary & Grammar: Use of cohesive devices and correct punctuation.

UNIT-III

Developing Writing Skills II: Précis Writing; Techniques of writing precisely. Letter Writing – Structure, format of a formal letter; Letter of request and the response.

Vocabulary and Grammar: Subject-verb agreement. Use of prefixes and suffixes to form derivatives. Avoiding redundancies.

UNIT-IV

Developing Writing Skills III: Report writing – Importance, structure, elements of style of formal reports; Writing a formal report.

Vocabulary and Grammar: Avoiding ambiguity - Misplaced modifiers. Use of synonyms and antonyms.

UNIT-V

Developing Reading Skills: The reading process, purpose, different kinds of texts; Reading comprehension; Techniques of comprehension – skimming, scanning, drawing inferences and conclusions.

Vocabulary and Grammar: Words often confused; Use of standard abbreviations.

TEXT BOOKS:

1. "Language and Life: A Skills Approach", Board of Editors, 2018th Edition, Orient Black Swan, 2018.
2. Swan Michael, "Practical English Usage", OUP, 1995.

SUGGESTED READINGS:

1. Wood F.T, "Remedial English Grammar", Macmillan,2007.
2. Zinsser William, "On Writing Well", Harper Resource Book, 2001.
3. Sanjay Kumar and Pushp Lata, "Communication Skills", Oxford University Press, 2011.

22PYC03

OPTICS AND SEMICONDUCTOR PHYSICS LAB
(CSE, IT, CSE (AI&ML), CSE (IoT & Cyber Security including Block Chain Technology), AI&ML, AI&DS)

Instruction	3P Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Apply theoretical physics knowledge in doing experiments
2. Understand the behaviour of the light experimentally
3. Analyze the conduction behaviour of semiconductor materials and optoelectronic devices

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Interpret the errors in the results of an experiment.
2. Demonstrate physical properties of light experimentally
3. Make use of lasers and optical fibers for engineering applications
4. Explain the V-I characteristics of some optoelectronic and semiconductor devices
5. Find the applications of thermistor

CO-PO Articulation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	2	2	3	1	3	1	3	3	2	1	2
C02	3	2	1	2	2	2	1	2	2	1	1	3
C03	3	2	3	2	3	1	2	2	3	2	1	2
C04	3	3	2	2	2	1	2	3	2	1	1	3
C05	3	1	2	3	2	1	1	2	2	2	1	2

Experiments

1. Error Analysis : Estimation of errors in the determination of time period of a torsional Pendulum
2. Fresnel's Biprism : Determination of wavelength of given monochromatic source
3. Newton's Rings : Determination of radius of curvature of a given plano-convex lens using Na vapor lamp
4. Single Slit Diffraction : Determination of wavelength of given monochromatic source
5. Diffraction Grating : Determination of wavelengths of two yellow lines of light of Mercury lamp
6. Laser : Determination of wavelength of given semiconductor laser
7. Holography : Recording and reconstruction of a hologram
8. Optical Fiber : Determination of numerical aperture and power losses of given optical fiber
9. Energy Gap : Determination of energy gap of given semiconductor
10. P-N Junction Diode : Study of V-I characteristics and calculation of resistance of given diode in forward bias and reverse bias
11. Thermistor : Determination of temperature coefficient of resistance of given thermistor
12. Hall Effect : Determination of Hall coefficient, carrier concentration and mobility ofcharge carriers of given semiconductor specimen
13. LED : Study of I-V characteristics of given LED
14. Solar Cell : Study of I-V characteristics of given solar cell and calculation of fill factor, efficiency and series resistance
15. Planck's Constant : Determination of Planck's constant using photo cell

NOTE: A minimum of TWELVE experiments should be done.

22EGC02

ENGLISH LAB
(Common to All Branches)

Instruction	2P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to

1. To nuances of Phonetics and give them sufficient practice in correct pronunciation.
2. To word stress and intonation.
3. To listen to listening comprehension material for honing their listening skills.
4. To activities enabling them overcome their inhibitions while speaking in English with the focus being on fluency rather than accuracy.
5. To team work, role behavior while developing their ability to discuss in groups and making oral presentations.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Define the speech sounds in English and understand the nuances of pronunciation in English
2. Apply stress correctly and speak with the proper tone, intonation and rhythm.
3. Analyze listening comprehension texts to enhance their listening skills.
4. Determine the context and speak appropriately in various situations.
5. Design and present effective posters while working in teams, and discuss and participate in Group discussions.

CO-PO-PSO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	-	-	-	1	1	-	1
CO 2	-	-	-	-	-	1	-	1	2	2	1	2
CO 3	-	-	-	-	-	1	1	1	2	1	1	2
CO 4	1	-	-	-	-	1	2	2	2	3	1	3
CO 5	1	1	1	1	1	2	2	2	3	3	2	3

EXERCISES

1. **Introduction to English Phonetics**: Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English**: Phonetic sounds and phonemic sounds, introduction to International Phonetic Alphabet, classification and description of English phonemic sounds, minimal pairs. The syllable: types of syllables, consonant clusters.
3. **Word stress**: Primary stress, secondary stress, functional stress, rules of word stress.
4. **Rhythm & Intonation:** Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
5. **Listening skills** – Practice with Software available in (K-van solutions)
6. **Public speaking –** Speaking with confidence and clarity in different contexts on various issues.
7. **Group Discussions -** Dynamics of a group discussion, group discussion techniques, body language.
8. **Pictionary –** weaving an imaginative story around a given picture.
9. **Information Gap Activity** – Writing a brief report on a newspaper headline by building on the hints given
10. **Poster presentation** – Theme, poster preparation, team work and representation.

SUGGESTED READING

1. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan, 2008.
2. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India, 2005.
3. PriyadarshiPatnaik. Group Discussions and Interviews, Cambridge University Press Pvt Ltd 2011
4. ArunaKoneru, Professional Speaking Skills, Oxford University Press, 2016

22CSC02

PROBLEM SOLVING AND PROGRAMMING LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to:

1. Master the fundamentals of writing Python scrips.
2. Learn Python elements such as variables, flow controls structures, and functions.
3. Discover how to work with lists and sequence data, and files.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand various Python program development Environments.
2. Demonstrate the concepts of Python.
3. Implement algorithms/flowcharts using Python to solve real-world problems.
4. Build and manage dictionaries to manage data.
5. Write Python functions to facilitate code reuse.
6. Use Python to handle files and memory.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	3	2	1	-	-	-	-	-	-	-	-	1
2	3	3	2	2	3	-	-	-	-	-	-	1
3	2	3	3	2	3	-	-	-	-	-	-	1
4	2	3	3	2	2	-	-	-	-	-	-	1
5	2	3	3	3	3	-	-	-	-	-	-	1
6	2	3	3	3	3	-	-	-	-	-	-	1

LABORATORY / PRACTICAL EXPERIMENTS:

1. Explore various Python Program Development Environments.
2. Demonstration of input/output operations.
3. Demonstration of operators.
4. Demonstration of selective control structures.
5. Demonstration of looping control structures.
6. Demonstration of List, Tuple and Set
7. Demonstration of Python Dictionaries.
8. Implementation of searching and sorting techniques.
9. Implementation of string manipulation operations.
10. File handling and memory management operations.

TEXT BOOKS AND REFERENCES:

1. R.S. Salaria, “Programming for Problem Solving”, First Edition, Khanna Book Publishing Co., Delhi.
2. Jeeva Jose, “Taming Python by Programming”, Revised Edition, Khanna Book Publishing Co., Delhi.
3. Mark Lutz, “Learning Python”, 5th Edition, , O'Reilly Media, Inc.,
4. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes, No Starch Press.
5. “Programming in Python”, R.S. Salaria, Khanna Book Publishing Co., Delhi.

NPTEL/SWAYAM Course:

1. Introduction to Problem Solving and Programming, Video Lectures, Prof. D Gupta, IIT Delhi.
2. Problem Solving Aspects and Python Programming, Dr. S Malinga, Dr Thangarajan, Dr. S V Kogilavani, Kongu Engineering College.
3. https://www.coursera.org/specializations/python-3-programming.

22MEC01

CAD AND DRAFTING

Instruction	1 T + 3 D Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	2.5

COURSE OBJECTIVES:

1. To get exposure to a cad package and its utility.
2. Understanding orthographic projections.
3. To visualize different solids and their sections in orthographic projection
4. To prepare the student to communicate effectively by using isometric projection.
5. To prepare the student to use the techniques, skills, and modern tools necessary for practice.

Outcomes: At the end of the course, the Students are able to

1. Become conversant with appropriate use of CAD software for drafting.
2. Recognize BIS, ISO Standards and conventions in Engineering Drafting.
3. Construct the projections of points, lines, planes, solids
4. Analyse the internal details of solids through sectional views
5. Create an isometric projections and views

CO-PO-PSO Correlation Matrix

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

List of Exercises:

1. Introduction to CAD package: Settings, draw, modify tools, dimensioning and documentation
2. Construction of Conic Sections by General method
3. Orthographic projection: Principles, conventions, Projection of points
4. Projection of straight lines: Simple position, inclined to one plane
5. Projection of straight lines inclined to both the planes (without traces and mid-point)
6. Projection of planes: Perpendicular planes
7. Projection of planes: Oblique planes
8. Projection of solids: Simple position
9. Projection of solids: Inclined to one plane
10. Sections of solids: Prism, pyramid in simple position
11. Sections of solids: Cone and cylinder in simple position
12. Isometric projections and views
13. Conversion of isometric views to orthographic projections and vice-versa.

TEXT BOOKS:

1. N.D.Bhatt, “Elementary Engineering Drawing”, Charotar Publishers, 2012.
2. K.Venugopal, “Engineering Drawing and Graphics + AutoCAD”, New Age International Pvt.Ltd, 2011.
3. Basanth Agrawal and C M Agrawal, “Engineering Drawing”, 2/e, McGraw-Hill Education (India) Pvt. Ltd.

SUGGESTED READING:

1. Shaw M.B and Rana B.C., “Engineering Drawing”, 2/e, Pearson, 2009.
2. K.L. Narayana and P.K. Kannaiah, “Text Book of Engineering Drawing”, Scitech Publications, 2011.

22MEC38

DIGITAL FABRICATION LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to

1. Give a feel of Engineering Practices & develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization, positive &team work attitude to get things right the first time.
3. Provide basic knowledge of Steel, Plastic, Composite and other materials for suitable applications.
4. Study of Principle and hands on practice on techniques of fabrication, welding, casting, manufacturing, metrology, and allied skills.
5. Advance important hard & pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand safety measures to be followed in workshop to avoid accidents.
2. Identify various tools used in carpentry, house wiring and plumbing.
3. Make a given model by using workshop trades like carpentry, plumbing, House wiring and 3d modeling using solid works software for Additive Manufacturing.
4. Perform pre-processing operations on STL files for 3D printing, also understand reverse engineering process.
5. Conceptualize and produce simple device/mechanism of their choice.

CO-PO-PSO Correlation Matrix

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

List of exercises:
Group-1

1. To make a lap joint on the given wooden piece according to the given dimensions.
2. To make a dove tail-joint on the given wooden piece according to the given dimensions.
3.
    a. Wiring of one light point controlled by one single pole switch, a three pin socket controlled by a single pole switch
    b. Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs. Wiring of two light points connected in parallel from two single pole switches and a three pin socket
4. Stair case wiring-wiring of one light point controlled from two different places independently using two 2-way switches.
5. To make external threads for GI pipes using die and connect the GI pipes as per the given diagram using taps, couplings & bends.

6.
   a. A. To connect the GI pipes as per the given diagram using, couplings, unions, reducer & bends.
   b. To connect the GI pipes as per the given diagram using shower, tap & valves and Demonstrate by giving water connection

Group- 2

1. To Study the method of Additive Manufacturing process using a 3D printer
2. To create a 3D CAD model of a door bracket using a modeling software
3. To Print a door bracket using an extruder type 3D Printer.
4. To create a 3D CAD model by reverse Engineering
5. To Design an innovative component using the CAD software
6. To Print the selected innovative component by the students using a 3D printer

TEXT BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., Elements of Workshop Technology, Vol. I, 2008 and Vol. II, Media promoters and publishers private limited, Mumbai, 2010.
2. Kalpakjian S. And Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
3. Sachidanand Jha, 3D PRINTING PROJECTS: 200 3D Practice Drawings For 3D Printing On Your 3D Printer, June 7, 2019.

SUGGESTED READING:

1. Gowri P. Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Oliver Bothmann , 3D Printers: A Beginner's Guide , January 1, 2015

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

Scheme of Instructions of II Semester of B.E. – Artificial Intelligence and Data Science
(Inline with AICTE Model Curriculum with effect from AY 2022-23)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER –II

S. No	Course Code	Title of the Course	Scheme of Instruction			Scheme of Examination			Credits
			Hours per Week			Duration of SEE in Hours	Maximum Marks		
			L	T	P/D		CIE	SEE	
THEORY									
1	22MTC04	Differential Equations & Numerical Methods	3	1	0	3	40	60	4
2	22CYC01	Chemistry	3	0	0	3	40	60	3
3	22EEC01	Basic Electrical Engineering	2	1	0	3	40	60	3
4	22CSC03	Object Oriented Programming	2	1	0	3	40	60	3
PRACTICAL									
5	22CYC02	Chemistry Lab	0	0	3	3	50	50	1.5
6	22MBC02	Community Engagement	0	0	3		50		1.5
7	22CSC04	Object-Oriented Programming Lab	0	0	2	3	50	50	1
8	22MEC37	Robotics & Drones Lab	0	2	2	3	100		3
9	22EEC02	Basic Electrical Engineering Lab	0	0	2	3	50	50	1
TOTAL			**10**	**5**	**12**		**460**	**390**	**21**

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**

CIE - Continuous Internal Evaluation **SEE - Semester End Examination**

22MTC04

DIFFERENTIAL EQUATIONS & NUMERICAL METHODS
(AI&DS)

Instruction	3 L+1T per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

COURSE OBJECTIVES:

1. To explain the relevant methods to solve first order differential equations.
2. To explain the relevant methods to solve higher order differential equations.
3. To discuss numerical methods to solve algebraic and transcendental equations.
4. To discuss the interpolation and numerical differentiation.
5. To discuss convergence and divergence of Infinite series.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Calculate the solutions of first order linear differential equations.
2. Calculate the solutions of higher order linear differential equations.
3. Solve the algebraic, transcendental and system of equations.
4. Apply interpolation and numerical differentiation techniques for given data.
5. Test the convergence and divergence of Infinite series.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	2	2	2	2	-	-	-	-	-	-	-	1
CO 4	2	2	2	2	-	-	-	-	-	-	-	1
CO 5	1	1	1	1	-	-	-	-	-	-	-	1

UNIT - I

Differential Equations of First Order: Exact Differential Equations, Equations Reducible to Exact Equations, Linear Equations, Bernoulli's Equations, Riccati's and Clairaut's Equations, Orthogonal trajectories, Rate of decay of radio-active materials.

UNIT-II

Higher Order Linear Differential Equations: Higher order linear differential equations with constant coefficients, rules for finding Complementary function, Particular Integral and General solution. Method of Variation of Parameters, solution of Cauchy- Euler equation. LR and LCR circuits.

UNIT-III

Numerical solution of equations: Numerical solutions of algebraic and transcendental equations by Bisection method, Regula-falsi method and Newton-Raphson's method, Solution of system of linear equations by LU decomposition methods, Crout's method, Jacobi's method, Gauss Seidel method.

UNIT-IV

Interpolation and Numerical Differentiation: Forward, Backward and Central differences, Newton's forward and backward interpolation formulae, Gauss's forward and backward interpolation formulae, Lagrange interpolation, Numerical differentiation at the tabulated points with forward, backward and central differences.

UNIT-V

Infinite Series: Convergence of sequence and series. Series of positive terms, Necessary condition for convergence, Comparison tests, limit form comparison test, D'Alembert's Ratio test, Raabe's test, Cauchy's root test, Alternating series, Leibnitz's rule, absolutely and conditionally convergence.

TEXT BOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley & Sons, 2011.
3. M.K. Jain, S.R.K Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering and Computation", New age International Publications, 2008.

SUGGESTED READING:

1. R.K.Jain, S.R.K. Iyengar, "Advanced Engineering Mathematics",5th edition, Narosa Publications, 2016.
2. Ramana B.V, "Higher Engineering Mathematics",11th Reprint, Tata McGraw Hill New Delhi, 2010.
3. A.R.Vasishtha and R.K.Guptha, "Integral Transforms", Reprint, Krishna's Educational Publishers, 2014.

22CYC01

CHEMISTRY
(Common to CSE, CSE-AIML, AIML, CSE-IOT, AIDS)

Instruction:	3L Hours per Week
Duration of SEE:	3 Hours
SEE	60 Marks
CIE:	40 Marks
Credits:	3

COURSE OBJECTIVES:

1. This syllabus helps at providing the concepts of chemical bonding and chemical kinetics to the students aspiring to become practicing engineers
2. Thermodynamic and Electrochemistry units give conceptual knowledge about processes and how they can be producing electrical energy and efficiency of systems.
3. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
4. Water chemistry unit impart the knowledge and understand the role of chemistry in the daily life.
5. New materials lead to discovering of technologies in strategic areas for which an insight into Polymers, nanomaterials and basic drugs of modern chemistry is essential.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Identify the microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemical reactions.
2. Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role in batteries and fuel cells.
3. Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
4. Classify the various methods used in treatment of water for domestic and industrial use.
5. Outline the synthesis of various Engineering materials & Drugs.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	2	-	-	2	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	3	-	-	2	2	-	-	-	-	2
CO 5	3	2	2	-	-	2	2	-	-	-	-	2

UNIT-I

Atomic and molecular structure and Chemical Kinetics:

Atomic and molecular structure: Molecular Orbital theory - atomic and molecular orbitals. Linear combination of atomic orbitals (LCAO) method. Molecular orbitals of diatomic molecules. Molecular Orbital Energy level diagrams (MOED) of diatomic molecules & molecular ions (H_2 , He_2^+ ,N_2 , O_2 , O_2^- , CO, NO). Pi- molecular orbitals of benzene and its aromaticity.

Chemical Kinetics: Introduction, Terms involved in kinetics: rate of reaction, order & molecularity; First order reaction-Characteristics: units of first order rate constant & its half-life period, second order reaction-Characteristics: units of second order rate constant & its half- life period. Numericals.

UNIT-II

Use of free energy in chemical equilibria

Use of free energy in chemical equilibria: Thermodynamic functions: Internal energy, entropy and free energy. Significance of entropy and free energy (criteria of spontaneity). Free energy and emf (Gibbs Helmholtz equations and its applications). Cell potentials, electrode potentials, – Reference electrodes (NHE, SCE)- electrochemical series. Nernst equation and its applications. Determination of pH using combined Glass & Calomel electrode. Potentiometric Acid base & Redox Titrations. Numericals.

Battery technology: Rechargeable batteries & Fuel cells.
Lithium batteries: Introduction, construction, working and applications of Li-MnO_2 and Li-ion batteries.
Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell.

UNIT- III
Stereochemistry and Organic reactions
Stereochemistry: Representations of 3 dimensional structures, Types of stereoisomerism- Conformational isomerism – confirmations of n-butane (Newman and sawhorse representations), Configurational isomerism - Geometrical (cis-trans) isomerism & Optical isomerism- optical activity, Symmetry and chirality: Enantiomers (lactic acid) & Diastereomers (Tartaric acid), Absolute configurations, Sequence rules for R&S notation.
Types of Organic reactions: Substitution Reactions- Electrophilic substitution (Nitration of Benzene); Nucleophilic Substitution (S_N1& S_N2); Free Radical Substitution (Halogenation of Alkanes)
Addition Reactions: Electrophilic Addition – Markonikoff's rule, Free radical Addition - Anti Markonikoff's rule (Peroxide effect), Nucleophilic Addition – (Addition of HCN to carbonyl compounds) Eliminations-E1 and E2 (dehydrohalogenation of alkyl halides) Cyclization (Diels - Alder reaction)

UNIT–IV
Water Chemistry:
Hardness of water – Types, units of hardness, Disadvantages of hard water, Alkalinity and Estimation of Alkalinity of water, Boiler troubles - scales & sludge formation, causes and effects, Softening of water by lime soda process (Cold lime soda process), ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water. Disinfection of water by Chlorination; break point chlorination, BOD and COD definition, Estimation (only brief procedure) and significance, Numericals.

UNIT-V
Engineering Materials and Drugs:
Introduction, Terms used in polymer science; Thermoplastic polymers (PVC) &Thermosetting polymers (Bakelite); Elastomers (Natural rubber). Conducting polymers- Definition, classification and applications.
Polymers for Electronics: Polymer resists for integrated circuit fabrication, lithography and photolithography.
Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation-Sol-gel method. Carbon nanotubes and their applications. Characterisation of nanomaterials by SEM and TEM (only Principle).
Drugs-Introduction, Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

TEXT BOOKS:

1. P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd.,New Delhi,16th edition (2015).
2. W.U. Malik, G.D.Tuli and R.D.Madan, "Selected topics in Inorganic Chemistry", S Chand & Company Ltd, New Delhi, reprint (2009).
3. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, "Organic Chemistry", Pearson, Delhi, 7th edition (2019).
4. A Textbook of Polymer Science and Technology , Shashi Chawla,Dhanpat Rai & Co. (2014)
5. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill Education, Delhi, 2012
6. G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C.Sudhakar, "Drugs", Universities Press (India) Limited, Hyderabad (2007).

SUGGESTED READINGS:

1. B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3rd edition (2013).
2. B.R. Puri, L.R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & Company Ltd., 46th edition (2013).
3. T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, "Organic Chemistry", Wiley, 12th edition (2017).
4. P.W. Atkins, J.D. Paula, "Physical Chemistry", Oxford, 8th edition (2006).

22EEC01

BASIC ELECTRICAL ENGINEERING

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. To understand the behaviour of different circuit elements R, L & C, and the basic concepts of electrical AC circuit analysis
2. To comprehend the basic principle of operation of AC and DC machines
3. To infer about different types of electrical wires and cables, domestic and industrial wiring, safety rules and methods of earthing.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand the concepts of Kirchhoff's laws and their application various theorems to get solution of simple dc circuits.
2. Predict the steady state response of RLC circuits with AC single phase/three phase supply.
3. Infer the basics of single phase transformer
4. Describe the construction, working principle of DC machine and 3-phase Induction motor.
5. Acquire the knowledge of electrical wires, cables, earthing, Electrical safety precautions to be followed in electrical installations and electric shock and its safety and energy calculations.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO-1	3	3	2	-	-	-	-	-	1	2	-	3
CO-2	3	3	2	-	-	-	-	-	1	2	-	3
CO-3	3	3	2	1	-	-	-	-	1	2	-	3
CO-4	2	1	-	-	-	-	-	-	1	2	-	3
CO-5	2	-	2	-	-	-	-	-	1	2	-	3

UNIT-I

DC Circuits: Electrical circuit elements (R,L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation, Superposition, Thevenin's and Norton's Theorems.

UNIT-II

AC Circuits: 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 R, L, C, series RL and RC. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT-III

Single Phase Transformer: Construction, Working principle, EMF Equation, Ideal and Practical transformer, Equivalent circuit of Transformer, OC and SC tests on a transformer, Efficiency and Regulation

UNIT-IV

DC and AC Machines: DC Generators: Construction, Principle of operation, EMF equation, Classification, Characteristics of shunt generators. DC Motors: Classification, Torque Equation, Characteristics and Speed control of DC Shunt and Series Motors, Losses and efficiency Three - Phase Induction Motors: Principle of operation, Applications

UNIT-V

Electrical Installations: Electrical Wiring: Types of wires and cables, Electrical Safety precautions in handling electrical appliances, electric shock, and first aid for electric shock, safety rules. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, Earthing (Elementary Treatment only), Elementary calculations for energy consumption

TEXT BOOKS:

1. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
2. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

SUGGESTED READING:

1. D. P. Kothari & I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989
3. D.C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009
4. P.V. Prasad, S. Sivanagaraju, R. Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition, 2013

22CSC03

OBJECT ORIENTED PROGRAMMING

Instruction	2L + 1T per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to:

1. Explore the concepts object-oriented programming like classes, constructors, Polymorphism, Inheritance, and File handling.
2. Prepare student for solving real-world problems using OOPs concepts.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand the concepts of Object-Oriented features.
2. Apply OOPs concepts and different libraries to solve programming problems.
3. Understand the advanced concepts of Python.
4. Develop programs to access databases and web data.
5. Understand APIs and third-party libraries to be used with Python.

CO-PO Articulation Matrix:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	3	1	2	-	1	-	-	-	-	-	-	1
2	3	1	3	2	2	-	-	-	-	-	-	2
3	3	1	2	1	1	-	-	-	-	-	-	1
4	3	2	3	1	2	-	-	-	-	-	-	2
5	3	2	3	1	2	-	-	-	-	-	-	2

UNIT I

Introduction to Object Oriented Programming Paradigms - Programming paradigms, advantages of OOP, comparison of OOP with Procedural Paradigms; Classes and Objects: Prototyping, referencing the variables in functions, inline, static functions, Memory allocation for classes and objects, arrays of objects, constructors.

UNIT II

Polymorphism and Inheritance: Overriding methods, type conversions, base classes and derived classes, types of inheritance, various types of classes, invocation of constructors and destructors inheritance, aggregation, composition, classification hierarchies, metaclass/ abstract classes, unit testing and exceptions.

UNIT III

Python Libraries -Basics of Open Source libraries for data pre-processing, modeling and visualization.

UNIT IV:

Python to access Web Data - Regular Expressions, extracting data, sockets, using the Developer Console to Explore HTTP, Retrieving Web Page, and Passing Web Pages.

UNIT V:

Using Databases with Python - Using Databases, Single Table CRUD, Designing and representing a data model, reconstructing data with JOIN, many-to-many relationships.

TEXT BOOKS AND REFERENCES:

1. Allen Downey, Jeff Elkner, Chris Meyers, "How to Think Like a Computer Scientist: Learning with Python", SoHo Books, 2009.
2. R.S. Salaria , "Mastering Object-Oriented Programming", 6th Edition, Khanna Book Publishing Co., Delhi.
3. Jeeva Jose, "Introduction to Computing & Problem Solving with Python", First Edition, Khanna Book Publishing, 2019.
4. Paul Barry , "Head First Python", O'Reilly, 2010.

NPTEL/SWAYAM Course:

1. Python for Data Science, Prof. Raghunathan Rengasamy, IIT Madras.
2. The Joy of Computing using Python Prof. Sudarshan, Prof. Yayati Guptaingar, IIT Ropar, IIIT Dharwad.
3. https://www.coursera.org/specializations/python-3-programming#courses.

22CYC02

CHEMISTRY LAB

(Common to CSE, CSE-AIML, AIML, CSE-IOT, AIDS)

Instruction:	3P Hours per Week
Duration of SEE	3 Hours
SEE:	50 Marks
CIE	50 Marks
Credits:	1.5

Course Objectives

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in Chemistry laboratory.
2. To provide the knowledge in both qualitative and quantitative chemical analysis
3. The student should be conversant with the principles of volumetric analysis
4. To apply various instrumental methods to analyse the chemical compounds and to improve understanding of theoretical concepts.
5. To interpret the theoretical concepts in the preparation of new materials like drugs and polymers.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Identify the basic chemical methods to analyse the substances quantitatively & qualitatively.
2. Estimate the amount of chemical substances by volumetric analysis.
3. Determine the rate constants of reactions from concentration of reactants/ products as a function of time.
4. Calculate the concentration and amount of various substances using instrumental techniques.
5. Develop the basic drug molecules and polymeric compounds.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2

List of Experiments:

1. Introduction: Preparation of standard solution of oxalic acid and standardisation of NaOH.
2. Estimation of metal ions (Co^{+2}& Ni^{+2}) by EDTA method.
3. Estimation of temporary and permanent hardness of water using EDTA solution
4. Determination of Alkalinity of water
5. Determination of rate constant for the reaction of hydrolysis of methyl acetate. (first order)
6. Determination of rate constant for the reaction between potassium per sulphate and potassium Iodide. (second order)
7. Estimation of amount of HCl Conductometrically using NaOH solution.
8. Estimation of amount of HCl and CH_3COOH present in the given mixture of acids
   i. Conductometrically using NaOH solution.
9. Estimation of amount of HCl Potentiometrically using NaOH solution.
10. Estimation of amount of Fe^{+2} Potentiometrically using $KMnO_4$ solution
11. Preparation of Nitrobenzene from Benzene.
12. Synthesis of Aspirin drug and Paracetamol drug.
13. Synthesis of phenol formaldehyde resin.

TEXT BOOKS:

1. J. Mendham and Thomas, "Vogel's text book of quantitative chemical analysis", Pearson education Pvt.Ltd. New Delhi, 6th ed. 2002.
2. Senior practical physical chemistry by B.D.Khosla, V.C.Garg&A.Gulati,; R. Chand & Co. : New Delhi (2011).

SUGGESTED READINGS:

1. Dr.Subdharani, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2012.
2. S.S. Dara, "A Textbook on experiment and calculation in engineering chemistry", S.Chand and Company, 9th revised edition, 2015.

22MBC02

COMMUNITY ENGAGEMENT

Instruction	3P Hours per week
SEE	Nil
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aims to
1. Develop an appreciation of Rural culture, life-style and wisdom among the Students.
2. Learn about the various livelihood activities that contribute to Rural economy.
3. Familiarize the Rural Institutions and the Rural Development Programmes in India.

COURSE OUTCOMES: After the completion of this Course, Student will be able to
1. Gain an understanding of Rural life, Culture and Social realities.
2. Develop a sense of empathy and bonds of mutuality with Local Communities.
3. Appreciate significant contributions of Local communities to Indian Society and Economy.
4. Exhibit the knowledge of Rural Institutions and contributing to Community's Socio-Economic improvements.
5. Utilise the opportunities provided by Rural Development Programmes.

Module I Appreciation of Rural Society
Rural life style, Rural society, Caste and Gender relations, Rural values with respect to Community, Nature and Resources, elaboration of 'soul of India lies in villages' (Gandhi), Rural Infrastructure.

Module II Understanding Rural Economy and Livelihood
Agriculture, Farming, Landownership, Water management, Animal Husbandry, Non-farm Livelihood and Artisans, Rural Entrepreneurs, Rural markets, Rural Credit Societies, Farmer Production Organization/Company.

Module III Rural Institutions
Traditional Rural organizations, Self-Help Groups, Panchayati Raj Institutions (Gram Sabha), Gram Panchayat, Standing Committees, Local Civil Society, Local Administration.

Module IV Rural Development Programmes
History of Rural Development in India, Current National Programmes: SarvaShiksha Abhiyan, BetiBhachao, BetiPadhao, Ayushman, Bharat, Swachh Bharat, PM Awas Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA etc.

TEXT BOOKS:
1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015, un.org/sdgs
4. M.P Boraia, Best Practices in Rural Development, Shanlax Publishers, 2016.

Journals:
1. Journal of Rural development (published by NIRD & PR, Hyderabad).
2. Indian Journal of Social Work, (by TISS, Bombay).
3. Indian Journal of Extension Educations (by Indian Society of Extension Education).
4. Journal of Extension Education (by Extension Education Society).
5. Kurukshetra (Ministry of Rural Development, GOI).
6. Yojana (Ministry of Information & Broadcasting, GOI).

22CSC04

OBJECT-ORIENTED PROGRAMMING LAB

Instruction	2P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to:
1. Master the concepts of Object Oriented Programming.
2. Explore the OOPs features of Python and build applications.

COURSE OUTCOMES: After the completion of this course, the student will be able to
1. Demonstrate the features of Object-Oriented Programming.
2. Understand APIs and third-party libraries to be used with Python.
3. Use Python libraries to solve real-world problems.
4. Write scripts to solve data science/machine leaning problems using NumPy and Pandas.
5. Develop applications by accessing web data and databases.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	3	2	3	1	3	-	-	-	-	-	-	2
2	3	3	2	2	2	-	-	-	-	-	-	2
3	3	3	3	2	3	-	-	-	-	-	-	2
4	3	3	3	3	3	-	-	-	-	-	-	2
5	3	3	3	3	3	-	-	-	-	-	-	2

Laboratory / Practical:
1. Demonstration of classes and objects with referencing the class variables, instance variables and static variables.
2. Demonstration of Inheritance types with constructor and destructor invocation in inheritance.
3. Demonstration of Exception handling and unit testing.
4. Write a NumPy program to compute the cross product of two given vectors.
5. Write NumPy program to calculate the QR decomposition of a given matrix.
6. Write a Pandas program to convert a Panda Module Series to Python list and its type.
7. Write a Pandas program to convert a NumPy array to a Pandas series.
8. Create a Python project to get the citation from Google scholar using title and year of publication and volume and pages of journal.
9. Create a Python project to get total COVID-19 cases, total deaths due to Covid-19, total Covid-19 patients recovered in the world.
10. Demonstration of database connectivity and different types of JOIN operations on tables.

Note: Programs need to be on OOPS concepts.

Text Book:
1. Reema Thareja, "Python Programming", First Edition, Oxford Press, 2017.

ONLINE RESOURCES:
1. https://vknight.org/cfm/labsheets/04-object-oriented-programming/
2. http://learning-python.com/class/Workbook/x-exercises.htm
3. https://inst.eecs.berkeley.edu/~cs61a/fa14/lab/lab06/#inheritance
4. https://anandology.com/python-practice-book/object_oriented_programming.html
5. http://stanfordpython.com/
6. https://docs.python.org/3/

22MEC37

ROBOTICS AND DRONES LAB
(Common to All Branches)

Instruction	2T + 2P Hours per week
CIE	100 Marks
Credits	3

COURSE OBJECTIVES: This course aims to
1. To develop the students' knowledge in various robot and drone structures and their workspace.
2. To develop multidisciplinary robotics that have practical importance by participating in robotics competitions
3. To develop students' skills in performing spatial transformations associated with rigid body motions, kinematic and dynamitic analysis of robot systems.
4. Through projects done in lab, increase the true hands-on student learning experience and enhance their conceptual understanding, increase students' ability, competence and teamwork skills on dealing with real-life engineering problems

COURSE OUTCOMES: After the completion of this course, the student will be able to
1. Demonstrate knowledge of the relationship between mechanical structures of robotics and their operational workspace characteristics
2. Understand mechanical components, motors, sensors and electronic circuits of robots and build robots.
3. Demonstrate knowledge of robot controllers.
4. Use Linux environment for robotic programming.
5. Write Python scripts to control robots using Python and Open CV.

CO-PO Articulation Matrix

PO#/CO#	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	P010	PO11	PO12
CO1	**3**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**2**	**2**
CO2	**2**	**3**	**1**	**2**	**3**	**1**	**1**	**1**	**1**	**2**	**2**	**1**
CO3	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**2**
CO4	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**
CO5	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**3**	**3**	**3**

Lab Experiments:
1. Assembling of robot mechanical components, mounting of motors, sensors, electronic circuits to the chassis.
2. Connecting to electronic circuitry: motor drivers, incremental encoders proximity sensors, micro controller,
3. Different types of batteries, selection of suitable battery for application, safety precaution.
4. Introduction to Linux Command Line Interface: basic file and directory management and other useful commands
5. Controlling robot using Python: i) Move robot using Python code, ii) Make robot move in patterns using Python
6. Robot programming with Sensor inputs: i) Read sensor data using Python, ii) Visualize sensor data using Python, iii) Code robot to avoid obstacles by using sensor data
7. Open CV: i) Create an Image and display an image; ii) Read and change pixel values; iii) Create colored shapes and save image; iv) Extract the RGB values of a pixel; v) Reading and Writing Videos
8. Open CV: i) Extraction of Regions of Interest; ii) Extraction of RGB values of a pixel
9. Coding robot to work with colors, follow colored objects, identifying shape of the object-oriented
10. Projects: i)Making a line follower robot using a Camera; ii) Writing code for a complex function
11. Assembly of a drone

SUGGESTED READINGS:

1. https://www.geeksforgeeks.org/robotics-introduction/
2. https://www.ohio.edu/mechanical-faculty/williams/html/PDF/IntroRob.pdf
3. https://www.idtechex.com/en/research-report/new-robotics-and-drones-2018-2038-technologies-forecasts-players/584
4. https://dronebotworkshop.com/

22EEC02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2P Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to

1. To acquire the knowledge on different types of electrical elements and to verify the basic electrical circuit laws and theorems.
2. To determine the parameters and power factor of a coil, calculate the time and frequency responses of RLC circuits and to familiarize with measurement of electric power & energy.
3. To determine the characteristics of Transformers, dc, ac machines and switch gear components

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Comprehend the circuit analysis techniques using various circuital laws and theorems.
2. Analyse the parameters of the given coil and measurement of power and energy in AC circuits
3. Determine the turns ration/performance parameters of single-phase transformer
4. Infer the characteristics of DC shunt motor different tests.
5. Illustrate different parts and their function of electrical components, equipment and machines.

CO-PO Articulation Matrix

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2

List of Laboratory Experiments/Demonstrations:

1. Verification of KCL and KVL.
2. Verification of Thevenin's theorem.
3. Verification of Norton's theorem.
4. Charging and discharging of Capacitor.
5. Determination of parameters of a choke or coil by Wattmeter Method.
6. Power factor improvement of single-phase AC System.
7. Active and Reactive Power measurement of a single-phase system using
   (i) 3-Ammeter method (ii) 3-Voltmeter method
8. Measurement of 3-Phase Power in a balanced system
9. Calibration of single-phase energy meter.
10. Verification of Turns/voltage ratio of single-phase Transformer.
11. Open Circuit and Short Circuit tests on a given single phase Transformer
12. Brake test on DC Shunt Motor
13. Speed control of DC Shunt Motor
14. Demonstration of Measuring Instruments and Electrical Lab components.
15. Demonstration of Low-Tension Switchgear Equipment/Components
16. Demonstration of cut - out section of Machines like DC Machine, Induction Machine etc.

Note: TEN experiments to be conducted to cover all five Course Outcomes

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

(Inline with AICTE Model Curriculum with effect from AY 2023-24)

B.E. (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

SEMESTER – III

S.NO	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1.	22MTC07	Mathematical and Statistical Foundations	3	-	3	40	60	3
2.	22CSC15	Operating Systems	3	-	3	40	60	3
3.	22CSC11	Database Management Systems	3	-	3	40	60	3
4.	22ITC02	Java Programming	3	-	3	40	60	3
5.	22ITC01	Digital Logic and Computer Architecture	3	-	3	40	60	3
6.	22CSC05	Data Structures	3	-	3	40	60	3
7.	22EGM01	Indian Constitution and Fundamental Principles	2	-	2	-	50	NC
PRACTICALS								
8.	22CSC33	Database Management Systems Lab	-	2	3	50	50	1
9.	22ITC03	Java Programming Lab	-	2	3	50	50	1
10.	22CSC31	Data Structures Lab	-	2	3	50	50	1
11.	22ADI01	MOOCs/Training/Internship	3-4 Weeks/ 90 Hours		-	50	-	2
TOTAL			**20**	**6**	**29**	**390**	**500**	**23**
Clock Hours Per Week: 26								

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**
CIE – Continuous Internal Evaluation **SEE - Semester End Examination**

22MTC07

MATHEMATICAL AND STATISTICAL FOUNDATIONS

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES:

1. Able to learn and analysing data in using statistical tools.
2. Able to fit the hypothetical data using probability distribution.
3. Able to fit the random data using distribution function.
4. Able to understand the data using the testing of Hypothesis.
5. Able to understand the basic concepts of the Number Theory for data security.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Apply the statistical averages for identifying behaviour of the data.
2. Analyse the data using probabilistic models.
3. Apply the probability function to characterise the random phenomenon.
4. Analyse data using different methods of hypothesis testing.
5. Apply the number theory concept to cryptography domain.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	3	3	2	2	-	-	-	-	-	-	-	2	2	2	3
CO 2	3	3	2	2	-	-	-	-	-	-	-	2	2	2	2
CO 3	3	3	2	2	-	-	-	-	-	-	-	2	2	2	2
CO 4	3	3	2	2	-	-	-	-	-	-	-	2	2	2	3
CO 5	3	3	2	2	-	-	-	-	-	-	-	2	1	2	1

UNIT-I

Basic Statistics: Measures of Central Tendency, Measures of Dispersion, Skewness, Karl Pearson's coefficient of skewness and Bowley's coefficient of skewness for frequency distribution, Kurtosis. Correlation, linear regression, properties of regression coefficient.

UNIT-II

Mathematical Expectation (One Dimensional Random variables): Conditional Probability, Baye's theorem. Random variable, discrete random variable, Probability Mass Function, continuous random variable, probability density function. Mathematical expectation, properties of Expectation, Variance and co-variance. Moments (Moments about the mean and moments about a point).

UNIT-III

Probability Distributions : Poisson distribution, Mean, Variance, MGF and CGF, Recurrence formula for the probabilities of Poisson distribution (Fitting of Poisson distribution). Normal distribution, Characteristics of normal distribution, Mean, Variance, MGF and CGF, Areas under normal curve. Uniform distribution, Mean, Variance and MGF, Exponential distribution, Mean, Variance, MGF and CGF.

UNIT-IV

Testing of Hypothesis: Large and Small Sample Tests: Tests of significance for large samples, for Single Proportion, difference of Proportions, Single mean and difference of means. Small sample test: t-test for single mean and differences of means. F-test for equality of two population variances.

UNIT-V

Number Theory: Greatest common divisors, The Euclidean algorithm, the fundamental theorem of arithmetic, Factorization of integers and the Fermat numbers. Introduction to Congruence, Linear congruence, The Chinese Remainder Theorem, System of linear congruences.

TEXT BOOKS:

1. S.C.Gupta, V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.
2. Kenneth H. Rosen, Elementary number theory & its applications, Sixth edition, Addison-wesley, ISBN978 0-321-50031-1.

SUGGESTED READING:

1. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, 3rd Ed., Wiley, 1968.
2. Sheldon Ross, "A First Course in Probability", 9th Edition, Pearson publications, 2014.
3. S.C.Gupta, V.K.Kapoor, "Fundamentals of Applied Statistics", Sultan Chand and Sons, 2014.

22CSC15

OPERATING SYSTEMS
(Common to IT and AI&DS)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Computer Architecture and Programming Fundamentals.

COURSE OBJECTIVES: This course aims to:
1. Understand the basic concepts and design of an operating system.
2. Interpret the structure and organization of the file system
3. Learn Inter Process Communication mechanisms and memory management approaches.
4. Explore cloud infrastructures and technologies.

COURSE OUTCOMES: After the completion of this course, the student will be able to
1. Understand the basics of Operating systems and its major components.
2. Illustrate the concepts related to process management.
3. Distinguish various memory management techniques.
4. Apply concepts of process synchronization and deadlocks to a given situation.
5. Evaluate various file allocation methods and Apply security as well as recovery features in the design Operating system.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	2	1	1	-	-	-	-	-	-	-	-	-	1	1	2
CO 2	3	3	-	3	1	-	-	-	-	-	-	-	-	2	2
CO 3	3	3	2	1	1	-	-	-	-	-	-	-	-	-	2
CO 4	3	3	1	3	-	-	-	-	-	-	-	-	-	1	2
CO 5	3	3	2	3	1	-	-	-	-	-	-	-	1	1	2

UNIT – I

Introduction to Operating Systems: Computer System overview, Components of a computer system, functions of OS, Examples, different types of OS (RTOS vs. desktop vs. mobile etc.), OS distributions and versions.

OS architectures: Micro-kernel, Layered, Kernel Approaches and examples.

UNIT – II

Process management: Program vs. process, process states, Process Control Block (PCB), OS services and system calls (fork, wait, exec, getpid, getppid etc.), system calls vs. System programs, Process scheduling- Process context switching, Scheduling algorithms, scheduling criteria.

Inter Process Communication: Linux IPC Mechanisms, RPC, RPC exception handling, Security issues.

UNIT – III

Memory Management: Memory view of a process, Process memory usage requirements, virtual and physical memory related system calls (mmap, munmap, sbrk, mprotect). Address translation mechanisms --- static mapping, segmentation, paging, page faults, page replacement algorithms, page sharing, read/write permissions, swapping.

Secondary Memory Management: Disk structure, disk scheduling, disk management, buffering, swap space management, RAID levels.

UNIT – IV

Concurrency and Synchronization: Introduction to threads, benefits, types and thread APIs, Synchronization, issues, hardware and software solutions for synchronization, Classical problems of synchronization.

Deadlocks: Introduction, necessary conditions for deadlock occurrence, RAG, deadlock handling mechanisms - prevention, avoidance, and recovery.

UNIT - V

File Systems: File concepts, file types, allocation and organization methods, file handling system calls, File system metadata, directory structure, caching optimizations File Systems case study.

OS Security: Types of threats in OS, basic security mechanisms, malware taxonomy, viruses, worms, and rootkits; Defense: overview, logging, auditing, and recovery, OS-level memory protection.

TEXT BOOKS:

1. Galvin, Silberschatz, "Operating system Concepts", 10th Edition, John Wiley & Sons, 2018.
2. Maurice J. Bach, "Design of the UNIX Operating System", Pearson Education India; 1st Edition, 2015.
3. Ekta Walia Khanna ,"Operating System Concepts", Publishing House; 2nd Edition,2019.
4. Dhananjay Dhamdhare, "Operating Systems-A Concept Based Approach", 3rd Edition, McGraw Hill Education, 2017.

SUGGESTED READING:

1. W. Richard Stevens, Stephen A. Rago, "Advanced Programming in the UNIX® Environment" Pearson Education India; 3rd Edition, 2013.

ONLINE RESOURCES:

1. Remzi H. Arpaci-Dusseau and Andrea C. , "Three Easy Pieces", Arpaci-Dusseau Arpaci-Dusseau Books, LLC https://pages.cs.wisc.edu/~remzi/OSTEP/ (online version)
2. Frans Kaashoek, Robert Morris, and Russ Cox, Xv6, a simple Unix-like teaching operating system [T4-R] https://github.com/mit-pdos/xv6-riscv (RISC-V version) [T4-X] https://github.com/mit-pdos/xv6-public (x86 version)

22CSC11

DATA BASE MANAGEMENT SYSTEMS

(Common to AI&DS, AI&ML, CSE(AI&ML and CET)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Discrete mathematics of computer science, Programming and Data Structures.

COURSE OBJECTIVES: This course aims to:

1. Familiarize students with fundamental concepts of database management. These concepts include aspects of database design, database languages and database-system implementation.
2. Understand about data storage techniques and indexing.
3. Impart knowledge in transaction management, concurrency control techniques and recovery procedures.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Design database schema for an application using RDBMS concepts.
2. Write SQL queries for tasks of various complexities.
3. Build applications using database system as backend.
4. Understand internal working of a DBMS including data storage, indexing, query processing, transaction processing, concurrency control and recovery mechanisms.
5. Analyze non-relational and parallel/distributed data management systems with a focus on scalability.

CO-PO Articulation Matrix

PO/PSO / CO	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	PSO 3
CO 1	2	2	2	2	3	-	-	-	-	-	-	1	1	2	2
CO 2	2	3	2	2	3	-	-	-	-	-	-	1	2	2	2
CO 3	2	1	2	1	3	-	-	-	-	-	-	-	2	2	3
CO 4	2	1	1	-	-	-	-	-	-	-	-	-	1	2	3
CO 5	2	1	-	1	-	-	-	-	-	-	-	-	2	2	3

UNIT - I

Introduction: Motivation, Introduction to Data Models (Relational, Semi structured, ER).

Relational Data Bases: Relational Data Model, Relational Algebra, Relational Calculus.

UNIT - II

SQL + Interaction with Database: SQL Data Types, Basic Structure of SQL Queries, Modification of the Database, Set Operations, Aggregate Functions, Data-Definition Language, Integrity Constraints, Null Values, Views, Join Expression. Index Definition in SQL. Simple Queries (select/project/join/ aggregate queries), Complex queries (With Clause, Nested Subqueries, Views), Programming in a standard language and interfacing with a DB backend.

UNIT- III

Big Data: Key-value Stores and Semi structured Data, using JSON and MongoDB, or other combinations

Database Design: Introduction to ER model, Mapping from ER to relational model, Functional Dependencies, Normalization.

UNIT - IV

Physical Design: Overview of Physical Storage (Hard Disks, Flash/SSD/RAM), sequential vs random I/O, Reliability via RAID, Storage Organization (Records, Pages and Files), Database Buffers, Database Metadata, Indexing, B+-Trees.

UNIT - V

Query Processing and Optimization: Query Processing, External sort, Joins using nested loops, indexed nested loops. **Overview of Query Optimization:** Equivalent expressions and concept of cost based optimization. **Transaction Processing:** Concept of transactions and schedules, ACID properties, Conflict-serializability, **Concurrency control:** locks, 2PL, Strict 2PL, optional: isolation levels, Recovery using undo and redo logs.

TEXT BOOKS:

1. Silberschatz, Korth and Sudarshan, "Database System Concepts", 7th Edition, McGraw-Hill. Indian Edition, 2021
2. Elmasri and Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Pubs, 2017
3. Lemahieu, Broucke and Baesens, "Principles of Database Management", Cambridge University Press, 2018
4. RP Mahapatra, "Database Management Systems", Khanna Publishing House, 2020.
5. Krishnan, "Database Management Systems", McGraw Hill.

SUGGESTED READING:

1. MySQL Explained: Your Step By Step Guide To Database Design
2. Pro SQL Server 2008 Relational Database Design and Implementation (Expert's Voice in SQL Server) 1st Edition

ONLINE RESOURCES:

1. http://www.nptelvideos.in/2012/11/database-managementsystem.html.
2. https://www.oracle.com/news/connect/json-database-semistructured-sql.html

22ITC01

DIGITAL LOGIC AND COMPUTER ARCHITECTURE

(Common to IT, AI&DS and CET)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to:

1. Familiarize with logic gates, combinational and Sequential logic circuits.
2. Provide understanding of Digital Counters, registers and Data representation.
3. Present the operation of the Central Processing Unit.
4. Facilitate the techniques that computers use to communicate with input and output devices.
5. Introduce the concept of memory hierarchy and memory management.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Apply Boolean algebra for simplification and learn representation of data using numbers.
2. Understand fundamentals of combinational & sequential logic gates, registers and counters.
3. Infer the architecture and functionality of the central processing unit.
4. Explore the techniques that computers use to communicate with I/O devices for data transfer.
5. Comprehend memory hierarchy, cache memory and virtual memory.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	2	2	1	0	1	0	0	0	1	0	0	1	-	-	1
CO 2	2	1	1	0	1	0	0	0	0	0	0	1	1	-	1
CO 3	2	2	1	0	0	0	0	0	0	0	2	2	-	-	1
CO 4	2	1	0	0	0	0	0	0	0	0	0	2	-	-	1
CO 5	2	2	1	0	0	0	1	0	1	0	2	2	1	-	1

UNIT–I

Data Representation: Number Systems, Octal and Hexadecimal Numbers, Decimal Representation, Complements: (r-1)'s Complement, r's Complement, Subtraction of Unsigned Numbers, Fixed–Point Representation, and Floating –Point Representation.

Digital Logic Circuits : Digital Computers, Logic Gates, Boolean Algebra, Map simplification, Product –of-sums Simplification, Don't –Care Conditions.

UNIT–II

Combinational Circuits: Decoders, Encoders, Multiplexers, Half-Adder, Full–Adders, **Flip-Flops:** SR, D, JK, T Flip- Flops, Edge triggered Flip-Flops, Excitation Tables.

Registers: Register with Parallel load, Bidirectional Shift Register with Parallel load, 4-bit Synchronous Binary Counter.

UNIT–III

Central Processing Unit: General register Organization, Instruction Formats: Three Address Instructions, Two-Address Instructions, One-Address Instructions, and Zero-Address Instructions. Addressing Modes: Data Transfer and Manipulation, Program Control, Multi core Processors and their Performance.424286

UNIT–IV

Input-Output Organization: Peripheral Devices: ASCII Alphanumeric Characters, Input-output Interface: I/O Bus and Interface Modules, Asynchronous Data Transfer: Strobe Control, Handshaking, Asynchronous Communication Interface, First-In- First-Out Buffer, Modes of Transfer: Interrupt-Initiated I/O, Priority Interrupt: Daisy Chaining, Parallel Priority Interrupt, Priority Encoder, Direct Memory Access (DMA): DMA Controller.

UNIT–V

Memory Organization: Memory Hierarchy, Main Memory: RAM and ROM Chips, Memory Address Map, Memory Connection to CPU, Auxiliary memory: Magnetic Disks, Solid State Drive, Associative Memory: Hardware Organization, Read and Write Operations, Cache Memory: Associative Mapping, Direct Mapping, Set-Associative Mapping, Virtual Memory: Address Space and Memory Space, Address Mapping using Pages, Associative Memory Page Table.

TEXT BOOK:

1. M.Morris Mano, "Computer System Architecture", 3rd Edition, Pearson Education. 2016.

SUGGESTED READING:

1. Stephen Brown, ZvonkoVranesic, "Fundamentals of Digital Logic with VHDL design", 2nd Edition, McGraw Hill, 2009.
2. ZVI Kohavi, "Switching and Finite Automata Theory", 2nd Edition, Tata McGraw Hill, 1995.
3. William Stallings, "Computer Organization and Achitecture", 8th Edition, PHI.2010
4. Carl Hamachar, Vranesic, Zaky, "Computer Organization", 5th Edition, McGraw Hill.2002.

WEB RESOURCES:

1. https://nptel.ac.in/courses/117106114Week1%20Slides1.1Introduction.pdf
2. https://ece.gmu.edu/coursewebpages/ECE/ECE545/F10/viewgraphs/ECE545_lecture1_digital_logic_review.ppt
3. http://www.nptelvideos.in/2012/11/computer-organization.html

22ITC02

JAVA PROGRAMMING
(Common to IT and AI&DS)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES:

1. Deliver the Object-oriented programming features and principles for code development.
2. Explore the reusability of the code, coupling and cohesion.
3. Handle the exceptions and multiple flow of the execution.
4. Understand the collection framework.
5. Develop the database applications.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Apply the concept of OOP to design, implement and execute programs.
2. Use the strings, interfaces, packages and inner classes for application development.
3. Apply the exception handling mechanisms and multithreading for the development.
4. Develop applications using collection framework.
5. Develop database applications using SQL package.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	2	2	3	3	2	2	-	1	2	1	2	2	2	2	2
CO 2	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO 3	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO 4	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO 5	2	2	3	2	3	1	-	1	2	1	2	2	2	3	3

UNIT-I

Introduction to Java: Procedural and object-oriented programming paradigms, Principles, Features, Basic structure a java program, Java Primitive Data Types, Basic Operators, Flow-control statements. Defining Classes, Adding Instance Fields and Methods, Object Creation, Constructors, Access Modifiers, Method Overloading and Constructor Overloading, Use of static and final keyword, Arrays, Strings and String Tokenizer.

UNIT-II

Inheritances and Packages: Types of Inheritance, super keyword, preventing inheritance, the Object class, method overriding and dynamic method dispatch, abstract classes and methods. Interfaces, Interfaces vs. Abstract classes, Inner classes and types, Packages, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

UNIT-III

Exception Handling and Threading: What are exceptions, Error vs. Exception, usage of try, catch, throw, throws and finally clauses. Multithreading in Java, Life cycle of Thread, how to create threads, Thread class in java, Thread priorities, Thread Synchronization. Introduction to Generics.

UNIT-IV

Collections: Overview of Java Collection Framework, Collection Interfaces – Collection, Set, List, Map, Collection classes – Array List, Linked List, Hash Set, Tree Set, Hash Map, Tree Map, legacy and class, Iteration over Collections – Iterator and List Iterator, Enumeration interfaces, differentiate Comparable and Comparator interface, Introduction to Java 8 Features.

UNIT-V

Servlets, JSP and Databases: Introduction to Servlets , Servlet Life cycle, Request and Response methods- Servlet Collaboration. Servlet Config vs. Servlet Context, JSP, Databases: Connecting to Database - JDBC, Drivers, Connection, Statement and its types, Result set, CRUD operations.

TEXT BOOKS:

1. Herbert Schildt, "Java: The Complete Reference", 12th Edition, Tata McGraw Hill Publications, 2020.
2. K Somasundaram "Advanced Programming in Java2" Jaico Publishing House, 2008.
3. Bruce W.perry "Java Servlet and JSP Cookbook", O'reilly Media Inc., 2004.

SUGGESTED READING:

1. Sachin Malhotra, Saurabh Choudhary, "Programming in Java", Oxford University Press, 2nd Edition, 2014.
2. C.ThomasWu, "An Introduction to Object-Oriented Programming with Java", TataMcGraw-Hill, 4th Edition, 2010.
3. E Balaguruswamy "Programming with Java", TataMcGraw-Hill, 6th Edition, 2019.
4. Cay S. Horstmann, Gary Cornell, "Core Java, Volume I— Fundamentals", 8th Edition, Prentice Hall, 2008.
5. K Somasundaram "Introduction to Java Programming", Jaico Publishing House, 2016.
6. Paul Deitel and Harvey Deitel "Java How to Program, Early Objects", 11th Edition., 2018.

WEB RESOURCES:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html
2. https://nptel.ac.in/courses/106106147/2

22CSC05

DATA STRUCTURES

(Common to CSE, IT, AI&DS, AI&ML, CSE(AI&ML) and CET)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Basic knowledge of programming language such as python.

COURSE OBJECTIVES: This course aims to:

1. Study various linear and non-linear data structures.
2. Understand the performance of operations on data structures.
3. Explore various searching and sorting techniques.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand the basic concepts and types of data structures.
2. Analyze various linear and nonlinear data structures.
3. Identify the applications of linear and nonlinear data structures and significance of balanced search trees, hashing.
4. Evaluate various searching and sorting techniques.
5. Use appropriate data structures to design efficient algorithms.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	3	3	-	-	-	-	-	-	-	-	-	-	2	2	3
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	2	2	3
CO 3	3	2	-	-	-	-	-	-	-	-	-	-	2	3	3
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	2	2	3
CO 5	3	3	1	-	-	-	-	-	-	-	-	-	3	3	3

UNIT-I

Introduction: Data structures, Classification of data structures, Abstract Data Types, Analysis of Algorithms; **Recursion**: Examples illustrating Recursion (Factorial, Binary Search), Analyzing Recursive Algorithms; **Sorting:** Quick sort, Merge Sort, Selection Sort, Radix sort, Comparison of Sorting Algorithms.

UNIT–II

Stacks: Stack ADT, Applications of stack, Array based stack implementation**; Queues:** Queue ADT, applications of queues, Array based queue implementation, Double Ended Queues, Circular queues.

UNIT-III

Linked Lists: Introduction, Linked lists, Representation of linked list, types of linked list, singly linked lists, implementing stack with a singly linked list and Queue, Circular linked lists, doubly linked lists, Applications of linked lists.

UNIT-IV

Trees: General Trees, Binary Trees, Implementing Trees, Tree traversals; **Search Trees:** Binary Search Trees, Balanced search trees- AVL trees, B- trees; **Priority Queue and Heaps:** Priority queue ADT, Priority queue applications, Heap Trees, implementing a priority queue with a Heap, Heap Sort.

UNIT-V

Graphs: Introduction, Applications of graphs, Graph representations, graph traversals.

Hashing: Introduction, Hash Functions-Modulo, Middle of Square, Folding, Collision Resolution Techniques-Separate Chaining, Open addressing,- LinearProbing, Quadratic Probing, Double Hashing.

TEXT BOOKS:

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structure and Algorithms in Python”, Wiley, 2021.
2. Narasimha karumanchi, “Data Structures and Algorithms Made Easy”, Career Monk Publications, 2020
3. S. Sahni and Susan Anderson-Freed, “Fundamentals of Data structures in C”, E. Horowitz, Universities Press, 2nd Edition, .
4. Reema Thareja, “Data Structures using C”, Oxford University Press, 2nd Edition, 2014.

SUGGESTED READING:

1. D. S. Kushwaha and A K. Misra, “Data structures A Programming Approach with C”, PHI, 2nd edition, 2014.
2. Seymour Lipschutz, “Data Structures with C”, Schaums Outlines, MGH, Kindle Edition, 2017.
3. Kenneth A. Lambert, " Fundamentals of Python: Data Structures", Cengage Learning, 2018
4. D. Samantha, “Classic Data Structures”, Prentice Hall India, 2nd Edition, 2013

ONLINE RESOURCES:

1. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
2. https://www.edx.org/course/foundations-of-data-structures
3. https://sites.google.com/site/merasemester/data-structures/data-structures-#DS
4. https://www.cs.usfca.edu/~galles/visualization/Algorithms
5. https://www.coursera.org/specializations/data-structures-algorithms

22EGM01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

Instruction	2 L Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Basic Awareness of Indian Constitution and Government.

COURSE OBJECTIVES: This course aims to

1. Understand the history of framing of the Indian Constitution.
2. Awareness on Fundamental Rights, Duties and Directive Principles of State Policy.
3. Explore the organization of Union Government, and functions of President and Prime Minister.
4. Gain an insight into the inter-functionality of Union Legislature and Judiciary
5. Educate on the local governance and problems in development of rural and urban areas.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand the history of framing of the Indian Constitution and its features.
2. Assess the realization of Fundamental Rights and Directive Principles of State Policy.
3. Analyze the challenges to federal system and position of the President and the Prime Minister in the Union Government.
4. Underline the role of the Legislature and the Judiciary in Union Government and their mutual relations.
5. Evolve the development of the local governments in India and assess the role of Collector in district administration.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	-	-	1	-	-	1	1	1	1	-	-	-	-	-	-
CO 2	-	-	2	-	-	3	2	2	1	-	-	-	-	-	-
CO 3	-	-	1	-	-	1	1	-	-	-	-	-	-	-	-
CO 4	-	-	1	-	-	1	1	-	-	-	-	-	-	-	-
CO 5	-	-	2	-	-	3	2	1	1	-	-	-	-	-	-

UNIT-I

Constitutional History and Framing of Indian Constitution: East India Company rule (1757-1857): Social, Economic, Political and Administrative impact of Company rule in India. British Rule (1858-1947): Indian National Movement, Government of India Acts 1909, 1919 and 1935, and Indian Independence Act 1947. Framing of the Indian Constitution: Constituent Assembly, Preamble and Salient Features.

UNIT-II

Fundamental Rights, Duties and Directive Principles of State Policy: The Fundamental Rights**:** Features and significance of Rights. Fundamental Duties: Importance and the legal status of Duties. Directive Principles of State Policy: Socialist, Gandhian and Liberal-intellectual principles, importance and relevance.

#

Union Government and its Administration: Federalism: Division of legislative and financial powers between the Union and the State. Union Executive: Role and position of President, Prime Minister and Council of Ministers. Emergency Provisions: National Emergency, Constitutional Emergency and Financial Emergency.

UNIT-IV

Union Legislature and Judiciary: Union Legislature: Parliament of India-Composition and functions of Parliament, and Parliamentary Committees. Union Judiciary: Supreme Court of India-Composition and Functions.

UNIT-V

Local Self Governments : Rural Local Governments: Zilla Parishad- CEO and functions of Zilla Parishad, Mandal Parishad- Role of Elected and Officials, Gram Panchayat- Sarpanch, Secretary and Gram Sabha. Urban Local Governments: Structure and functions of Municipalities and Municipal Corporations. District Collector: Powers and functions of Collector.

TEXT BOOKS:

1. Sastry Ravindra, (Ed), "Indian Government & Politics", Telugu Akademy, 2nd edition, 2018.
2. "Indian Constitution at Work", NCERT, First edition 2006, Reprinted in 2022.

SUGGESTED READING:

1. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, "Framing of Indian Constitution", 1st Edition, 2015.
3. Granville Austin, "The Indian Constitution: The Cornerstone of a Nation", OUP, 2nd Edition, 1999.
4. M.V. Pylee, "India's Constitution", S. Chand Publishing, 16th Edition, 2017.
5. Rajeev Bhargava (ed), "Politics and Ethics of the Indian Constitution", OUP, 2008.

ONLINE RESOURCES:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

22CSC33

DATA BASE MANAGEMENT SYSTEMS LAB

(Common to AI&DS, AI&ML, CSE(AI&ML) and CET)

Instruction	2 P Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to:

1. Become familiar with the concepts of structured query language.
2. Understand about programming language / structured query language (PL/SQL).
3. Become familiar with generation of form and open database connectivity.
4. Add constraints on Databases implement DCL, TCL and advanced SQL commands.
5. Develop programs using cursors, triggers, exceptions, procedures and functions in PL/SQL.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Outline the built-in functions of SQL and apply these functions to write simple and complex queries using SQL operators.
2. Demonstrate Queries to Retrieve and Change Data using Select, Insert, Delete and Update. Construct Queries using Group By, Order By and Having Clauses.
3. Demonstrate Commit, Rollback, Save point commands, SQL Plus Reports and formulate the Queries for Creating, Dropping and Altering Tables, Views, constraints.
4. Develop queries using Joins, Sub-Queries and Working with Index, Sequence, Synonym, Controlling Access and Locking Rows for Update, Creating Password and Security features.
5. Develop PL/SQL code using Cursors, Exception, Composite Data Types and Procedures, Functions and Packages.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	3	2	2	2	3	-	-	-	2	-	1	3	1	2	2
CO 2	3	3	2	3	3	-	-	-	2	-	1	3	2	2	2
CO 3	3	2	2	2	3	-	-	-	2	-	1	1	2	2	3
CO 4	3	1	1	1	-	-	-	-	2	-	1	-	1	2	3
CO 5	3	1	-	1	-	-	-	-	1	-	1	-	2	2	3

List of Experiments

SQL:

1. Queries using Built-In functions, like aggregate functions, String Functions, Numeric Functions, Data Functions, Conversion Functions and other miscellaneous.
2. Queries using operators in SQL.
3. Queries to Retrieve and Change Data: Select Insert, Delete and Update.
4. Queries using Group By, Order By and Having Clauses.
5. Queries on Controlling Data: Commit, Rollback and Save point.
6. Queries to Build Report in SQL *PLUS.
7. Queries for Creating, Dropping and Altering Tables, Views and Constraints.
8. Queries on Joins and Correlated Sub-Queries.
9. Queries on Working with Index, Sequence, Synonym, Controlling Access and Locking Rows for Update,
10. Creating Password and Security features.
11. Querying in NoSql

PL/SQL:

1. Write a PL/SQL code using Basic Variable, Anchored Declarations and Usage of Assignment Operation.
2. Write a PL/SQL code Bind and Substitution Variables, Printing in PL/SQL.
3. Write a PL/SQL block using SQL and Control Structures in PL/SQL.
4. Write a PL/SQL code using Cursors, Exception and Composite Data Types.
5. Write a PL/SQL code using Procedures, Functions and Packages.

Note: The creation of sample database for the purpose of the experiments is expected to be pre-decided by the instructor.

TEXT BOOKS / SUGGESTED READING:

1. "Oracle: The complete Reference", by Oracle Press.
2. Nilesh Shah, "Database Systems Using Oracle", PHI, 2007.
3. Rick F Vander Lans, "Introduction to SQL", Fourth Edition, Pearson Education, 2007.

22ITC03

JAVA PROGRAMMING LAB
(Common to IT and AI&DS)

Instruction	2 P Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to:
1. Deliver the basic principles of OOP.
2. Explore the object-orientation process in creating classes, object, etc.,
3. Demonstrate the inheritances and polymorphism.
4. Handle the exceptions in runtime and multithreading.
5. Develop the database applications.

COURSE OUTCOMES: After the completion of this course, the student will be able to
1. Practice the basics of OOPs to develop java applications.
2. Use the inheritance and interfaces for application development.
3. Apply the exception handling and multithreading to handle multiple flows of execution.
4. Develop applications using collection framework.
5. Apply the SQL concepts for application development.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	2	2	3	3	2	2	-	1	2	1	2	2	2	2	2
CO 2	3	3	3	2	2	1	-	1	2	2	2	3	2	2	2
CO 3	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO 4	2	2	3	2	2	1	-	1	2	1	2	2	2	2	2
CO 5	3	3	3	2	3	1	-	1	2	2	2	3	2	3	3

LIST OF EXPERIMENTS
1. Implement the program(s) to handle the various data types, operators, expressions, control-flow, and strings.
2. Develop a java program(s) for dynamic method dispatch and constructor.
3. Develop a java program(s) to deal with different types of inheritances and interfaces.
4. Implement the program(s) to demonstrate the packages.
5. Develop a java program(s) to handle user defined exceptions with multiple catch blocks.
6. Implement program(s) to demonstrate Multithreading and thread synchronization.
7. Implement the collection framework classes with Iterator/ListIterator/Enum Interface.
8. Develop a java program(s) to implement the features of JDK8.
9. Implement a java program(s) to implement the concept of Servlets and JSP.
10. Create a web application to implement CRUD operations using Servlets, JSP and Databases.

TEXT BOOKS:
1. Herbert Schildt, “Java: The Complete Reference”, 12th Edition, Tata McGraw Hill Publications, 2020.
2. K Somasundaram “Advanced Programming in Java2” Jaico Publishing House, 2008.
3. Bruce W.perry “Java Servlet and JSP Cookbook”, O’reilly Media Inc., 2004.

SUGGESTED READING:

1. Sachin Malhotra, Saurabh Choudhary, "Programming in Java", Oxford University Press, 2nd Edition, 2014.
2. C.ThomasWu, "An Introduction to Object-Oriented Programming with Java", TataMcGraw-Hill, 4th Edition, 2010.
3. E Balaguruswamy "Programming with Java", TataMcGraw-Hill, 6th Edition, 2019.
4. Cay S. Horstmann, Gary Cornell," Core Java, Volume I— Fundamentals", 8th Edition, Prentice Hall, 2008.
5. K Somasundaram "Introduction to Java Programming" , Jaico Publishing House, 2016.
6. Paul Deitel and Harvey Deitel "Java How to Program, Early Objects", 11th Edition., 2018.

WEB RESOURCES:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html
2. https://nptel.ac.in/courses/106106147/2

22CSC31

DATA STRUCTURES LAB

(Common to IT, AI&DS, AI&ML, CSE(AI&ML) and CET)

Instruction	2 P Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Pre-requisites: Any Programming Language.

COURSE OBJECTIVES: This course aims to:
1. Understand the basic concepts of data structures and abstract data types.
2. Explore linear and non-linear data structures.
3. Study various searching, sorting and hashing techniques.

COURSE OUTCOMES: After the completion of this course, the student will be able to
1. Implement the abstract data type.
2. Implement linear and non-linear data structures.
3. Evaluate various sorting techniques.
4. Analyze various algorithms of linear and nonlinear data structures.
5. Choose or create appropriate data structures to solve real world problems.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	2	2	-	-	-	-	-	-	-	-	-	-	2	2	3
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	2	2	3
CO 3	2	3	-	-	-	-	-	-	-	-	-	-	2	3	3
CO 4	2	3	-	-	-	-	-	-	-	-	-	-	2	2	3
CO 5	2	3	1	-	-	-	-	-	-	-	-	-	3	3	3

List of Experiments
1. Implementation of Quick sort, Merge sort and Selection sort.
2. Implementing Stack using array.
3. Conversion of Infix expression to Postfix expression.
4. Implement the algorithm for Evaluation of Postfix.
5. Implementing Queues using array
6. Implementation of Insert, Delete and Display operations on Single Linked List.
7. Implementation of Stack and Queue using linked list.
8. Implementation of Insert, Delete and Display operations on doubly Linked List.
9. Implementation of Binary Search Tree operations.
10. Implementation of Heap Sort.

TEXT BOOKS:
1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structure and Algorithms in Python”, Wiley, 2021.
2. Narasimha karumanchi, “Data Structures and Algorithms Made Easy”, Career Monk Publications, 2020.

22ADI01

MOOCS / TRAINING / INTERNSHIP

Instruction / Demonstration / Training	3-4 Weeks / 90 Hours
Duration of Semester End Presentation	--
Semester End Evaluation	--
Mid Term Evaluation	50 Marks
Credits	2

COURSE OBJECTIVES: This course aims to:

1. Exposing the students to the industrial environment and technologies
2. Provide possible opportunities to learn, make them to understand and sharpen them to the real time technical/ managerial skills required at the job
3. Expose with the current technological developments relevant to program domain
4. Understand Engineer's responsibilities and ethics and provide opportunity to interact with the people of industry/society to understand the real conditions.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Learn new technologies and solve real time projects.
2. Expose to the industrial environment problems and technologies
3. Gain knowledge on contemporary technologies industrial requirements.
4. Identify, Design and Develop solutions for real world problems
5. Communicate their ideas and learning experiences through reports and presentation.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	3	3	3	3	2	2	1	1	3	2	3	3	3	2	3
CO 2	2	2	2	1	1	2	2	1	3	2	3	3	3	2	3
CO 3	3	2	1	1	1	2	2	1	2	2	3	3	3	2	2
CO 4	2	3	3	3	1	2	1	-	3	3	3	3	3	2	3
CO 5	1	1	1	1	1	1	-	-	2	3	3	3	2	2	3

Process to be followed for carrying out Instructions to Students:

1. Students may apply for internships through the AICTE Portal or through CDC of the institute by filling the application form IAP-101.
2. Industry shall scrutinize the students based on their criteria and communicate a provisional offer or confirmation letter to the student.
3. If students apply through CDC, then CDC shall nominate the students for various opportunities accordingly by issuing NOC (IAP-104).
4. The respective head of the department shall assign a faculty mentor.
5. Student shall undergo internship/industrial training at the concerned Industry/Organization by submitting the form, IAP-103.
6. During the internship, Faculty Mentor will evaluate the performance of students twice either by visiting the Industry/Organization or through obtaining periodic reports from students.
7. Student shall submit internship report to the industry/organization at the end of internship program.
8. On successful completion of the Internship, Industry/Organization shall issue Internship Certificate to the students
9. All the students should maintain discipline, professional ethics and follow the health and safety precautions during internship
10. Students should get approval for MOOCS and Training Programs and same evaluation process will be followed.

Student shall maintain diary during the internship and submit the internship report at the end of the internship. The report will be evaluated by the supervisor on the basis of the following criteria:

- Originality
- Adequacy and purposeful write-up
- Organization, format, drawings, sketches, style, language etc.
- Variety and relevance of learning experience
- Practical applications, relationships with basic theory and concepts taught in the course

Evaluation of Internship: The internship of the students will be evaluated in three stages:

a. Evaluation by the Industry (in the scale of 1 to **10** where 1-Unsatisfactory; 10-Excellent)
b. Evaluation by faculty Mentor on the basis of site visit(s) or periodic communication (**15** marks)
c. Evaluation through seminar presentation/Viva-Voce at the Institute(This can be reflected through marks assigned by Faculty Mentor (**25 marks**)

For further details regarding templates, assessment guidelines please refer to the document from page number 16 onwards available at: https://www.cbit.ac.in/wp-content/uploads/2019/04/R22-Rules-with-internship-guidelines-10-11-2022..pdf

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
(Inline with AICTE Model Curriculum with effect from AY 2023-24)

B.E. (ARTIFICIAL INTELLIGENCE AND DATA SCIENCE)

SEMESTER – IV

NO	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/ D		CIE	SEE	
THEORY								
1.	22MTC16	Stochastic Process and Queueing Theory	3	-	3	40	60	3
2.	22ECC39	Systems and Signal Processing	3	-	3	40	60	3
3.	22CSC14	Design and Analysis of Algorithms	3	-	3	40	60	3
4.	22ADC01	Fundamentals of Machine Learning	3	-	3	40	60	3
5.		Professional Elective – I	3	-	3	40	60	3
6.	22MBC01	Engineering Economics and Accountancy	3	-	3	40	60	3
7.	22CEM01	Environmental Science	2	-	2	-	50	NC
PRACTICAL								
8.	22MTC17	Stochastic Process and Queueing Theory Lab	-	2	3	50	50	1
9.	22CSC34	Design and Analysis of Algorithms Lab	-	2	3	50	50	1
10.	22ADC02	Machine Learning Lab	-	2	3	50	50	1
11.	22ADC04	Linux and Latex Lab	-	2	3	50	50	1
			20	**8**	**32**	**440**	**550**	**22**
Clock Hours Per Week: 28								

L: Lecture T: Tutorial D: Drawing P: Practical
CIE – Continuous Internal Evaluation SEE - Semester End Examination

Professional Elective #1	Digital Image Processing (22ITE02)	Web Technologies (22ITC17)	Mobile Application Development (22ITE04)	Data Analysis and Visualization (22ADE01)	Data Warehousing and Data Mining (22ADE02)

22MTC16

STOCHASTIC PROCESS AND QUEUEING THEORY

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to:

1. Learn methods to solve bivariate probability functions.
2. Know characterizing the random process.
3. Identify the tools for interpretating the random process.
4. Know the statistical techniques for random process.
5. Analyses the queuing models.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Estimate the marginal probabilities of statistical averages.
2. Distinguish the random process of auto correlation and cross correlation.
3. Characterize the random process of ensemble averages.
4. Analyze the effect the thermal noise in the system.
5. Analyze the queuing behavior of different queuing models.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2
CO 2	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2
CO 3	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2
CO 4	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2
CO 5	3	2	3	1	-	-	-	-	-	-	-	2	2	3	2

UNIT-I

Two-Dimensional Random Variables: Two-dimensional or Joint Probability Mass Function, Two-dimensional Distribution Function, Marginal Distribution Functions, Joint Density Function, Marginal Density Function, The Conditional Distribution Function and Conditional Probability Density Function, Stochastic Independence ,Generalization of n dimensional random variable, transformation of One-dimensional Random variable, transformation of Two-dimensional random variable.

UNIT-II

Random Processes: Classification of Random Processes, Methods of Description of a Random Process, Special classes of Random Processes, Average values of Random Process, Stationarity, Strict Strong Stationary process, Analytical Representation of a Random process, Autocorrelation Function and Its properties of R(t),Cross-Correlation Function and its Properties wide sense stationary process.

UNIT-III

Discrete Time Process: Ergodicity, Mean-Ergodic Process, Mean Ergodic Theorem, Correlation Ergodic Process, Distribution Ergodic Process, Power Spectral density function, Properties of power spectral Density function, Properties of Power Spectral Density Function, System in the Form of Convolution, Unit Impulse Response of the System, Properties.

UNIT-IV

Applications of Random Process: Definition of Gaussian process, Properties, Band Pass Process, Narrow-Band Gaussian process, Property, Noise, Thermal noise, Filters, Poisson process, Probability law of Poisson process, Mean and Autocorrelation of the Poisson process, Properties of Poisson process, Markov process, Definition of a Markov chain and Transition Probabilities.

UNIT-V

Queueing Theory: Introduction-Queueing system-The arrival pattern-The service pattern-The queue discipline, Symbolic Representation of a Queueing Model –Characteristics of Infinite Capacity, Single server Poisson Queue Model Queueing problem-Pure Birth and Death Process-Probability Distribution of Departures(pure death process)-Basic queueing Models-Measures of the (M/M/1):$(\infty/FIFO)$ $model$-Characteristic of Finite Capacity, Single Server Poisson Queue Model III (M/M/1):$(N/FCFS)$ Model.

TEXT BOOKS

1. "Probability Statistics and Random Processess" by T Veerarajan,2nd Edition Tata McGraw-Hill.
2. "Fundamentals of Mathematical Statistics" by V.K.Kapoor & S.C.Gupta 11th revised Edition Sultan chand & Sons.

SUGGESTED READING:

1. "Stochastic Process and Queueing Theory" by Randolph Nelson 1995,Ist edition, Springer- verlag Newyork.

22ECC39

SYSTEMS AND SIGNAL PROCESSING
(Common to CSE and AI&DS)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of Differential and Integral Calculus.

COURSE OBJECTIVES: This course aims to

1. Know Signals and systems representation/classification and also the time and frequency domain analysis of continuous time signals with Fourier series, Fourier transforms and Laplace transforms.
2. Understand Sampling, time and frequency domain analysis of discrete time signals with DTFT, DFT and Z-Transforms.
3. Understand concepts of convolution integrals.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Classify signals, analyse the signals using Transform techniques.
2. Evaluate signal characteristics in frequency domain.
3. Assess the system stability and causality using ROC and Pole-Zero Plot.
4. Classify systems and analyse the signals using Transform techniques
5. Describe and analyse the DT Signal/systems using DFT, DCT, DWT, FFT and Z-Transform.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	3	3	2	3	-	-	-	-	-	-	-	1	-	-	-
CO 2	3	3	3	3	-	-	-	-	-	-	-	1	-	-	-
CO 3	3	3	3	3	-	-	-	-	-	-	-	1	-	-	-
CO 4	3	3	3	2	-	-	-	-	-	-	-	1	-	-	-
CO 5	3	2	1	2	-	-	-	-	-	-	-	1	-	-	-

UNIT-I

Continuous Time Signals: Introduction to signals, signal representations and classification.
Fourier Series: Exponential Fourier series, Amplitude and Phase spectra. Power Spectral Density.

UNIT-II

Fourier Transforms: Direct Fourier transforms, Inverse Fourier transforms, Existence, Frequency spectrum and properties of Fourier Transforms, FT of basic signals, Energy Spectral Density.

UNIT-III

Laplace Transforms: Laplace transforms. Region of convergence and its properties. Properties of Laplace transform, Inverse Laplace transform, Laplace transform of periodic signals.

UNIT-IV

Z–Transform: Direct Z-Transform, Region of convergence and its properties. Z–Transform properties. Inverse Z–Transform, Discrete Fourier Transform, Properties of Discrete Fourier Transform, FFT, DCT and DWT

UNIT-V

Continuous & Discrete Systems: Introduction to systems, System classifications-Linear, Causal, Stable, Time-invariant, Impulse response, System transfer function, Distortion less system, Non-linear systems- Filters

TEXT BOOKS:

1. B. P. Lathi, “Signals, Systems and Communications”, BS Publications, 3rd Edition, 2008.
2. Simon Haykin, “Signals and Systems”, Wiley India, 5th Edition,2009.

SUGGESTED READING:

1. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawad, “Signals and Systems”, PHI 2nd Edition, 2015.
2. M. J. Robert, “Fundamentals of signals and systems”, McGraw Hill, 2008.

22CSC14

DESIGN AND ANALYSIS OF ALGORITHMS

(Common to IT, AI&DS and CET)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Basics of Data structures and algorithms.

COURSE OBJECTIVES: This course aims to:

1. Provide an introduction to formalisms to understand, analyze and denote time complexities of algorithms.
2. Introduce the different algorithmic approaches for problem solving through numerous example problems.
3. Provide some theoretical grounding in terms of finding the lower bounds of algorithms and the NP-completeness.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Analyzing performance of algorithms using asymptotic notations.
2. Demonstrate familiarity with major algorithms and importance of algorithm design techniques.
3. Apply algorithm design techniques on different problems.
4. Analyze the efficiency of the algorithms.
5. Understanding limits of efficient computation with the help of complexity classes.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	3	3	2	2	2	1	-	-	-	-	-	-	1	2	2
CO 2	3	3	2	-	1	-	-	-	1	-	1	1	1	2	3
CO 3	3	2	2	2	2	-	-	-	1	-	1	-	1	2	3
CO 4	3	3	2	2	2	-	1	-	1	-	-	-	1	2	3
CO 5	3	2	2	2	2	1	1	-	1	-	-	-	1	2	3

UNIT-I

Introduction: Characteristics of algorithm. **Analysis of algorithm:** Asymptotic analysis of complexity bounds–best, average and worst-case behavior. Performance measurements of Algorithm, Time and space trade-offs. **Divide and Conquer:** The general method. **Analysis of recursive algorithms through recurrence relations:** Substitution method, Recursion tree method and Masters' theorem, Randomized Quicksort.

UNIT-II

Greedy Algorithms: The general method, Knapsack Problem, Huffman Codes, Job Scheduling with Deadlines. **Dynamic Programming**: The general method, 0/1 Knapsack, Travelling Salesman Problem, Matrix Chain Multiplication, Longest Common Subsequence, Optimal Binary Search Tree.

UNIT-III

Backtracking: The general Method, 8-Queens Problem, Graph Coloring, Hamiltonian Cycle. **Branch-and-Bound**: The general method, FIFO Branch and Bound, LC Branch and Bound, 0/1 Knapsack Problem, Travelling Salesperson problem.

UNIT-IV

Graph Algorithms: Applications of DFS: Bi-Connected components, Strongly Connected Components, Topological Sorting. **Shortest Path Algorithms**: Dijkstra's, Bellman-Ford, Floyd-Warshall and Johnson's algorithms. **Minimum Spanning Tree Algorithms**: Prims and Kruskal.

UNIT-V

Theory of NP-Completeness: Polynomial Time, Polynomial Time Verification, P, NP, NP-Hard and NP-Complete Classes, NP-Completeness and Reducibility. **Standard NP-Complete Problems and Reduction Techniques:** The Clique Problem, Vertex-Cover and Subset Sum Problem.

TEXT BOOKS:

1. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press/McGraw-Hill, 3rd Edition, 2009.
2. E. Horowitz, sartaj sahni and sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms",Universities Press, 2008.

SUGGESTED READING:

1. Michael T Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis", and Internet Examples, Wiley Second Edition.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/106101060/

22ADC01

FUNDAMENTALS OF MACHINE LEARNING

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to:
1. Impart knowledge on the basic concepts of machine learning.
2. Familiarize different machine learning techniques.
3. Learn various Classification and Regression algorithms.
4. Familiarize various Kernels, SVMs and Ensemble methods.
5. Facilitate Dimensionality Reduction and Clustering.

COURSE OUTCOMES: After the completion of this course, the student will be able to
1. Explain the types of machine learning and handle the challenges of machine learning.
2. Construct Decision Trees, Measure performance of classifiers.
3. Apply Regression, Logistic Regression and gradient descent to solve problems.
4. Design solutions using Bayesian classifier, SVMs and Ensemble methods.
5. Perform Dimensionality reduction and clustering of data.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	-	1	-	2	-	-	-	-	-	-	-	1	2	2	3
CO 2	1	1	1	1	-	-	-	-	-	-	-	1	2	3	3
CO 3	2	2	1	2	1	-	-	-	-	-	1	1	2	3	3
CO 4	2	2	1	2	1	-	-	-	-	-	1	1	2	3	3
CO 5	2	2	1	2	1	-	-	-	-	-	1	1	2	3	3

UNIT - I

The Machine Learning Landscape: What Is Machine Learning, Why Use Machine Learning, Examples of Applications, **Types of Machine Learning Systems:** Supervised/Unsupervised Learning, Batch and Online Learning, Instance-Based Versus Model-Based Learning, **Main Challenges of Machine Learning:** Insufficient Quantity of Training Data, Non representative Training Data, Poor-Quality Data, Irrelevant Features, Overfitting the Training Data, Under fitting the Training Data, Stepping Back, **Testing and Validation:** Hyper parameters Tuning and Model Selection , Data Mismatch.

UNIT - II

Classification: Training a Classifier, **Performance Measures:** Measuring Accuracy Using Cross-Validation, Confusion Matrix, Precision and Recall, Precision/Recall Trade-off, the ROC Curve, Multiclass Classification. **Decision Trees:** Training and Visualizing a Decision Tree, Making Predictions, Estimating Class Probabilities, The CART Training Algorithm, Computational Complexity, Gini Impurity or Entropy? Regularization Hyper parameters, Regression, Instability.

UNIT - III

Support Vector Machines: Linear SVM Classification, Soft Margin Classification, **Nonlinear SVM Classification:** Polynomial Kernel, Similarity Features, Gaussian RBF Kernel, Computational Complexity, SVM Regression, **Under the Hood:** Decision Function and Predictions, Training Objective, Kernelized SVMs. **Bayes Classification:** Maximum Posteriori, Bayes Belief Networks.

UNIT - IV

Regression: Linear Regression: The Normal Equation, Computational Complexity, **Gradient Descent:** Batch Gradient Descent, Stochastic Gradient Descent, Mini-batch Gradient Descent, Polynomial Regression, Learning Curves, **Regularized Linear Models:** Ridge Regression, Lasso Regression, Elastic Net, Early Stopping, **Logistic Regression:** Estimating Probabilities, Training and Cost Function, Decision Boundaries, Softmax Regression.

UNIT - V

Dimensionality Reduction: The Curse of Dimensionality, PCA, Randomized PCA, Incremental PCA, Kernel PCA, LLE. **Unsupervised Learning Techniques: Clustering:** K-Means, Limits of K-Means, Using Clustering for Image Segmentation, DBSCAN, Other Clustering Algorithms, Gaussian Mixtures. **Ensemble Learning and Random Forests:** Voting Classifiers, Bagging and Pasting, Random Patches and Random Subspaces, Random Forests, Boosting.

TEXT BOOKS:

1. Aurelien Geron, “Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow”- Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd edition, O’Reilly,2019

SUGGESTED READING:

1. Tom Mitchel, “Machine Learning”, Tata McGraW Hill, 2017.
2. Stephen Marshland, “Machine Learning: An Algorithmic Perspective”, CRC Press Taylor & Francis, 2nd Edition, 2015

WEB RESOURCES:

1. https://www.coursera.org/specializations/machine-learning

22MBC01

ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to:

1. Demonstrate the importance of Managerial Economics in Decision Making.
2. Explain the concept of Accountancy and provide basic knowledge on preparation of Final accounts.
3. Understand the importance of Project Evaluation in achieving a firm's Objective.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Apply fundamental knowledge of Managerial Economics concepts and tools.
2. Analyze various aspects of Demand Analysis, Supply and Demand Forecasting.
3. Understand Production and Cost relationships to make best use of resources available.
4. Apply Accountancy Concepts and Conventions and preparation of Final Accounts.
5. Evaluate Capital and Capital Budgeting decision based on any technique.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	1	1	3	1	1	1	1	1	1	1	-	-	-	-	-
CO 2	2	2	2	2	-	1	1	1	-	1	-	1	**1**	-	**1**
CO 3	1	2	1	2	2	-	2	1	-	1	-	-	-	-	**1**
CO 4	2	2	1	2	2	1	1	3	-	1	-	-	-	-	**1**
CO 5	1	3	1	2	1	1	2	-	-	1	2	1	-	-	**1**

UNIT - I

Introduction to Managerial Economics: Introduction to Economics and its evolution - Managerial Economics - its Nature and Scope, Importance; Relationship with other Subjects. Its usefulness to Engineers; Basic concepts of Managerial economics - Incremental, Time perspective, Discounting Principle, Opportunity Cost, Equimarginal Principle, Contribution, Negotiation Principle.

UNIT - II

Demand and Supply Analysis: Demand Analysis - Concept of Demand, Determinants, Law of demand - Assumptions and Exceptions; Elasticity of demand - Price, Income and Cross elasticity - simple numerical problems; Concept of Supply - Determinants of Supply, Law of Supply; Demand Forecasting - Methods.

UNIT - III

Production and Cost Analysis: Theory of Production - Production function - Isoquants and Isocosts, MRTS, Input-Output Relations; Laws of returns.

Cost Analysis: Cost concepts – Types of Costs, Cost-Output Relationship – Short Run and Long Run; Market structures – Types of Competition, Features of Perfect Competition, Price Output Determination under Perfect Competition, Features of Monopoly Competition, Price Output Determination under Monopoly Competition Break-even Analysis – Concepts, Assumptions, Limitations, Numerical problems.

Unit - IV

Accountancy: Book-keeping, Principles and Significance of Double Entry Bookkeeping, Accounting Concepts and Conventions, Accounting Cycle, Journalization, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments.

Unit - V Capital and Capital Budgeting: Capital and its Significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising finance. Capital Budgeting, Methods: Traditional and Discounted Cash Flow Methods - Numerical problems.

TEXT BOOKS:

1. Mehta P.L.,"Managerial Economics: Analysis, Problems and Cases", Sultan Chand & Son's Educational publishers, 2016.
2. Maheswari S.N. "Introduction to Accountancy", Vikas Publishing House, 12th Edition, 2018.

SUGGESTED READINGS:

1. Panday I.M. "Financial Management", 11th edition, Vikas Publishing House, 2016.
2. Varshney and K L Maheswari, Managerial Economics, Sultan Chand, 2014.
3. M. Kasi Reddy and S. Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of India Pvt Ltd, 2007.
4. A. R. Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2018.

22CEM01

ENVIRONMENTAL SCIENCE (MANDATORY COURSE)

Instruction	2 L Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
CIE	-
Credits	0

COURSE OBJECTIVES: This course aims to

1. To equip the students with inputs on the environment, natural resources and their conservation.
2. To study the interrelationship between the living organisms and the natural environment and also to enable the students to understand the structure and functioning of the ecosystems. To understand the importance of biodiversity and create awareness on its threats and conservation strategies.
3. To enable the students become aware of pollution of various environmental segments including their causes, effects, and control measures. To create awareness about environmental legislations in the context of national conventions.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Identify the natural resources and realise the importance of water, food, forest, mineral, energy, land resources and effects of over utilisation.
2. Understand the concept of ecosystems and realise the importance of interlinking of food chains.
3. Contribute for the conservation of bio-diversity.
4. Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
5. Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	1	-	-	-	-	-	3	-	-	-	-	1	-	-	-
CO 2	1	-	-	-	-	-	2	1	-	-	-	1	-	-	-
CO 3	1	-	-	-	-	-	2	1	-	-	-	1	-	-	-
CO 4	1	-	-	-	-	1	2	1	-	-	-	1	-	-	-
CO 5	1	-	-	-	-	1	2	1	-	-	-	1	-	-	-

UNIT- I

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT – II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

UNIT – III

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT – IV

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards

UNIT – V

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

TEXT BOOKS:

1. Y. Anjaneyulu, "Introduction to Environmental Science", B S Publications, 2004.
2. Suresh K. Dhameja, "Environmental Studies", S. K. Kataria& Sons, 2009.

SUGGESTED READING:

1. C. S. Rao," Environmental Pollution Control Engineering", Wiley, 1991.
2. S. S. Dara, "A Text Book of Environmental Chemistry &Pollution Control", S. Chand Limited, 2006

22ADE01

DATA ANALYSIS AND VISUALIZATION
(Professional Elective – I)
(Common to IT and AI&DS)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to:

1. Introduce the Numpy library in Python to support storage and operations on large multi-dimensionalarrays and matrices
2. Introduce large collection of mathematical functions to operate on multidimensional sequential data structures
3. Demonstrate the functionality of the Pandas library in Python for open source data analysis and manipulation
4. Demonstrate Data Aggregation, Grouping and Time Series analysis with Pandas
5. Introduce the Matplotlib library in Python for resting static, animated and interactive visualizations

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Use Numpy library utilities for various numerical operations.
2. Apply pandas library functions for handling data frames.
3. Perform various preprocessing operations on datasets using Pandas Series and DataFrame objects.
4. Analyze the given dataset and derive conclusions using inferential statistics.
5. Apply 2-D and 3-D plotting techniques on datasets using matplotlib and seaborn

CO-PO Articulation Matrix

PO/PSO CO	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	PSO 3
CO 1	2	-	-	-	-	-	-	-	-	-	-	3	-	-	2
CO 2	3	2	-	1	1	-	-	-	-	-	-	3	-	-	2
CO 3	3	1	-	3	1	-	-	-	-	1	-	3	3	3	3
CO 4	3	2	1	3	1	-	-	-	-	3	-	3	3	3	3
CO 5	2	2	-	2	1	-	-	-	-	3	-	3	2	-	2

UNIT - I

Introduction to Numpy: Data types in Python - Fixed type arrays, creating arrays, array indexing, array slicing, reshaping arrays, array concatenation and splitting, Universal Functions, Aggregations, Broadcasting rules, Comparisons, Boolean Arrays, Masks Fancy Indexing, Fast Sorting using np.sort and np.argsort, partial sorting Creating Structured Arrays, Compound types and Record Arrays.

UNIT - II

Introduction to Pandas: Series Object, DataFrame Object, Data Indexing and Selecting for Series and DataFrames, Universal Functions for Index Preservation, Index Alignment and Operations between Series and DataFrames, Handling missing data, operating on Null values, Hierarchical Indexing.

UNIT - III

Combining Datasets: Concat, Append, Merge and Joins, Aggregation and Grouping, Pivot Tables, Vectorized String Operations, Working with Time Series, High-Performance functions - query() and eval()

UNIT – IV

Inferential Statistics - Normal distribution, Poisson distribution, Bernoulli distribution, z-score, p-score, One-tailed and two-tailed, Type 1 and Type-2 errors, Confidence interval, Correlation, Z-test vs T-test, F- distribution, Chi-square distribution, the chi-square test of independence, ANOVA, data mining, titanic survivors dataset analysis

UNIT - V

Visualization with Matplotlib : Simple Line plots, Scatter plots, Visualizing errors, Density and Contour plots, Histograms, Binnings, Multiple subplots, Three-dimensional plotting with Matplotlib, Geographic data with Basemap, Visualization with Seaborn.

TEXT BOOKS:

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media, 2016.
2. Samir Madhavan, "Mastering Python for Data Science", Packt Publishing, 2015.

WEB RESOURCES:

1. https://www.coursera.org/learn/python-data-analysis?specialization=data-science-python
2. https://www.coursera.org/learn/python-plotting

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instruction of III Semester of B.E. - Artificial Intelligence and Data Science as per AICTE Model Curriculum with effect from 2021-22

DEPARTMENT OF INFORMATION TECHNOLOGY

SEMESTER - III

S. No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	20ECC34	DC Circuits, Sensors and Transducers	3	-	3	40	60	3
2	20MTC09	Probability and Statistics	3/1	-	3	40	60	4
3	20ITC08	Database Management Systems	3	-	3	40	60	3
4	20ADC01	Java Programming	3	-	3	40	60	3
5	20ITC05	Digital Logic and Computer Architecture	3	-	3	40	60	3
6	20EGM01	Indian Constitution and Fundamental Principles	2	-	2	-	50	NC
7	20EGM02	Indian Traditional Knowledge	2	-	2	-	50	NC
PRACTICALS								
8	20ITC10	DBMS Lab	-	2	3	50	50	1
9	20ADC02	Java Programming Lab	-	2	3	50	50	1
10	20ADC03	Artificial Intelligence & Machine Learning Tools, Techniques and Applications	-	2	3	50	50	1
11	20ITC12	Mini Project - I	-	2	-	50	-	1
12	20ADI01	MOOCs/Training/Internship	2-3 Weeks/ 90 Hours		-	-	-	2
TOTAL			**20**	**8**		**400**	**550**	**22**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE – Continuous Internal Evaluation SEE - Semester End Examination

20ECC34 **DC CIRCUITS, SENSORS AND TRANSDUCERS**

BE (AI&DS)

Instruction	3 L Hours per Week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Concepts of Semiconductor Physics and Applied Physics.

Course Objectives:

1. Understand DC circuit theory for sensors and transducers.
2. Describe semiconductor device's principles and understand the characteristics of junction diode and transistors.
3. Understand working principles of Oscillators, Sensors, and Transducers.
4. Understand Interfacing of various modules of DAQ with myDAQ and myRIO

Course Outcomes:

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

1. Understand about the basics of lower power systems, DC circuits.
2. Use semiconductor devices in making circuits like rectifiers, filters, regulators, etc.
3. Design transistorized circuits of amplifiers and oscillators
4. Acquire the data from various sensors and transducers with the help of DAQ.
5. Analyze usage of sensors/transducer for the development of real-time applications.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	2	3	2	3	2	3	2	1	-	1
CO2	3	3	3	2	1	2	3	2	3	2	3	2	-	-	1
CO3	3	2	3	2	3	3	3	2	3	2	3	2	-	1	1
CO4	3	3	3	3	3	3	3	2	3	2	3	2	1	1	1
CO5	3	3	3	3	3	3	3	2	3	2	3	2	2	2	1

UNIT-I

DC Circuit theory: Basic DC theory, Voltage and Current relationship, Power in Electronics and its calculation, Types of Current - Direct Current (DC) and Alternating Current (AC), DC Voltage, Conventional Current Flow vs. Electron Flow. Measurement of DC current and power in a circuit, Parallel and Series circuits, Batteries and alternative sources of energies.

UNIT-II

Introduction to semiconductor: Characteristics of P-N Junction diode, current equation. Characteristics of Zener Diode

Applications: Zener Diode as a voltage regulator, Half Wave Rectifier and Full Wave Rectifier

Introduction to Transistors: Classification, Bipolar Junction Transistors Configurations.

UNIT-III

Feedback Circuits: Principles of Negative Feedback Amplifiers, Advantages, Types, Topologies of negative feedback, Outline the Effect of negative feedback on Gain, Input Impedance and Output Impedance; Principle of Oscillator, Operation of LC Type- Hartley, Colpitts; RC phase shift Oscillator.

Op-Amps Circuits: Basic Principle, Ideal and practical Characteristics and Applications: Summer, Integrator, and Differentiator.

UNIT-IV

Sensors: Definition, classification of sensors

Proximity Sensors: Eddy current proximity sensors and its Applications, Inductive proximity switch and its Applications

Velocity, motion, force and pressure sensors: Tachogenerator, Optical encoders, Strain Gauge as force Sensor, Fluid pressure: Tactile sensors
Temperature and light sensors: Resistance Temperature detectors, Photo Diodes, Applications of Photo Diodes.

UNIT-V
Transducers: Definition, classification of Transducers
Mechanical Transducers: Displacement-to-Pressure, Seismic Displacement Transducers
Passive Electrical Transducers: LVDT, Resistor Moisture Transducer
Active Electrical Transducers: Hall Effect Transducer, Piezoelectric transducer
Data Acquisition methods: myDAQ, MyRIO-1900 Architecture, myDAQ Interfacing: Interfacing LED's, Seven segment display, temperature sensors, IR Sensors, Range Finder sensors, Motors, motor driver interfaces, Thermistors, Buzzers.

Text Books:

1. John Bird, Electrical Circuit Theory and Technology, Fifth Edition, 2014.
2. Robert L. Boylestad, Louis Nashelsky, "Electronic Devices and Circuits Theory", Pearson Education, 9th edition, LPE, Reprinted, 2006.
3. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
4. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
5. Ed Doering, NI myRIO Project Essentials Guide, Feb.2016

Suggested Reading:

1. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.
2. Anindya Nag, Subhas Chandra Mukhopadhyay, Jurgen Kosel ,Printed Flexible Sensors: Fabrication, Characterization and Implementation, Springer International Publishing, Year: 2019, ISBN: 978-3-030-13764-9,978-3-030-13765-6
3. User guide, NI myDAQ
4. User guide and specifications NI myRIO-1900

20MTC09 **PROBABILITY AND STATISTICS**

Instruction	3 L+1T Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Course Objectives:

1. Able to learn and Analyzing data in Linear and Non-Linear form.
2. Able to fit the hypothetical data using probability distribution.
3. Understand the data using the testing of Hypothesis.
4. Able to Analyzing time series data using trend analysis.
5. Able to formulate and get the solution of real world problem.

Course Outcomes:

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

1. Use the principle of Least Squares approximating for estimating the value.
2. Use the basic probability for fitting the Random phenomenon.
3. Analyzing data using different methods of hypothesis testing.
4. Use the Moving Averages Methods for trend analysis.
5. Analyze the random phenomena of real world data.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	-	-	-	1	-	-	1	-	1	1
CO2	2	2	-	-	-	-	-	-	1	-	-	1	-	1	1
CO3	2	2	-	-	-	-	-	-	1	-	-	1	-	1	1
CO4	2	2	2	-	-	-	-	-	1	-	-	1	-	1	1
CO5	2	2	2	-	-	-	-	-	1	-	-	1	-	1	1

UNIT-I: Curve Fitting

Measures of Central Tendency, Measures of Dispersion, Moments (Moments about the mean and moments about a point). Skewness, Karl Pearson's coefficient of skewness and Bowley's coefficient of skewness for frequency distribution, Kurtosis. Curve fitting by the Method of Least Squares, Fitting of Straight lines, Second degree parabola and Growth curve ($y = ae^{bx}$, $y = ax^b and y = ab^x$).

UNIT-II: Discrete Probability Distribution

Basic Probability, Conditional Probability, Baye's theorem. Random variable, discrete random variable, Probability Mass Function, continuous random variable, probability density function. Mathematical expectation, properties of Expectation, properties of variance and co-variance. Poisson distribution, MGF and Cumulates of the Poisson distribution, Recurrence formula for the probabilities of Poisson distribution (Fitting of Poisson distribution).

UNIT-III: Continuous Probability Distribution

Normal distribution, Characteristics of normal distribution and Normal probability Curve, MGF and CGF of Normal distribution, Areas under normal curve. Uniform distribution, moment generating function, mean and variance of uniform distribution. Gamma distribution, MGF, CGF, Mean and Variance of Gamma distribution. Exponential distribution, MGF, CGF, Mean and Variance of Exponential distribution.

UNIT-IV: Large and Small Sample Tests

Tests of significance, tests of significance for large samples. Tests of significance for single proportion, and difference of proportions. Tests of significance for single mean and difference of means. Tests of significance of differences of standard deviations. Small sample test, t-test for single mean and differences of Means. F-test for equality of two population variances. Chi-Square test of goodness of fit and test of independent of attributes.

UNIT-V: Time Series Analysis and Analysis of Variance

One way classification-Assumptions for ANOVA Test-ANOVA for fixed effect model-Two way classification-ANOVA for fixed effect model-Components of Time series-Measurement of Trend- Method of semi Averages-Moving Averages Method (3 Years and 5 Years).

Text Books:

1. S.C.Gupta, V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.
2. S.C.Gupta, V.K.Kapoor, "Fundamentals of **Applied** Statistics", Sultan Chand and Sons, 2014.

Suggested Reading:

1. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, 3rd Ed., Wiley, 1968.
2. Sheldon Ross, "A First Course in Probability", 9th Edition, Pearson publications, 2014.

20ITC08 **DATABASE MANAGEMENT SYSTEMS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce the fundamental concepts and the role of a database system in an organization
2. To acquire knowledge on Data base design models, constraints and notations.
3. To familiarize with querying databases using SQL.
4. To acquaint with design and implementation issues of a database system.
5. To discuss the concepts of database security, concurrency and recoverability.

Course Outcomes:

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

1. Understand the purpose of database systems and design any domain specific database using E-R model.
2. Design and implement a database using Relational data model, formulate Relational algebra expressions. Use SQL for efficient data retrieval queries.
3. Access databases from high level languages, define triggers and apply normalization.
4. Understand the concepts of database transactions, locking protocols, concurrency control, backup and recovery.
5. Efficiently organize and manage data using indexing and hashing.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	1	1	-	-	-	1	1	1	1	3	-	2
CO2	2	1	2	1	2	-	-	-	-	-	1	-	2	-	2
CO3	2	1	2	2	1	-	-	-	-	-	-	-	2	-	2
CO4	2	1	1	1	1	-	-	-	-	-	-	1	2	-	2
CO5	2	1	1	1	1	-	-	-	-	-	-	1	3	-	2

UNIT-I

Introduction: Database-System Applications, Purpose of Database Systems, View of Data, Database Languages, Database Design, Database Engine, Database and Application Architecture, Database Users and Administrators and History of Database Systems.

Database Design Using the E-R Model: Overview of the Design Process, The Entity- Relationship Model, Complex Attributes, Mapping Cardinalities, Primary Key, Removing Redundant Attributes in Entity Sets, Reducing E-R Diagrams to Relational Schemas, Extended E-R Features and Entity-Relationship Design Issues,

UNIT-II

Introduction to the Relational Model: Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages and The Relational Algebra.

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: Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schemas, Index Definition in SQL and Authorization.

UNIT-III

Advanced SQL: Accessing SQL from a Programming Language, Functions and Procedures, Triggers, Recursive Queries, Advanced Aggregation Features.

Relational Database Design: Features of Good Relational Designs, Decomposition using Functional Dependencies, Normal Forms, Functional-Dependency Theory, Algorithms for Decomposition Using Functional Dependencies, More Normal Forms, Atomic Domains and First Normal Form, Database-Design

Process.

UNIT-IV

Transactions: Transaction Concept, a Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity.

Concurrency Control: Lock-Based Protocols, Deadlock Handling, Multiple Granularity, Timestamp-Based Protocols and Validation-Based Protocols.

UNIT-V

Recovery System: Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management and ARIES.

Indexing and Hashing: Basic Concepts, Ordered Indices, B+ -Tree Index Files, Hash Indices, Multiple-Key Access, Creation of Indices and Bitmap Indices.

Text Book:

1. Abraham Silberschatz, Henry F Korth, S. Sudarshan, "Database System Concepts", 7th Edition, McGraw-Hill International Edition, 2020.

Suggested Reading:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database System", 6th Ed, Add-Wes, 2011.
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 3rd Ed, Mc GH Intl 2014.
3. Rick F Vander Lans, "Introduction to SQL", 4th Ed, Pearson Education, 2007.
4. Benjamin Rosenzweig, Elena Silvestrova, "Oracle PL/SQL by Example", 5th Ed, Pearson Ed, 2015.

Web Resources:

1. http://db-book.com/
2. https://www.tutorialspoint.com/dbms/
3. https://www.w3schools.in/dbms/
4. http://www.oracle-dba-online.com/sql/oracle_sql_tutorial.htm.
5. http://www.tutorialspoint.com/plsq

20ADC01 **JAVA PROGRAMMING**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To familiarize with fundamentals of object-oriented programming paradigm.
2. To impart the knowledge of string handling, interfaces, packages and inner classes.
3. To acquaint with Exception handling mechanisms and Multithreading.
4. To gain knowledge on collection framework, stream classes.
5. To familiarize with the concept of Regular Expressions and new features introduced in java Version 8

Course Outcomes:

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

1. Understand object-oriented concepts.
2. Create Java applications using best OOP practices e.g. Inheritance, interfaces, packages, and inner classes.
3. Implement the concepts of Exception Handling and Multi-threading.
4. Develop applications using Collections framework and handle files.
5. Use Regular expression and java 8 concepts in application development

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	1	-	-	-	1	-	-	1	2	3	-
CO2	2	1	1	-	1	-	-	-	-	-	-	1	1	3	-
CO3	2	2	1	-	-	-	-	-	-	-	2	2	2	3	2
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	3	3
CO5	2	1	-	-	-	-	-	-	1	-	-	2	2	3	3

UNIT-I

Introduction to Java: Objects, Classes, structure a java program, difference between jdk and jre, Java Primitive Types, Basic Operators, Conditional and Logical statements. Defining Classes: Adding Instance Fields and Methods, Constructors, Access Modifiers (Visibility Modes), Object Creation Examples, Method Overloading and Constructor Overloading, Use of static and final keywords, Objects as parameters, Difference between local variable and instance field, importance of Object class.

UNIT–II

Inheritance, Interfaces and Packages in Java: Defining super / sub classes, Abstract classes, Method overriding, Interfaces and new features in latest version. Packages: Defining, Creating and Accessing a Package, importing packages.

Arrays, Strings in Java: How to create and define arrays, Introduction to java. util. Array class, Difference between String &String Buffer classes, StringTokenizer class and Wrapper classes and conversion between Objects and primitives, Autoboxing and unboxing

Inner classes in Java: Types of inner classes, Creating static / non-static inner classes, Local and anonymous inner classes.

UNIT–III

Exception Handling in Java: What are exceptions, Error vs. Exception, usage of try, catch, throw throws and finally clauses, writing your own exception classes, Difference between checked vs. unchecked Exceptions.

Generics: Need of Generics concept, Generic classes, bounded types, Generic methods and interfaces.

Multithreading in Java: The java Thread Model, How to create threads, Thread class in java, Thread priorities, Inter thread communication, Thread synchronization

UNIT–IV

Collections: Overview of Java Collection Framework, Collection Interfaces – Collection, Set, List, Map, Commonly used Collection classes – ArrayList, LinkedList, HashSet, TreeSet, HashMap, TreeMap, legacy and class, Iteration over Collections – Iterator and ListIterator, Enumeration interfaces, differentiate Comparable and Comparator

File Handling: Stream classes, Reader and Writer classes, File and Directory class, How to read user input from keyboard.

UNIT-V

Regular Expression : Introduction, Application areas of Regular Expression, Pattern class**,** Matcher class, Important methods of Matcher class, Character classes, Predefined character classes, Quantifiers, Pattern class split() method, String class split() method.

Java 8 new Features: Collections and Java Stream, Functional Interfaces in Java 8 Stream, Converting Java Stream to Collection or Array, Java Stream Intermediate Operations, Terminal Operations, Functional Interfaces, Lambda Expressions.

Text Books:

1. Herbert Schildt, "Java: The Complete Reference", 11th Ed, Tata McGraw Hill Publications, 2020.
2. Cay S. Horstmann, Gary Cornell, "Core Java, Volume I-Fundamentals", 8th Ed, Prentice Hall, 2008.

Suggested Reading:

1. Sachin Malhotra, Saurabh Choudhary, "Programming in Java", OUP, 2nd Ed, 2014.
2. C.Thomas Wu, "An Introduction to Object-Oriented Programming with Java", Tata Mc GH, 4th Ed, 2010.

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html
2. https://nptel.ac.in/courses/106106147/2
3. https://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-092-introduction-to-programming-in-java-january-iap-2010/ lecture-notes/

20ITC05 DIGITAL LOGIC AND COMPUTER ARCHITECTURE

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To familiarize with logic gates, combinational and Sequential logic circuits.
2. To provide understanding of Data representation.
3. To present the operation of the Central Processing Unit.
4. To facilitate with the techniques that computers use to communicate with input and output devices.
5. To introduce the concept of memory hierarchy and memory management.

Course Outcomes:

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

1. Understand simplification of logic gates, fundamentals of combinational and sequential logic gates.
2. Design of registers, counters and representation of data using numbers.
3. Understand the architecture and functionality of central processing unit.
4. Discuss the techniques that computers use to communicate with I/O devices for data transfer.
5. Comprehend memory hierarchy, cache memory and virtual memory.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	1	-	-	-	1	-	-	1	2	-	3
CO2	2	1	1	-	1	-	-	-	-	-	-	1	1	-	3
CO3	2	2	1	-	-	-	-	-	-	-	2	2	-	-	3
CO4	2	1	-	-	-	-	-	-	-	-	-	2	-	-	3
CO5	2	2	1	-	-	-	1	-	1	-	2	2	1	-	3

UNIT-I

Digital Logic Circuits: Digital Computers, Logic Gates, Boolean Algebra, Map simplification, Product –of-sums Simplification, Don't –Care Conditions, Combinational Circuits, Half-Adder, Full–Adder, Flip-Flops: SR, D , JK, T Flip- Flops, Edge triggered Flip-Flops, Excitation Tables.

UNIT-II

Digital Components: Integrated circuits, Decoders. Encoders, Multiplexers

Registers: Register with Parallel load, Shift Register, Counters.

Data Representation: Data Types, Number Systems, Octal and Hexa decimal Numbers, Decimal Representation, Complements: (r-1)'s Complement's Complement, Subtraction of Unsigned Numbers, Fixed–Point Representation, Floating –Point Representation.

UNIT-III

Central Processing Unit: Computer Registers, General register Organization, Instruction Cycle, Instruction Formats: Three Address Instructions, Two-Address Instructions, One-Address Instructions,Zero-AddressInstructions,RISCInstructions,AddressingModes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer(RISC):CISC Characteristics, RISC Characteristics, Multicore Processors and their Performance.

UNIT-IV

Input-Output Organization: Peripheral Devices: ASCII Alphanumeric Characters, Input-output Interface: I/O Bus and Interface Modules, Asynchronous Data Transfer: Strobe Control, Handshaking, Asynchronous Communication Interface,First-In-First-OutBuffer,ModesofTransfer:Interrupt-InitiatedI/O, Priority Interrupt:

Daisy Chaining Priority, Parallel Priority Interrupt, Priority Encoder, Direct Memory Access(DMA): DMA Controller.

UNIT-V

Memory Organization: Memory Hierarchy, Main Memory: RAM and ROM Chips, Memory Address Map, Memory Connection to CPU, Auxiliary memory: Magnetic Disks, solid state drive and Linear Tape Open Technology, Associative Memory: Hardware Organization, MatchLogic,ReadandWriteOperations,CacheMemory:AssociativeMapping, Direct Mapping, Set-Associative Mapping, Virtual Memory: Address Space and Memory Space, Address Mapping using Pages, Associative Memory Page Table, Page Replacement.

Text Books:

1. M.MorrisMano,"ComputerSystemArchitecture",3rdEdition,Pearson Education, 2016.
2. John L. Hennessy, David A. Patterson Morgan Kaufman, "Computer Architecture - A Quantitative Approach", 5th edition,, Elsevier,2012
3. William Stallings, "Computer Organization and Architecture", 9th edition, Pearson Education, 2013

Suggested Reading:

1. Stephen Brown, ZvonkoVranesic,"FundamentalsofDigitalLogicwithVHDLdesign",2nd Edition, McGrawHill,2009.
2. ZVI Kohavi, "Switching and Finite Automata Theory", 2nd Edition, TataMcGrawHill,1995.
3. William Stallings, "Computer Organization and Architecture", 8thEdition, PHI.
4. CarlHamachar,Vranesic,Zaky,"ComputerOrganization",5thEdition, McGraw Hill.

Web Resources:

1. https://nptel.ac.in/courses/117106114Week1%20Slides1.1Introduction.pdf
2. https://ece.gmu.edu/coursewebpages/ECE/ECE545/F10/viewgraphs/ECE545_lecture1_digital_logic_review.ppt
3. http://www.nptelvideos.in/2012/11/computer-organization.html

20EGM01 **INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES**

(BE/ B.Tech. III/IV Semester - Common to all branches)

Instruction	2 L Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
Credits	No Credits

Course Objectives:

The course will introduce the students to:

1. History of Indian Constitution and how it reflects the social, political and economic perspectives of the Indian society.
2. Growth of Indian opinion regarding modern Indian intellectual's constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Various Organs of Governance and Local Administration.

Course Outcomes:

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

1. Understand the making of the Indian Constitution, its features and learn the importance of Directive Principles of State Policy.
2. Identify the difference between Right to Equality and Right to Freedom and know the relevance of Fundamental Duties.
3. Analyze the structuring of the Indian Union, distribution of powers between the Union and the States, and the role and position of President in Union Government.
4. Distinguish between the LokSabha and RajyaSabha in law making process while appreciating the importance of Judiciary in interpretation of law and protection of citizens' rights.
5. Differentiate between the Municipalities and Panchayats in their functioning and know the role of Collector in district administration.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	1	1	-	1	-	-	-	-	-	-
CO2	-	-	-	-	-	1	1	1	1	-	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	1	1	1	-	-	-	-	1	-	-
CO5	-	-	-	-	-	1	1	1	1	-	-	-	1	-	-

UNIT-I

Constitution of India: Constitutional history-Govt of India Act 1909, 1919 and 1935, Constitution making and salient features. Directive Principles of State Policy - Its importance and implementation.

UNIT-II

Scheme of the Fundamental Rights & Duties: The Fundamental Rights - Right to Equality, Right to Freedom under Article 19, Right to Life and Personal Liberty Under Article 21.
Fundamental Duties - the legal status.

UNIT-III

Union Government and its Administration - Structure of the Indian Union, Federalism: distribution of legislative and financial powers between the Union and the States.
Parliamentary form of government in India: Union Executive-President's power, role and position.
Emergency Provisions: National, Constitutional and Financial Emergencies.

UNIT-IV

Union **Legislature and Judiciary:** Union Legislature-Parliament: LokSabha and RajyaSabha, functions of Parliament and Parliamentary Committees.

Union Judiciary: Supreme Court-Functions, Judicial Review and Judicial Activism

UNIT-V

Local Self Government - District's Administration Head (Collector): Role and Importance.
Municipalities: Introduction, Chairman/Mayor and Role of Elected Representatives, Commissioner of Municipality/Municipal Corporation.
Panchayati Raj: Zilla Panchayat-Elected Representatives and their roles, CEO of Zilla Panchayat: Position and Role. Block level: Organizational Hierarchy (Different departments). Village level: Role of Elected and Officials.

Text Books:

1. Indian Government & Politics, Ed. Prof V Ravindra Sastry, Telugu Academy, 2nd Edition, 2018.
2. Indian Constitution at Work, NCERT, First edition 2006, Reprinted- January 2020.

Suggested Reading:

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.

Web Resource:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

20EGM02 **INDIAN TRADITIONAL KNOWELDGE**

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	-

Prerequisite: Knowledge on Indian Culture

Course Objectives:

1. To get a knowledge in Indian Culture
2. To Know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India

Course Outcomes:

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

1. Understand philosophy of Indian culture
2. Distinguish the Indian languages and literature
3. Learn the philosophy of ancient, medieval and modern India
4. Acquire the information about the fine arts in India
5. Know the contribution of scientists of different eras.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	-	-	1	-	--	-	-	-	-	-	-	-
CO2	-	1	1	-	-	1	1	1	-	-	-	-	1	-	-
CO3	-	1	-	-	-	-	-	--	-	1	-	-		-	-
CO4	1	1	1	-	-	1	-	--	-	-	-	-	1	-	-
CO5	1	1	1	1	-	-	-	--	-	-	-	1	1	-	-

UNIT-I

Culture and Civilization: Culture, civilization and heritage, general characteristics of culture, importance of culture in human life, Cultural diversity, Aesthetics, Women seers, Indus culture, Indian cuisine, Martial arts

UNIT-II

Education System: Education in ancient, medieval and modern India, aims of education, subjects, Languages, Science and Scientists of ancient, medieval and modern India

UNIT-III

Linguistic Wealth: Indian Languages and Literature: the role of Sanskrit, Paleography, Significance of scriptures to current society, Indian semantics and lexicography, Bhakti literature, Darsanas

UNIT-IV

Art, Technology & Engineering: Sculpture, Painting and Handicrafts, Indian Music, Dance Drama and Theatre, Introduction to Mayamatam, Iron and steel technology, Use of metals in medicinal preparations

UNIT-V

Science and Logic: Helio-centic system, Sulbasutras, Katapayadi, Hindu calendar, 6 pramanas in Indian logic, Scientific method applied to therapeutics, Fallacies, Tarka – Induction &Deduction, Ayurvedic biology, Definition of health

Essential Readings:

1. Kapil Kapoor, **Text and Interpretation: The Indian Tradition,** ISBN: 81246033375, 2005
2. Samskrita Bharati, **Science in Samskrit**, ISBN-13: 978-8187276333, 2007
3. Satya Prakash, **Founders of sciences in Ancient Indi**a, Govindram Hasan and, ISBN-10: 8170770009, 1989
4. Brajendranath Seal, **The Positive Sciences of the Ancient Hindus**, Motilal Banarasi dass, ISBN-10: 8120809254, 1915.
5. KanchaIlaiah, Turning the Pot, Tilling the Land: Dignity of Labour in Our Times

Suggested Reading:

1. Swami Vivekananda, Caste, Culture and Socialism, Advaita Ashrama, Kolkata ISBN-9788175050280
2. Swami Lokeswarananda, Religion and Culture, Advaita Ashrama, Kolkata ISBN-9788185843384
3. Kapil Kapoor, Language, Linguistics and Literature: The Indian Perspective, ISBN-10: 8171880649, 1994.
4. Karan Singh, A Treasury of Indian Wisdom: An Anthology of Spiritual Learn, ISBN: 978-0143426158, 2016
5. Swami Vivekananda, The East and the West, AdvaitaAshrama, Kolkata 9788185301860
6. Srivastava R.N., Studies in Languages and Linguistics, Kalinga Publications ISBN-13: 978-8185163475
7. SubhashKak and T.R.N. Rao, Computation in Ancient India, Mount Meru Publishing ISBN-1988207126
8. R.N Misra, Outlines of Indian Arts Architecture, Painting, Sculpture, Dance and Drama, IIAS, Shimla & Aryan Books International, ISBN 8173055149
9. S. Narain, Examinations in ancient India, Arya Book Depot, 1993
10. M. Hiriyanna, Essentials of Indian Philosophy, Motilal Banarsidass Publishers, ISBN-13: 978-8120810990, 2014
11. Ravi Prakash Arya, Engineering and Technology in Ancient India, Indian Foundation for Vedic Science, ISBN-10: 1947593072020
12. Shashi Tharoor, The Hindu Way
13. Amartya Sen, Argumentative Indian

SWAYAM / NPTEL:

History of Indian Science and Technology - https://onlinecourses.swayam2.ac.in/arp20_ap35/preview
Introduction to Ancient Indian Technology – https://onlinecourses.nptel.ac.in/noc19_ae07/preview
Indian Culture & Heritage - https://onlinecourses.swayam2.ac.in/nos21_sc11/preview
Language and Society - https://nptel.ac.in/courses/109/106/109106091/
Science, Technology & Society - https://nptel.ac.in/courses/109/103/109103024/
Introduction to Indian Philosophy - https://nptel.ac.in/courses/109/106/109106059/
Introduction to Indian Art - An appreciation - https://onlinecourses.nptel.ac.in/noc20_hs09/preview

20ITC10 DATABASE MANAGEMENT SYSTEMS LAB

Instruction	2 Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To introduce the basic commands of SQL.
2. To familiarize with query writing.
3. To impart knowledge on triggers, procedures and triggers.
4. To introduce exception handling in PL/SQL.
5. To familiarize with design and development of database applications

Course Outcomes:

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

1. Design and implement database schemas by enforcing integrity constraints.
2. Use SQL for database administration, data manipulation and retrieval.
3. Develop PL/SQL programs and use cursors for the databases.
4. Design triggers for database validation.
5. Handle Exceptions in PL/SQL programs.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	2	-	-	-	3	1	1	-	3	-	2
CO2	1	1	-	-	1	-	-	-	-	-	-	-	-	-	2
CO3	2	1	2	2	1	-	-	-	1	1	-	-	1	-	2
CO4	2	2	2	2	1	-	-	-	1	1	-	-	3	-	2
CO5	2	2	2	2	1	-	-	-	1	1	-	-	2	-	2

List of Programs

1. Creation of database (Exercising commands like DDL and DML)
   (Note: use constraints while creating tables).
2. Exercising Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING clause and Creation and dropping of Views.
3. Exercising Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION INTERSECT Constructs.
4. Exercising all types of Joins.
5. Demonstration of PL/SQL Blocks and Cursors.
6. Demonstration of Procedures and Functions.
7. Usage of Triggers (BEFORE and AFTER Triggers, Row and Statement level Triggers and INSTEAD OF Triggers).
8. Demonstrate Exception Handling by PL/SQL procedures for data validation.
9. Creation of Forms and Generation of SQL reports.
10. Creation of full-fledged database application spreading over to 3 sessions.

Text Books:

1. Rick F Vander Lans, "Introduction to SQL", 4th Edition, Pearson Education, 2007.
2. Benjamin Rosenzweig, Elena Silvestrova, "Oracle PL/SQL by Example", 5th Edition, Pearson Education, 2015.
3. Alan Beaulieu, "Learning SQL", 2nd Edition, O'Reilly, 2009.

Suggested Reading:

1. Albert Lulushi, "Oracle Forms Developer's Handbook", Pearson Education, 2006.

Web Resources:

1. http://www.oracle-dba-online.com/sql/oracle_sql_tutorial.htm
2. https://www.javatpoint.com/pl-sql-tutorial

20ADC02 **JAVA PROGRAMMING LAB**

Instruction	2 Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To gain the fundamental programming knowledge of OOPs.
2. To use Exception handling mechanisms in application development.
3. To provide the knowledge of generics and Collections Framework.
4. To understand the Java.io package
5. To provide the knowledge in Regular Expressions and Java 8 Streams

Course Outcomes:

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

1. Develop Java applications using the concepts of Inheritance, interfaces, packages and access control modifiers.
2. Implement the concepts of Exception Handling and Multithreading in java Applications
3. Read and write data using different Java I/O streams.
4. Develop applications using Collections framework.
5. Validate inputs using regular expression and apply the knowledge of Java 8 new features in application Development.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	1	-	-	-	-	-	-	1	-	-	1	3	-
CO2	-	2	1	1	-	-	-	-	-	-	-	-	1	3	-
CO3	-	2	1	1	-	-	-	-	-	-	-	-	2	3	3
CO4	-	2	1	1	-	-	-	-	-	-	-	-	1	3	-
CO5	-	2	1	2	3	-	-	-	-	-	-	-	2	3	3

List of Programs

1. Program(s) to illustrate the concepts of constructor overloading, method overloading, static and final keywords usage.
2. Program(s) to illustrate the concepts of Inheritance, method overriding, super key word usage and Dynamic polymorphism.
3. Program(s) to illustrate concept of Abstract Class and Interface.
4. Program(s) to demonstrate String handling with String, String Buffer and String Tokenizer classes.
5. Program(s) to demonstrate various types of inner classes, Packages creation and usage.
6. Program(s) to demonstrate concept of exception handling and user defined exceptions.
7. Program(s) to demonstrate concept of Multithreading and Thread synchronization.
8. Program(s) using Generics, Collection framework classes and Interfaces.
9. Programs(s) on Comparator, Comparable interfaces to define Customized sorting order on collection objects
10. Program(s) to illustrate the usage of I/O streams.
11. Program(s) to demonstrate the use of Regular expressions
12. Program(s) on Java 8 stream concepts
13. Programs(s) on usage of java 8 function programming features.

Text Books:

1. Herbert Schildt, "Java: The Complete Reference", 11th Ed, Tata McGraw Hill Publications, 2020.
2. Cay S. Horstmann, Gary Cornell: "Core Java, Vol I-Fundamentals",8thEd,PrenticeHall,2008.

Suggested Reading:

1. Sachin Malhotra, Saurabh Chaudhary: "Programming in Java" , Oxford University Press,2nd Ed,2014.
2. C.Thomas Wu, "An Introduction to Object-Oriented Programming with Java", Tata McGH 4th Ed, 2010.

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html
2. https://nptel.ac.in/courses/106106147/2
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-092-introduction-to-programming-in-java-january-iap-2010/ lecture-notes/

20ADC03 ARTIFICIAL INTELLIGENCE & MACHINE LEARNING TOOLS, TECHNIQUES AND APPLICATIONS

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. To introduce fundamental concepts in AI
2. To demonstrate simple AI applications using Natural Language Processing, Audio engineering & Speech
3. To demonstrate simple AI applications using Computer Vision, pattern recognition and machine learning.
4. To present various modeling and formulation techniques to solve problems using AI techniques.
5. To introduce state-of-art AI tools and techniques to solve problems faced by Engineers in design and analysis.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Understand the importance of AI.
2. Understand concepts of Machine Learning algorithms and their limitations.
3. Develop Chatbots based on the requirements.
4. Analyse complex problems involving image processing, such as quality control, visual surveillance, multimodal human-machine interfaces, and image compression.
5. Understand the application of Reinforcement Learning.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	2	-	2	-	3	2
CO2	-	2	-	1	-	-	1	1	-	2	-	2	-	3	2
CO3	1	3	2	2	3	-	1	1	-	1	-	2	3	3	3
CO4	3	3	2	3	3	-	1	1	-	1	-	3	3	3	3
CO5	1	1	1	1	-	-	1	1	-	2	-	2	-	3	3

List of Programs

1. **Overview of AI, AI project lifecycle**
   a. Design/Construct the workflow of a general AI project using draw.io
2. **Teachable Machine** - To introduce Machine Learning Models, Computer Vision, Natural Language Processing
   a. Train a Machine Learning model to recognize a Person or Object including gestures
   b. Train a Machine Learning model to recognize various sound bites
   c. Train a Machine Learning model to recognize speech
3. **AI with App Inventor** - To introduce Image Classification, Audio Classification, Facial Recognition, Reinforcement Learning(Markov Models)
   a. Develop an app to recognize objects using Image Classification
   b. Train a Machine Learning model to identify different facial expressions using webcam
   c. Develop an Expression Match app using the trained ML model for facial expressions
   d. Develop a Voice Authentication app that uses a trained audio model of the user using audio classification to recognize the user's voice to authenticate.
   e. Develop a Rock-Paper-Scissors game that uses Reinforcement Learning (Markov Models) to learn from the patterns in the user's game choices
4. **Amazon Lex** - To introduce Automatic Speech Recognition(Speech to Text), Natural Language Understanding(intent of text), Conversational AI agents
   a. Develop a conversational Chabot to automatically recognize speech, understand the intent of the user and generate a response accordingly using Amazon Lex

5. **Wolfram Technology Framework -** To introduce Supervised Learning(Classification, Prediction, Sequence Prediction), Unsupervised Learning(Feature Extraction, Clustering), Neural Networks, Model Deployment
    a. Design a program using the Wolfram Language to Classify Data(Numbers, Images, Colors) using automatic model selection.
    b. Design a program using the Wolfram Language to predict the price of a house from a housing prices dataset using Regression.
    c. Design a program using the Wolfram Language to demonstrate Vector Encoding based Feature Extraction and Clustering for a dog image dataset.
    d. Construct a neural network from an image dataset and explore the hidden layers along with their outputs using the Wolfram Language

Web Resources:

1. https://teachablemachine.withgoogle.com/v1/
2. https://appinventor.mit.edu/explore/ai-with-mit-app-inventor
3. https://aws.amazon.com/lex/
4. https://www.wolfram.com/wolfram-u/machine-learning-zero-to-AI-60-minutes/
5. https://www.coursera.org/learn/ai-for-everyone

20ITC12 **MINI PROJECT –I**

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. To enable students learning by doing.
2. To develop capability to analyse and solve real world problems.
3. To inculcate innovative ideas of the students.
4. To impart team building and management skills among students.
5. To instill writing and presentation skills for completing the project.

Course Outcomes:

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

1. Interpret literature with the purpose of formulating a project proposal.
2. Plan, Analyse, Design and Implement a project.
3. Find the solution of identified problem with the help of modern Technology and give priority to real time scenarios.
4. Plan to work as a team and to focus on getting a working project done and submit a report within a stipulated period of time.
5. Prepare and submit the Report and deliver presentation before the Departmental Committee.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	3	2	1	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	2	1	2	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	-	2	3	3	3	3	3
CO4	2	2	2	3	3	3	3	2	3	3	2	3	2	3	3
CO5	1	2	1	2	3	3	-	-	2	3	-	-	-	3	-

The Students are required to choose a topic for mini project related to the courses of the current semester or previous semester. The student has to implement and present the project as per the given schedule. During the implementation of the project, Personnel Software Process (PSP) has to be followed. Report of the project work has to be submitted for evaluation.

Schedule

S No	Description	Duration
1.	Problem Identification / Selection	2 weeks
2.	Preparation of Abstract	1 week
3.	Design, Implementation and Testing of the Project	7 weeks
4.	Documentation and Project Presentation	4 weeks

Guidelines for the Award of Marks

S No	Description	Max. Marks
1.	Weekly Assessment	20
2.	PPT Preparation	5
3.	Presentation	10
4.	Question and Answers	5

5.	Report Preparation	10

Final Mini Project demonstration and PPT presentation is to be evaluated for the entire class together by all the faculty handling Mini Project for that class.

20ADI01

MOOCS / TRAINING / INTERNSHIP

Instruction/Demonstration/Training	3-4 Weeks/90 Hours
Duration of Semester End Presentation	--
Semester End Evaluation	60 Marks
Mid Term Evaluation	40 Marks
Credits	2

Prerequisite: Knowledge of basic Sciences

MOOCs/Training/Internship Objectives:
This MOOCs/Training/Internship aims to:

1.
2.
3.

MOOCs/Training/Internship Outcomes:
Upon completion of this MOOCs/Training/Internship, students will be able to:

1.
2.
3.
4.
5.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

Refer Internship Policy Document

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instruction of IV Semester of B.E. - Artificial Intelligence and Data Science as per AICTE Model Curriculum with effect from 2021-22

DEPARTMENT OF INFORMATION TECHNOLOGY

SEMESTER - IV

S.No	Course code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	20MTC10	Stochastic Process and Queueing Theory	3	-	3	40	60	3
2	20ITC06	Discrete Mathematics and Applications	3	-	3	40	60	3
3	20ITC15	Design and Analysis of Algorithms	3	-	3	40	60	3
4	20ADC 04	Machine Learning	3	-	3	40	60	3
5		Professional Elective – I	3	-	3	40	60	3
6	20MBC01	Engineering Economics and Accountancy	3	-	3	40	60	3
7	20CEM01	Environmental Science	2	-	2	-	50	NC
PRACTICALS								
8	20MTC11	Stochastic Process and Queueing Theory Lab	-	2	3	50	50	1
9	20ITC17	Design and Analysis of Algorithms Lab	-	2	3	50	50	1
10	20ADC 05	Machine Learning Lab	-	2	3	50	50	1
11	20ITC18	Mini Project – II	-	2	-	50	-	1
TOTAL			**21**	**8**	-	**440**	**560**	**22**

L:Lecture **T: Tutorial** **P: Practical**
CIE – Continuous Internal Evaluation **SEE - Semester End Examination**

Professional Elective #1	Image Processing 20ITE01	Data Analysis and Visualization 20ADE01	Mobile Application Development with Android and Kotlin 20ITE02	Fundamentals of Cryptography 20ITE03	Theory of Automata 20ADE02	Data Warehousing and Data Mining 20ITE04

20MTC10 **STOCHASTIC PROCESS AND QUEUEING THEORY**

Instruction	3 L Hours per week
Duration of Semester End Examination	3Hours
Semester End Examination	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Able to learn methods to solve bivariate probability functions.
2. Able to know characterizing the random process.
3. Able to identify the tools for interpretating the random process
4. Able to know the statistical techniques for random process
5. Able to analyse the queuing model's

Course outcomes: On successful completion of this course the students shall be able to

1. Estimate the marginal probabilities of statistical averages
2. Distinguish the random process of auto correlation and cross correlation
3. Characterize the random process of ensemble averages
4. Analyze the effect the thermal noise in the system
5. Analyze the queuing behavior of different queuing models.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	-	-	-	-	1	-	-	-	-	1	1
CO2	2	2	-	-	-	-	-	-	1	-	-	-	-	1	1
CO3	2	2	-	-	-	-	-	-	1	-	-	-	1	1	1
CO4	2	2	2	-	-	-	-	-	1	-	-	-	1	1	1
CO5	2	2	2	-	1	-	-	-	1	-	-	-	1	1	1

UNIT-I: Two-Dimensional Random Variables

Two-dimensional or Joint Probability Mass Function, Two-dimensional Distribution Function, Marginal Distribution Functions, Joint Density Function, Marginal Density Function, The Conditional Distribution Function and Conditional Probability Density Function, Stochastic Independence, Generalization of n dimensional random variable, transformation of One-dimensional Random variable, transformation of Two- dimensional random variable.

UNIT-II: Random Processes

Classification of Random Processes, Methods of Description of a Random Process, Special classes of Random Processes, Average values of Random Processes, Stationarity, Strict Strong Stationary process, Analytical Representation of a Random process, Autocorrelation Function and Its properties of R(t),Cross-Correlation Function and its Properties wide sense stationary process.

UNIT-III: Discrete Time Process

Ergodicity, Mean-Ergodic Process, Mean Ergodic Theorem, Correlation Ergodic Process, Distribution Ergodic Process, Power Spectral density function, Properties of power spectral Density function, Properties of Power Spectral Density Function, System in the Form of Convolution, Unit Impulse Response of the System, Properties.

UNIT-IV: Applications of Random Process

Definition of Gaussian process, Properties, Bank Pass Process, Narrow-Bank Gaussian process, Property, Noise, Thermal noise, Filters, Poisson process, Probability law of Poisson process, Mean and Autocorrelation of the Poisson process, Properties of Poisson process, Markow process, Definition of a Markov chain.

UNIT-V: Queueing Theory

Introduction-Queueing system-The arrival pattern-The service pattern-The queue discipline, Symbolic

Representation of a Queueing Model –Characteristics of Infinite Capacity, Single server Poisson Queue Model Queueing problem-Pure Birth and Death Process-Probability Distribution of Departures(pure death process)-Basic queueing Models-Measures of the (M/M/1):$(\infty/FIFO)$ $model$-Characteristic of Finite Capacity, Single Server Poisson Queue Model III (M/M/1):$(N/FCFS)$ Model.

Text Books:

1. "Probability Statistics and Random Processes" by T Veerarajan,2nd Edition Tata McGraw-Hill
2. "Fundamentals of Mathematical Statistics" by V.K. Kapoor & S.C. Gupta 11th revised Edition Sultan Chand & Sons

Suggested Reading:

1. "Stochastic Process and Queueing Theory" by Randolph Nelson 1995, Ist edition, Springer-verlag New York.

20ITC06 **DISCRETE MATHEMATICS AND APPLICATIONS**

Instruction	3Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce Propositional Logic, Proof strategy concepts and gain knowledge in Sets and Functions.
2. To acquire knowledge in Induction, Recursion and Number theory applications.
3. To gain knowledge in Counting, Permutations, Combinations and Solving recurrence relations.
4. To introduce basic concepts of graphs, digraphs and relations and their properties.
5. To familiarize with Algebraic Structures.

Course Outcomes:

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

1. Symbolize the given sentence using propositional logic and apply the onto and one-to-one functions between the sets.
2. Understand the mathematical induction and apply the modular arithmetic for cryptography and congruence applications.
3. Apply permutations and combinations to handle different types of objects, understand solving homogeneous and Non-homogeneous recurrence using generating functions.
4. Apply relations and graph concepts for basic problem solving.
5. Demonstrate Algebraic systems and their Properties.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	2	3	-	-	1	1	1	3	3	3
CO2	3	3	2	3	1	2	-	-	-	1	-	1	3	3	3
CO3	3	3	3	3	1	2	2	-	-	1	1	1	3	3	3
CO4	3	3	2	3	1	2	3	-	-	1	-	1	3	3	3
CO5	3	3	2	3	-	2	-	-	-	1	-	1	3	3	3

UNIT-I

The Foundations: Logic and Proofs: Propositional Logic, Applications of Propositional Logic, Propositional Equivalences, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy

Basic Structures: Sets, Functions, Sequences, Sums, and Matrices: Sets, Set Operations, Functions, Sequences and Summations, Cardinality of Sets, Matrices

UNIT-II

Number Theory and Cryptography: Divisibility and Modular Arithmetic, Integer Representations and Algorithms, Primes and Greatest Common Divisors, Solving Congruences, Applications of Congruences, Cryptography.

Induction and Recursion: Mathematical Induction, Strong Induction and Well-Ordering, Recursive Definitions and Structural Induction, Recursive Algorithms.

UNIT-III

Counting: The Basics of Counting, The Pigeonhole Principle, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Generating Permutations and Combinations.

Advanced Counting Techniques: Applications of Recurrence Relations, Solving Linear Recurrence Relations, Divide-and-Conquer Algorithms and Recurrence Relations, Generating Functions, Inclusion–Exclusion,

Applications of Inclusion–Exclusion

UNIT-IV

Relations: Relations and Their Properties, *n*-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Partial Orderings.

Graphs: Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Coloring.

UNIT-V

Algebraic Structures: Algebraic Systems: Examples and General Properties, Semi groups and Monoids.

Groups: Definitions and Examples, Subgroups, Homomorphism's and cyclic groups.

Text Books:

1. Kenneth H Rosen, "Discrete Mathematics and its applications", 8th Edition, McGraw Hill, 2019.
2. R.K. Bishit, H.S. Dhami, "Discrete Mathematics", Oxford University Press, 2015.

Suggested Reading:

1. J.P. Trembly, R. Manohar, "Discrete Mathematical Structure with Application to Computer Science", McGraw- Hill, 1997.
2. J. K. Sharma, "Discrete Mathematics", 2nd Edition, Macmillan, 2005.
3. Joel Mott, Abraham Kandel, T.P. Baker, "Discrete Mathematics for Computer Scientist &Mathematicians", 2nd Edition, Macmillan Prentice Hall.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc20_cs37/
2. https://www.coursera.org/learn/discrete-mathematics

20ITC15 **DESIGN AND ANALYSIS OF ALGORITHMS**

Instruction	3 Hours per Week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To analyse the performance of various algorithms.
2. To illustrate different paradigms of problem solving.
3. To learn about various algorithm design techniques and illustrates them using a number of well-known problems and applications.
4. To familiarize graph traversal and search techniques.
5. To discuss NP hard and NP complete problems and their applications.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Analyze best, average and worst case complexities of algorithms and choose appropriate data structure for designing algorithm.
2. Develop solutions using Divide and Conquer, Greedy techniques.
3. Design algorithms using dynamic programming approach, apply traversal and search techniques.
4. Apply backtracking, branch and bound techniques to solve problems.
5. Identify P, NP, NP-Complete and NP-Hard classes to which an algorithm belongs and design a feasible solution.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	2	2	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	2	2	3	3
CO3	3	3	2	2	-	-	-	-	-	-	2	2	2	-	3
CO4	3	3	2	2	-	-	-	-	-	-	-	2	2	-	3
CO5	3	3	2	2	-	-	-	-	-	-	-	2	2	3	3

UNIT-I

Introduction: Algorithm Specification, Performance analysis: Space Complexity, Time Complexity, Asymptotic Notation (O, Omega, Theta), Searching and Sorting techniques-Performance Measurement.

Elementary Data Structures: Complexity measures for the Data Structures - Stacks and Queues, Trees, Hashing/Dictionaries, Priority Queues, Sets and Disjoint Set Union.

UNIT-II

Divide and Conquer: The general method, Binary Search, Finding the Maximum and Minimum, Merge Sort, Quick Sort, Strassen's Matrix Multiplication.

Greedy Method: The General Method, Knapsack Problem, Job Sequencing with Deadlines, Minimum Cost Spanning Trees, Optimal Storage on Tapes, Optimal Merge Patterns, Single Source Shortest Paths.

UNIT-III

Dynamic Programming: The General Method, Multistage graphs, All Pair Shortest Paths, Single Source Shortest Paths, Optimal Binary Search Trees, -/1 Knapsack, Reliability Design, The Traveling Salesperson Problem.

Traversal and Search Techniques: Breadth First Search and Traversal, Depth First Search and Traversal, Connected Components and Spanning Trees, Biconnected Components and DFS.

UNIT-IV

Backtracking: The General Method, 8-Queens Problem, Graph Colouring, Hamilton cycles, Knapsack

Problem.
Branch and Bounds: The Method: Least Cost (LC) Search, The 15 puzzle, FIFO Branch and Bound, LC Branch and Bound, -/1 Knapsack Problem, Traveling Salesperson Problem.

UNIT-V
NP-Hard and NP-Complete Problems: Basic Concepts: Non-Deterministic Algorithms, the Classes NP Hard and NP Complete. Cook's theorem, NP-Hard Graph Problems: Node Cover Decision Problem, Chromatic Number Decision Problem, Directed Hamiltonian Cycle, Traveling Salesperson Decision Problem, NP Hard Scheduling Problems: Job Shop Scheduling.

Text Books:
1. Ellis Horowitz, Sartaj Sahani, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithm, 2nd Edition", Universities Press, 2011.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India Private Limited, 2006.

Suggested Reading:
1. Levitin A, "Introduction to the Design and Analysis of Algorithms", Pearson Education, 2008.
2. Aho, Hopcroft, Ullman, "The Design and Analysis of Computer Algorithm", Pearson Education, 2000.
3. Parag H. Dave, Himanshu B. Dave, "Design and Analysis of Algorithms", 2nd Edition, Pearson Education, 2014.

Web Resources:
1. http://nptel.ac.in/courses/106101060
2. http://nptel.ac.in/courses

20ADC04 **MACHINE LEARNING**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce machine learning concepts and models.
2. To familiarize with tree models and unsupervised learning.
3. To impart knowledge of dimensionality reduction and clustering techniques.
4. To learn the concepts of rule based models and kernel methods
5. To introduce the concept of neural network and ensemble methods.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Understand basic concepts of machine learning models.
2. Apply tree models, perform classification and regression tasks.
3. Understand rule based learning and linear models.
4. Apply distance based and probabilistic models for clustering and classification of data.
5. Design and develop a neural network, use dimensionality reduction techniques, ensemble methods.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	-	-	-	-	-	1	-	-	-	3	3
CO2	3	2	1	3	-	-	-	-	-	-	-	-	-	3	3
CO3	3	2	1	3	1	-	-	-	-	-	-	-	-	3	3
CO4	3	2	1	3	1	-	-	-	-	-	-	-	2	3	3
CO5	3	2	1	3	1	-	-	-	-	-	-	-	2	3	3

UNIT-I

Introduction: What Is Machine Learning, Examples of Machine Learning Applications. **Machine learning Models**: Geometric Models, Logical Models, Probabilistic Models. **Features**: Feature types, Feature Construction and Transformation, Feature Selection.

UNIT-II

Binary Classification: Introduction to classification, Scoring and Ranking, Class probability Estimation.
Beyond Binary Classification: Multi Class Classification, Regression, Unsupervised and Descriptive Learning.
Tree Models: Decision trees, Ranking and probability estimation trees, Tree learning as variance reduction.

UNIT-III

Rule Models: Learning ordered and unordered rule sets, Descriptive rule learning, First-order rule learning.
Linear Models: Least Squares method, Perceptron, Support Vector Machines, Soft Margin SVM, Kernel methods for non-Linearity.

UNIT-IV

Distance Based Models: Neighbours and Examples, Nearest Neighbours Classification, Distance based clustering-K means Algorithm, Hierarchical clustering, from kernels to distances. **Probabilistic Models:** the normal distribution and its geometric interpretations, Probabilistic models for categorical data, Discriminative learning by optimising conditional likelihood, Probabilistic models with hidden variables: Expectation-Maximisation.

UNIT- V

Model Ensembles: Bagging and random forests, Boosting, Bias, Variance and Margin. **Multilayer Perceptron:** Introduction, Neural Networks as a Paradigm for Parallel Processing, The Perceptron, Training a Perceptron, Learning Boolean Functions, Multilayer Perceptrons, MLP as a Universal Approximator, Back propagation Algorithm, Training Procedures, Tuning the Network Size, Bayesian View of Learning, Dimensionality Reduction, Learning Time.

Text Books:

1. Peter Flach "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, Edition 2012.
2. Ethem Alpaydin, "Introduction to Machine Learning", PHI, 2nd Edition, 2013.

Suggested Reading:

1. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer 1st Edition-2013

Web Resource:

1. https://www.coursera.org/specializations/machine-learning

20MBC01 **ENGINEERING ECONOMICS AND ACCOUNTANCY**

Instruction	3 Hours per Week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To demonstrate the importance of Managerial Economics in Decision Making.
2. To explain the concept of Accountancy and provide basic knowledge on preparation of Final accounts.
3. To understand the importance of Project Evaluation in achieving a firm's Objective.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Apply fundamental knowledge of Managerial Economics concepts and tools.
2. Analyze various aspects of Demand Analysis, Supply and Demand Forecasting.
3. Understand Production and Cost relationships to make best use of resources available.
4. Apply Accountancy Concepts and Conventions and preparation of Final Accounts.
5. Evaluate Capital and Capital Budgeting decision based on any technique.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	1	1	1	1	1	1	1	-	-	1	-	1
CO2	2	2	2	2	-	1	1	1	-	1	-	1	1	-	-
CO3	1	2	1	2	2	-	2	1	-	1	-	-	1	-	-
CO4	2	2	1	2	2	1	1	3	-	1	-	-	-	-	-
CO5	1	3	1	2	1	1	2	-	-	1	2	1	-	-	-

UNIT-I: Introduction to Managerial Economics

Introduction to Economics and its evolution - Managerial Economics - its Nature and Scope, Importance; Relationship with other Subjects. Its usefulness to Engineers; Basic concepts of Managerial economics - Incremental, Time perspective, Discounting Principle, Opportunity Cost, Equimarginal Principle, Contribution, Negotiation Principle.

UNIT-II: Demand and Supply Analysis

Demand Analysis - Concept of Demand, Determinants, Law of demand - Assumptions and Exceptions; Elasticity of demand - Price, Income and Cross elasticity - simple numerical problems; Concept of Supply - Determinants of Supply, Law of Supply; Demand Forecasting - Methods.

UNIT-III: Production and Cost Analysis

Theory of Production - Production function - Isoquants and Isocosts, MRTS, Input-Output Relations; Laws of returns; Internal and External Economies of Scale.

Cost Analysis: Cost concepts – Types of Costs, Cost-Output Relationship – Short Run and Long Run; Market structures – Types of Competition, Features, Price Output Determination under Perfect Competition, Monopoly and Monopolistic Competition; Break-even Analysis – Concepts, Assumptions, Limitations, Numerical problems.

UNIT-IV: Accountancy

Book-keeping, Principles and Significance of Double Entry Book Keeping, Accounting Concepts and Conventions, Accounting Cycle, Journalization, Subsidiary books, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments. Ratio Analysis.

UNIT-V: Capital and Capital Budgeting

Capital and its Significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising finance. Capital Budgeting, Methods: Traditional and Discounted Cash Flow Methods - Numerical problems.

Text Books:

1. Mehta P.L., "Managerial Economics: Analysis, Problems and Cases", Sultan Chand & Son's Educational publishers, 2016.
2. Maheswari S.N. "Introduction to Accountancy", Vikas Publishing House, 11th Edition, 2013.

Suggested Reading:

1. Panday I.M. "Financial Management", 11th edition, Vikas Publishing House, 2015.
2. Varshney and K L Maheswari, Managerial Economics, Sultan Chand, 2014.
3. M. Kasi Reddy and S. Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of India Pvt Ltd, 2007.
4. A. R. Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2013.

20CEM01 ENVIRONMENTAL SCIENCE (MANDATORY COURSE)

Instruction	2 L Hours per week
Duration of Semester End Examination	2 Hours
SEE	50 Marks
Credits	No Credits

Course Objectives:

1. Identify environmental problems arising due to over utilization of natural resources and understand the importance of use of renewable energy sources
2. Become aware about the importance of eco system and interlinking of food chain.
3. Identify the importance of biodiversity in maintaining ecological balance.
4. Learn about various attributes of pollution management and waste management practices.
5. Contribute for capacity building of nation for arresting and/or managing environmental disasters.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Identify the natural resources and realise the importance of water, food, forest, mineral, energy, land resources and affects of over utilisation.
2. Understand the concept of ecosystems and realise the importance of interlinking of food chains.
3. Contribute for the conservation of bio-diversity.
4. Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
5. Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	3	-	-	-	-	1	1	-	-
CO2	1	-	-	-	-	-	2	1	-	-	-	1	1	-	-
CO3	1	-	-	-	-	-	2	1	-	-	-	1	1	-	-
CO4	1	-	-	-	-	1	2	1	-	-	-	1	1	-	-
CO5	1	-	-	-	-	1	2	1	-	-	-	1	2	-	-

UNIT-I

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT–II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

UNIT–III

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT–IV

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards

UNIT–V

Social Issues and the Environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

Text Books:

1. Y. Anjaneyulu, "Introduction to Environmental Science", B S Publications, 2004.
2. Suresh K. Dhameja, "Environmental Studies", S. K. Kataria& Sons, 2009.

Suggested Reading:

1. C. S. Rao," Environmental Pollution Control Engineering", Wiley, 1991.
2. S. S. Dara, "A Text Book of Environmental Chemistry & Pollution Control", S. Chand Limited, 2006

20MTC11 **STOCHASTIC PROCESS AND QUEUEING THEORY (LAB)**

(For AI&DS)

Instruction	2 L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. Able to learn methods to solve problems related probability functions.
2. Able to know characterizing a random phenomenon.
3. Able to identify the tools for interpreting the bivariate data
4. Able to know the statistical techniques to study random process
5. Able to analyze the queueing models

Course Outcomes:

On successful completion of this course the students shall be able to

1. Interpret the plots of statistical averages
2. Compute the measures of variation for stochastic data
3. Characterize the bivariate probability distribution of averages
4. Analyze the probabilities using probability functions.
5. Analyze the queuing behavior of different queuing models.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	0	-	0	0	0	0	0	-	0	1	0	1	1
CO2	1	2	0	-	0	0	0	0	0	-	0	1	0	1	1
CO3	1	2	0	-	0	0	0	0	0	-	0	1	0	0	1
CO4	1	2	0	-	0	0	0	0	0	-	0	1	0	1	1
CO5	1	2	0	-	0	0	0	0	0	-	0	1	0	1	1

List of Experiments

1. Write a Program to create Graphs and Charts
2. Write a Program to calculate measures of Central Tendency for the data
3. Write a Program to compute Standard Deviation for the data
4. Write a Program for Correlation and Covariance using Pearson method
5. Write a Program for calculating marginal functions for bivariate probability distribution
6. Write a program for calculating Conditional Probability function for bivariate probability Distribution
7. Write a Program to compute probabilities using Poisson Distribution
8. Write a Program to compute probabilities using Normal Distribution
9. Write a program to compute probabilities using Exponential Distribution
10. Write a Program for plotting Bivariate Gaussian Function
11. Write a Program for Creating a Queueing Model

Text Books:

1. S.R.Mani Sekhar, Dr. T.V. Suresh Kumar, “Programming with R” CENGAGE Publishers, 2017.
2. K.G.Srinivasa, G.M.Siddesh, “Statistical Programming in R”, Oxford University Press, 2017.
3. Jared P Lander, “R for Everyone” Pearson.2018.
4. http://www.cyclismo.org/tutorial/R/

20ITC17 **DESIGN AND ANALYSIS OF ALGORITHMS LAB**

Instruction	2 L Hours per Week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To introduce Divide and Conquer algorithmic strategy.
2. To familiarize Greedy Algorithms.
3. To introduce Dynamic programming algorithms.
4. To gain knowledge of connected and biconnected components.
5. To introduce Backtracking technique.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Implement Divide and Conquer Algorithms.
2. Build solutions using Greedy technique.
3. Apply Dynamic programming algorithms to solve problems.
4. Implement connected and biconnected components algorithms.
5. Design solutions using Backtracking technique.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	-	-	-	2	2	3	3
CO2	3	3	2	2	1	-	-	-	-	-	-	2	2	3	3
CO3	3	3	2	2	1	-	-	-	-	-	2	2	2	-	3
CO4	3	3	2	2	1	-	-	-	-	-	-	2	2	-	3
CO5	3	3	2	2	1	-	-	-	-	-	-	2	2	3	3

List of Programs

1. Implement Binary Search Tree Operations.
2. Find Maximum and Minimum elements from a given list of elements using Divide and Conquer technique.
3. Implement Merge sort algorithm for sorting a list of integers in ascending order.
4. Implement greedy algorithm for job sequencing with deadlines.
5. Implement Prim's algorithm to generate minimum cost spanning tree.
6. Implement Kruskal's algorithm to generate minimum cost spanning tree.
7. Implement Dijkstra's algorithm for the Single source shortest path problem.
8. Implement Dynamic Programming algorithm for the -/1 Knapsack problem.
9. Implement Dynamic Programming algorithm for the Optimal Binary Search Tree Problem.
10. Check whether given graph having connected components or not.
11. To find articulation points of a given graph..
12. Implement backtracking algorithm for the N-queens problem.
13. Implement backtracking algorithm for the Hamiltonian Cycle problem.
14. Implement backtracking algorithm for the Graph Coloring problem.
15. Implement Least Cost Branch and Bound for the -/1 Knapsack problem

Note: All the programs can be implemented using Java Programming.

Text Books:

1. Ellis Horowitz, Sartaj Sahani, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithm", 2nd Edition, Universities Press, 2011.

2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India Private Limited, 2006.

Suggested Reading:

1. Levitin A, "Introduction to the Design And Analysis of Algorithms", Pearson Education, 2008.
2. Goodrich M.T, R Tomassia, "Algorithm Design foundations Analysis and Internet Examples", John Wiley and Sons, 2006.
3. Base Sara, Allen Van Gelder,"Computer Algorithms Introduction to Design and Analysis", Pearson, 3rd Edition, 1999.

Web Resources:

1. http://www.personal.kent.edu/~rmuhamma/Algorithms/algorithm.html
2. http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=IntroToAlgorithms
3. http://nptel.ac.in/courses/ 106101060
4. http://www.facweb.iitkgp.ernet.in/~sourav/daa.html

20ADC05 **MACHINE LEARNING LAB**

Instruction	2 L Hours per week
CIE	50 Marks
SEE	50 Marks
Credits	1

Course Objectives:

1. To introduce the concept of decision tree for supervised learning.
2. To familiarize with bayesian decision theory and probabilistic methods.
3. To impart knowledge of dimensionality reduction and clustering techniques.
4. To introduce the concept of neural network and SVM.
5. To familiarize with ensemble methods.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Build decision trees for classification.
2. Perform dimensionality reduction of a dataset.
3. Apply distance based models for clustering and classification of data.
4. Design and build neural networks.
5. Build solutions using SVM, ensemble methods.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	-	-	-	-	1	-	-	2	3	3
CO2	3	3	1	3	2	-	-	-	-	-	-	-	2	3	3
CO3	3	2	1	3	2	-	-	-	-	-	-	-	2	3	3
CO4	3	3	1	3	2	-	-	-	-	-	-	-	2	3	3
CO5	3	3	1	3	2	-	-	-	-	-	-	-	2	3	3

List of Programs

1. Build a decision tree algorithm for classification on a given data set.
2. Implement naïve Bayesian classifier and Compute its accuracy on test data set.
3. Construct a Bayesian network using standard Heart Disease Data Set to diagnosis heart patients.
4. Implement Support Vector Machine for linear and nonlinear data.
5. Build a Neural Network by implementing the Back propagation algorithm.
6. Implement k-Nearest Neighbour algorithm to classify the iris data set.
7. Apply EM algorithm, k-Means algorithm to cluster a given data and compare the quality these clusters.
8. Implement Linear and Logistic Regression algorithms.
9. Implement Bagging and Boosting methods.
10. Implement Principle Component Analysis.

Note: Students are supposed to implement the algorithms in Java/Python/R.

Text Books:

1. Aurelien Geron,"Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow", O'Reilly Media, Second Edition 2019.
2. Peter Flach: Machine Learning: "The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, Edition 2012.

.

Suggested Reading:

1. Ethem Alpaydin, "Introduction to Machine Learning", PHI 2nd Edition-2013.

Datasets:

1. https://www.kaggle.com/datasets

2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007

Web Resources:

1. https://www.coursera.org/specializations/machine-learning

20ITC18 **MINI PROJECT –II**

Instruction	2 L Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. To enable students learning by doing.
2. To develop capability to analyse and solve real world problems.
3. To inculcate innovative ideas of the students.
4. To impart team building and management skills among students.
5. To instill writing and presentation skills for completing the project.

Course Outcomes:

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

1. Interpret Literature with the purpose of formulating a project proposal.
2. Plan, Analyse, Design and Implement a project using SDLC model.
3. Find the solution of identified problem with the help of modern Technology and give priority to real time scenarios.
4. Plan to work as a team and to focus on getting a working project done and submit a report within a stipulated period of time.
5. Prepare and submit the Report and deliver presentation before the Departmental Committee.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	3	3	2	1	2	3	3	2	3	3
CO2	3	3	3	3	3	3	3	2	1	2	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	-	2	3	3	3	3	3
CO4	2	2	2	3	3	3	3	2	3	3	2	3	2	3	3
CO5	1	2	1	2	3	3	-	-	2	3	-	-	-	3	-

The Students are required to choose a topic for mini project related to the courses of the current semester or previous semester. The student has to implement and present the project as per the given schedule. During the implementation of the project, Personnel Software Process (PSP) has to be followed. Report of the project work has to be submitted for evaluation.

Schedule

S No	Description	Duration
1.	Problem Identification / Selection	2 weeks
2.	Preparation of Abstract	1 week
3.	Design, Implementation and Testing of the Project	7 weeks
4.	Documentation and Project Presentation	4 weeks

Guidelines for the Award of marks

S No	Description	Max. Marks
1.	Weekly Assessment	20
2.	PPT Preparation	5
3.	Presentation	10
4.	Question and Answers	5
5.	Report Preparation	10

Final Mini Project demonstration and PPT presentation is to be evaluated for the entire class together by all the faculty handling Mini Project for that class.

20ITE01 **DIGITALIMAGE PROCESSING**
(Professional Elective – I)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce the fundamental concepts and applications of digital image processing.
2. To impart knowledge on the image processing concepts: intensity transformations, spatial filtering, Smoothing and sharpening both in spatial and frequency domain.
2. To familiarize the image analysis concepts: morphological image processing, image segmentation, image representation and description, and object recognition.
3. To introduce colour image processing techniques.
4. To understand with various image compression methods.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Illuminate the fundamental concepts and applications of digital image processing techniques.
2. Demonstrate intensity transformations, spatial filtering, smoothing and sharpening in both spatial and frequency domains, image restoration concepts
3. Demonstrate image restoration and morphological image processing methods
4. Apply object recognition techniques by using image segmentation and image representation &description methods
5. Illustrate the various colour models and Application of image compression methods

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	-	1	-	-	-	-	1	2	3	3
CO2	2	2	2	1	-	2	1	-	-	1	-	1	2	3	3
CO3	2	2	2	1	-	2	1	-	-	1	-	1	2	3	3
CO4	2	1	1	2	1	-	1	-	-	-	-	1	2	3	3
CO5	2	2	2	1	-	2	1	-	-	1	-	1	2	3	3

UNIT-I

Introduction: Fundamental Steps in Digital Image Processing, Image Sampling and Quantization, Some Basic Relationships between Pixels; **Intensity Transformations:** Some Basic Intensity Transformation Functions, Histogram Processing - Histogram Equalization, Histogram Matching (Specification)

UNIT-II

Spatial Filtering: Fundamentals of Spatial Filtering, Smoothing Spatial Filters; Sharpening Spatial Filters; **Filtering in the Frequency Domain**: The 2-D Discrete Fourier Transform and its inverse; The Basics of Filtering in the Frequency Domain; Image Smoothing Using Frequency Domain Filters - Ideal, Butterworth and Gaussian Low pass Filters; Image Sharpening Using Frequency Domain Filters - Ideal, Butterworth and Gaussian High pass Filters.

UNIT-III

Image Restoration and Reconstruction: A Model of the Image Degradation/Restoration Process, Noise Models; Restoration in the Presence of Noise Only—Spatial Filtering; Periodic Noise Reduction by Frequency Domain Filtering; Estimating the Degradation Function; Inverse Filtering; Minimum Mean Square Error (Wiener) Filtering;

Morphological Image Processing: Preliminaries; Erosion and Dilation; Opening and Closing, The Hit or Miss Transform

UNIT-IV

Image Segmentation: Fundamentals; Points, Line and Edge Detection, Thresholding; Segmentation by Region Growing, Region Splitting and Merging

Feature Extraction: Boundary Pre-processing, Boundary Feature Descriptors, Some Simple Region Descriptors.

Image Pattern Classification: Patterns and Pattern Classes, Pattern Classification by Prototype Matching

UNIT-V

Colour Image Processing: Colour Fundamentals; Colour Models, Pseudo Colour Image Processing, Basics of full Colour Image Processing;

Image Compression: Fundamentals, Huffman Coding, Arithmetic Coding, LZW Coding

Text Book:

1. Rafael C Gonzalez and Richard E Woods, "Digital Image Processing", Pearson Education, 4th Edition, 2020.

Suggested Reading:

1. Vipula Singh, "Digital Image Processing with MatLab and lab View", Elsevier.
2. Thomas B. Moeslund, "Introduction to Video and Image Processing: Building Real Systems and Applications", Springer, 2012.
3. Milan Sonka, Vaclav Halvac and Roger Boyle, "Image Processing, Analysis, and Machine Vision", 2nd Edition, Thomson Learning Publishers.
4. Kenneth R.Castleman, "Digital Image Processing", Pearson Education, 2006.

Web Resources:

1. www.imageprocessingplace.com
2. https://in.mathworks.com/discovery/digital-image-processing.html
3. https://imagemagick.org/
4. https://nptel.ac.in/courses/117105079/

20ADE01 **DATA ANALYSIS AND VISUALIZATION**

(Professional Elective – I)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce the Numpy library in Python to support storage and operations on large multi-dimensional arrays and matrices
2. To introduce large collection of mathematical functions to operate on multidimensional sequential data structures
3. To demonstrate the functionality of the Pandas library in Python for open source data analysis and manipulation
4. To demonstrate Data Aggregation, Grouping and Time Series analysis with Pandas
5. To introduce the Matplotlib library in Python for resting static, animated and interactive visualizations

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Efficiently store and manipulate dense data in arrays with Numpy
2. Apply high level mathematical functions to aggregate, broadcast, index and sort multidimensional arrays.
3. Create Series and DataFrame objects to operate on datasets.
4. Perform Data cleaning, transformation, merging, aggregation on datasets.
5. Apply 2-D and 3-D plotting techniques on datasets

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	3	-	-	2
CO2	3	2	-	1	1	-	-	-	-	-	-	3	-	-	2
CO3	3	1	-	3	1	-	-	-	-	1	-	3	3	3	3
CO4	3	2	1	3	1	-	-	-	-	3	-	3	3	3	3
CO5	2	2	-	2	1	-	-	-	-	3	-	3	2	-	2

UNIT-I

Introduction to Numpy: Data types in Python - Fixed type arrays, creating arrays, array indexing, array slicing, reshaping arrays, array concatenation and splitting, Universal Functions, Aggregations, Broadcasting rules, Comparisons, Boolean Arrays, Masks Fancy Indexing, Fast Sorting using np.sort and np.argsort, partial sorting - partitioning with K-nearest neighbors, Creating Structured Arrays, Compound types and Record Arrays.

UNIT- II

Introduction to Pandas: Series Object, DataFrame Object, Data Indexing and Selecting for Series and DataFrames, Universal Functions for Index Preservation, Index Alignment and Operations between Series and DataFrames, Handling missing data, Operating on Null values, Hierarchical Indexing.

UNIT-III

Combining Datasets: Concat, Append, Merge and Joins, Aggregation and Grouping, Pivot Tables, Vectorized String Operations, Working with Time Series, High-Performance functions - query() and eval()

UNIT-IV

Inferential Statistics - Normal distribution, Poisson distribution, Bernoulli distribution, z-score, p-score, One-tailed and two-tailed, Type 1 and Type-2 errors, Confidence interval, Correlation, Z-test vs T-test, F- distribution, Chi-square distribution, the chi-square test of independence, ANOVA, data mining, titanic survivors dataset analysis

UNIT-V

Visualization with Matplotlib : Simple Line plots, Scatter plots, Visualizing errors, Density and Contour plots, Histograms, Binnings, Multiple subplots, Three-dimensional plotting with Matplotlib, Geographic data with Basemap, Visualization with Seaborn.

Text Books:

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly Media, 2016.
2. Samir Madhavan, "Mastering Python for Data Science", Packt Publishing, 2015.

Web Resources:

1. https://www.coursera.org/learn/python-data-analysis?specialization=data-science-python
2. https://www.coursera.org/learn/python-plotting

20ITE02 **MOBILE APPLICATION DEVELOPMENT WITH ANDROID AND KOTLIN**

(Professional Elective – I)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce the Kotlin Programming Language for Mobile Application Development
2. To demonstrate the development of basic mobile applications on android operating system
3. To demonstrate the Android Application Architecture
4. To introduce basic app design guidelines as well as styles, themes and material design
5. To demonstrate the publishing of a mobile app on Google Play

Course Outcomes:

Upon completing this course, students will be able to:

1. Understand the benefits of using Kotlin for Mobile application development
2. Understand the android project structure
3. Understand activity and fragment life cycles
4. Apply various styles, themes and material design to apps
5. Apply best practices to prepare and publish apps on Play store

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	1	2	-	2	-	-	-	1	-	-	2	3	-
CO2	-	2	1	2	-	2	-	-	-	-	-	-	1	3	-
CO3	-	2	1	2	-	2	-	-	-	-	-	-	2	3	3
CO4	-	2	1	2	-	2	-	-	-	-	-	-	2	3	-
CO5	-	2	2	2	3	2	-	-	3	-	-	1	2	3	3

UNIT-I

Introduction to Kotlin, Basic expressions, Control flow statements, null safety, Functions, passing functions as arguments, simple lambdas

Object oriented programming in Kotlin, Classes and Objects, Constructors, Visibility modifiers, Subclasses and Inheritance, Interfaces, Data classes, Singleton class enums, Pairs, Triples, Collections and Extensions in Kotlin

UNIT-II

Installing Android Studio, Android app project, deploying app on emulator or device, image resources and click handler, view layouts, adding libraries to module gradle file, layouts using XML and layout editor, app interactivity, ConstraintLayout, Data binding, Fragments, Navigation graphs, Navigational paths, Options menu, Safe Args plugin, External activity,

UNIT-III

Activity and Fragment life cycles, Android lifecycle library, configuration changes, Android App Architecture, Classes of Lifecycle, ViewModel and ViewModelFactory, LiveData and LiveData observers, Data binding with ViewModel and LiveData, LiveData Transformations

Room Persistence library, Coroutines, RecyclerView, Data binding with Recycler View, Retrofit library for web services, Moshi library for parsing JSON response, loading and displaying images from the internet, filtering data from the internet, Offline cache and repository, WorkManager, Background workers and periodic WorkerRequest

UNIT-IV

Basic App design, Styles and Themes, Material Design, best practices for app design Permissions, App

performance, Security, Handling user data, Compliance with personal data policies, logs, encryption of sensitive data, External storage, IP networking

UNIT-V

Firebase, Firebase analytics, Firebase notifications, Firebase database, App monetization, In-app purchases, Subscriptions, Advertising using Admob
Generate Signed APK, Preparing app for release, GooglePlay filters, Google Play developer console, Alpha and beta tests on Google Play, Pre-launch reports and Publishing

Text Books / Online Resources:

1. Android Development with Kotlin by Google
2. Android Development with Kotlin online videos

20ITE03 **FUNDAMENTALS OF CRYPTOGRAPHY**
(Professional Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce fundamental concepts of computer security and cryptography.
2. To familiarize with the concepts of block ciphers and symmetric encryption.
3. To provide knowledge on asymmetric key cryptography and key exchange.
4. To acquaint basic structure of cryptographic hash functions and message authentication codes.
5. To impart knowledge on digital signatures, key distribution, user authentication.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Demonstrate the key security concepts, security attacks and cryptography techniques.
2. Analyze block ciphers, symmetric encryption algorithms.
3. Describe the operations of asymmetric key cryptography and key exchange.
4. Comprehend cryptographic hash functions, message authentication codes.
5. Inspect the digital signature process, key distribution, user authentication.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	3	1	1	1	-	1	1	2	-	2
CO2	2	3	3	2	1	3	1	1	1	1	1	1	2	-	2
CO3	2	3	3	2	1	3	1	1	1	1	1	1	2	-	2
CO4	2	3	3	2	1	3	1	1	1	1	1	1	2	-	2
CO5	2	3	3	2	1	3	1	1	1	1	1	1	2	-	2

UNIT-I

Introduction: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Attack surfaces and Attack Trees, A Model for Network Security.
Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography.

UNIT-II

Block Ciphers and Data Encryption Standard: Traditional Block Cipher Structure, the Data Encryption Standard, DES Example, the Strength of DES, Block Cipher Design Principles, Multiple Encryption, Triple DES.
Advanced Encryption Standard: Finite Field Arithmetic**,** AES Structure, AES Transformation functions, AES Key Expansion, AES Example, AES Implementation.

UNIT-III

Asymmetric Key Cryptography: Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie- Hellman key exchange, ElGamal Cryptographic System, Elliptical Curve Arithmetic, Elliptical Curve Cryptography, pseudorandom number generation based on an Asymmetric cipher.

UNIT-IV

Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm.
Message Authentication Codes: Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of Macs, MACs Based on Hash Functions HMAC,

Security of HMAC.

UNIT-V

Digital Signatures: Digital Signature**,** ElGamal Digital Signature Scheme**,** NIST Digital Signature Algorithm.
Key Management and Distribution: Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public Key Infrastructure.
User Authentication: Kerberos, Federated Identity Management.

Text Book:

1. William Stallings, "Cryptography and Network Security Principles and Practice", Pearson Education, Seventh Edition,2017.

Suggested Reading:

1. V.K.Jain, "Cryptography and Network Security", First Edition, Khanna Book Publishing,2013.
2. Behrouz A Forouzan, "Cryptography and Network Security", Second Edition, Tata McGraw Hill, 2010.

Web Resources:

1. Foundations of Cryptography, https://nptel.ac.in/courses/106/106/106106221/
2. Cryptography and Network Security, https://nptel.ac.in/courses/106/105/106105162/

20ADE02 **THEORY OF AUTOMATA**
(Professional Elective - I)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To study abstract computing models: Finite Automata, Pushdown Automata and Turning Machines.
2. To introduce various grammars, formal languages and their relationships.
3. To learn about the relation among various grammars and recognizers for different formal languages.
4. To acquaint with mathematical methods to prove properties of languages, grammars and automata.
5. To familiarize with decidability and undecidability of computational problems.

Course Outcomes:

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

1. Build Deterministic, Non deterministic Finite automata for Languages and show the acceptance of strings using Formal Machines.
2. Develop regular expressions and their equivalent finite automata for different languages.
3. Infer Context-free grammars for certain languages and Test for Closure Properties and Decision Properties of CFL's.
4. Construct pushdown automata for languages and analyse Equivalence of PDA's and CFG's.
5. Identify Recursively Enumerable Languages, Undecidable problems and Model Turing Machines for Simple Computational Problems**.**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	-	1	-	-	-	-	1	-	-	2	-	2
CO2	2	2	1	-	-	-	-	-	-	1	-	-	-	-	2
CO3	2	2	1	-	-	-	-	-	-	1	-	-	1	-	2
CO4	1	2	1	-	1	-	-	-	-	1	-	-	2	-	2
CO5	2	2	2	-	1	-	-	-	-	1	-	-	2	-	2

UNIT-I

Introduction to Finite Automata, the Central Concepts of Automata Theory: Alphabets, Strings and Languages. Finite Automata: An Informal Picture of Finite Automata: The Ground Rules, the Protocol, Enabling the Automata to Ignore Actions, the Entire System as an Automaton. **Deterministic Finite Automata:** Definition of a DFA, Simpler Notations for DFA's, Extending the Transition Function to Strings, The Language of a DFA **Nondeterministic Finite Automata:** Definition of NFA, The Extended Transition Function, The Language of an NFA, Equivalence of NFA and DFA, An Application: Text Search, Finite Automata with Epsilon- Transitions: Use of €-transitions, The formal notation for an €- NFA, €-closure, Extended Transitions and Languages for €-NFA's, Eliminating €-transitions.

UNIT-II

Regular Expression and languages: Regular Expressions: The Operators of Regular Expressions, Building Regular Expressions. Finite Automata and Regular Expression: From DFAs to Regular Expressions, Converting DFA 's to Regular Expressions by Eliminating States, Converting Regular Expressions to Automata, Applications of Regular Expressions, Algebraic Laws for Regular Expressions.

Properties of Regular Languages: Proving Languages not to be Regular: The pumping lemma for Regular Languages, Applications of Pumping Lemma, Closure Properties of Regular Languages, Decision Properties of Regular Languages: Testing Emptiness of Regular Languages, Testing Membership in a Regular Language. Equivalence and Minimization of Automata: Testing Equivalence of States, Testing Equivalence of Regular

Languages, Minimization of DFA's.

UNIT-III

Context Free Grammars and Languages: Context-Free Grammars: Definition of Context Free Grammars, Derivations using a Grammar, Leftmost and Rightmost Derivation, The language of a Grammar, Parse Trees: Constructing Parse Trees, The Yield of a Parse Tree, Applications of CFGs, Ambiguity in Grammars and Languages: Ambiguous Grammars, Removing Ambiguity From Grammars, Leftmost Derivations as way to Express Ambiguity, Inherent Ambiguity.

Properties of Context Free Languages: Normal Forms for Context-Free Grammars: Eliminating Useless Symbols, Computing the Generating and Reachable Symbols, Eliminating Productions, Eliminating unit Productions, Chomsky Normal Form, Pumping Lemma for CFL 's: Statement of the Pumping Lemma, Applications of Pumping Lemma for CFL 's, Closure Properties of CFL 's, Decision Properties of CFL's: Testing Emptiness of CFL's, Testing Membership in a CFL's.

UNIT-IV

Pushdown Automata: Definition of pushdown automaton: The Formal Definition of PDA, Graphical Notation for PDA 's, Instantaneous Description of a PDA, The Language of a PDA: Acceptance by Final State, Acceptance by Empty Stack, From Empty Stack to Final State, From Final State to Empty Stack, Equivalence of PDA 's and CFG's: From Grammars to PDA's, From PDA's to Grammars, Deterministic Pushdown Automata: Definition, Regular Languages and Deterministic PDA's.

UNIT-V

Introduction to Turing Machines: Problems that Computer Cannot Solve: The Turing Machine: Notation for the TM, Instantaneous Descriptions for TM 's, Transitions Diagrams, The Language of a TM, Turing Machines and Halting, Programming Techniques for Turing Machines: Storage in the State, Multiple Tracks, Subroutines. Extensions to the Basic Turing machine, Restricted Turing machines, Turing Machine and Computers: Simulating a Computer by a TM.

Undecidability: A Language That Is Not Recursively Enumerable: Enumerating the Binary Strings, Codes for Turing Machines, The Diagonalization Language, An Undecidable problem that is RE: Recursive Languages, Compliments of Recursive and RE languages, The Universal Languages, Undecidablity of the Universal Language, Undecidable problems about Turing Machines: Reductions, TM's That Accept The Empty Language, Rice's Theorem and Properties of RE languages, Post's Correspondence Problem: Definition of PCP, The Modified PCP, Other Undecidable Problems.

Text Book:

1. John E. Hopcroft, Rajeev Motwani, Jeffery D Ullman, "Introduction to Automata Theory Languages and Computation", 3rd Ed, Pearson Education, 2007.

Suggested Reading:

1. John C Martin, "Introduction to Language and Theory of Computation", 3rd Ed, TMH, 2003.
2. Daniel Cohen, "Introduction to Computer Theory", 2nd Ed, Wiley Publications, 2007.
3. Mishra K., Chandra Sekaran N," Theory of Computer Science (Automata, Languages and Computation)", 3rd Ed, Prentice Hall of India 2008.
4. Shyamalendra Kandar, "Introduction to Automata Theory, Formal Languages and Computation", Pearson, 2013.

Web Resources:

1. http://nptel.ac.in/courses/106106049/
2. http://online.stanford.edu/course/automata-theory

20ITE04 **DATA WAREHOUSING AND DATA MINING**
(Professional Elective - I)

Instruction	3 L Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce the concepts of Data Warehouse and Data Mining.
2. To familiarize different kinds of data and various preprocessing techniques.
3. To study different frequent pattern discovery methods.
4. To learn various classification and clustering techniques.
5. To introduce the concept of outlier analysis.

Course Outcomes:

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

1. Understand the concepts and issues of data mining, apply preprocessing techniques.
2. Build multidimensional data model and perform OLAP operations, generate association rules.
3. Evaluate various models for classification and prediction.
4. Analyze advanced classification methods and clustering techniques.
5. Understand outlier detection and real time applications of data mining.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	2	-	-	-	-	1	1	1	2	3	2
CO2	2	1	2	2	-	-	-	-	-	1	-	1	3	3	2
CO3	3	3	2	2	2	-	1	-	-	-	1	1	3	3	2
CO4	2	3	2	3	2	-	1	-	-	-	1	1	3	3	2
CO5	2	1	1	2	1	-	1	-	-	-	1	1	1	3	2

UNIT-I

Introduction: Data mining, Kinds of data, Kinds of pattern, Major issues in data mining. Getting to know your data: Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Measuring Data Similarity and Dissimilarity. **Data Preprocessing:** An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

UNIT-II

Data Warehousing and Online Analytical Processing: Data Warehouse - Basic Concepts, Data Warehouse Modeling - Data Cube and OLAP, **Data Warehouse Design and Usage:** A Business Analysis Framework for Data Warehouse Design, Data Warehouse Design Process, and Data Warehouse Usage for Information Processing. **Mining Frequent Patterns, Associations and correlations:** Basic Concepts, Frequent Item Set Mining Methods, Interesting patterns, Pattern Evaluation Methods. **Advanced Pattern Mining:** Pattern Mining in Multilevel and Multidimensional Space.

UNIT-III

Classification: Basic Concepts, Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification, Model Evaluation and Selection, **Techniques to Improve Classification Accuracy:** Introducing Ensemble Methods, Bagging, Boosting, Random Forests, Improving Classification Accuracy of Class Imbalanced Data.

UNIT-IV

Classification: Advanced Methods: Bayesian Belief Networks, Classification by Back propagation, Support Vector Machines, Lazy Learners (or Learning from Your Neighbors), Other Classification Methods. Cluster Analysis: Basic Concepts and Methods: Cluster Analysis, Partitioning Methods, Hierarchical Methods: Agglomerative versus Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods, DBSCAN, Evaluation of Clustering, Clustering graph and network data.

UNIT-V

Outlier Detection: Outliers and Outlier Analysis, Outlier Detection Methods, Statistical Approaches, ProximityBased Approaches. Data Mining Trends and Research Frontiers: Mining Complex Data Types: Mining Sequence Data: Mining Other Kinds of Data, Data Mining Applications, Data Mining and Society, Data Mining Trends.

Text Book:

1. Han J, Kamber M, Jian P, "Data Mining: Concepts and Techniques", 3rd Edition, Elsevier, 2012.

Suggested Reading:

1. Pang-Ning Tan, Michael Steinback, Vipin Kumar, "Introduction to Data Mining", Pearson Education, 2008.
2. M. Humphires, M.Hawkins, M.Dy, "Data Warehousing: Architecture and Implementation", Pearson Education, 2009.
3. Anahory, Murray, "Data Warehousing in the Real World", Pearson Education, 2008.
4. Kargupta, Joshi, et al, "Data Mining: Next Generation Challenges and Future Directions", Prentice Hall of India Pvt. Ltd, 2007.

Web Resources:

1. https://hanj.cs.illinois.edu/bk3/
2. https://www.kdnuggets.com/
3. http://archive.ics.uci.edu/ml/index.php

R-20
B.E. (AI&DS)
Scheme and Syllabus of
V-VI Semesters
w.e.f. 2022-23

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instruction of V Semester of B.E. – Artificial Intelligence and Data Science as per AICTE Model Curriculum, with effective from 2022-23

SEMESTER - V

S. No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	20ADC06	Artificial Intelligence	3	-	3	40	60	3
2	20ITC24	Embedded Systems and IoT	3	-	3	40	60	3
3	20ITC19	Operating Systems	3	-	3	40	60	3
4	20ADC07	Full Stack Development	3	-	3	40	60	3
5	20ITC20	Computer Networks	3	-	3	40	60	3
6		Professional Elective – 2	3	-	3	40	60	3
PRACTICALS								
7	20ADC08	Artificial Intelligence Lab	-	2	3	50	50	1
8	20ITC26	Embedded Systems and IoT Lab	-	3	3	50	50	1.5
9	20ADC09	Minor Project - I (Full Stack Development)	-	3	-	50	-	1.5
10		Industrial / Rural Internship	90 Hours		-	-	-	2
TOTAL			**18**	**8**	**24**	**390**	**460**	**24**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE – Continuous Internal Evaluation SEE - Semester End Examination

Professional Elective #2	Natural Language Processing 20ADE03	NoSQL Databases 20ADE04	Computer Vision 20ITE13	Cyber Security 20ITE08	Compiler Design 20ADE05	Augmented Reality and Virtual Reality 20ITE07

20ADC06 **ARTIFICIAL INTELLIGENCE**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Concepts of Semiconductor Physics and Applied Physics.

Course Objectives:

1. To understand problem solving through search techniques.
2. To familiarize with knowledge representation and logical reasoning techniques in AI.
3. To learn the knowledge representation techniques.
4. To learn probabilistic reasoning models on uncertain data.
5. To acquaint with reinforcement learning.

Course Outcomes:

Students who complete this course should be able to

1. Solve problems using Exhaustive and Heuristic Search Techniques.
2. Apply inference methods in propositional logic to prove statements.
3. Construct knowledge representation models.
4. Inspect probabilistic reasoning models on uncertain data.
5. Appraise the learning techniques on data.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	2	3	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	2	3	3	2
CO3	3	3	2	2	-	-	-	-	-	-	-	2	3	3	3
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	3	2
CO5	3	3	2	2	-	-	-	-	-	-	-	2	3	3	3

UNIT-I

Introduction: The Foundations of AI, History of AI. Intelligent agents – Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Solving problems by searching: Problem Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed Search Strategies, Heuristic Functions.

UNIT-II

Adversarial search: Games, Optimal decisions in games, Alpha-Beta Pruning. Constraint Satisfaction Problems- Defining constraint satisfaction Problems.

Logic Concepts and Logic Programming: Introduction, Propositional Calculus, Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Tableau System in Propositional Logic, Resolution Refutation in Propositional Logic, Predicate Logic, Logic Programming.

UNIT-III

Knowledge Representation: Introduction, Approaches to Knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames.

Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and its Use.

UNIT-IV

Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Networks.

Probabilistic Reasoning over Time: Time and Uncertainty, Inference in Temporal Models, Hidden Markov Models, Kalman Filters.

UNIT-V

Learning with hidden variables: The EM Algorithm. **Reinforcement Learning:** Introduction, Passive Reinforcement Learning, Active Reinforcement Learning, Generalization in Reinforcement Learning, Policy Search, Applications of Reinforcement Learning.

Text Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, 3rd Edition.
2. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.

Suggested Reading:

1. Nilsson, N., ―Artificial Intelligence: A New Synthesis‖, San Francisco, Morgan Kaufmann, 1998.
2. Rich, Knight, Nair: ―Artificial intelligence‖, Tata McGraw Hill, Third Edition, 2009.
3. Tom M. Mitchell, ―Machine Learning‖, McGraw Hill, 1997.
4. Kulkarni, Parag, Joshi, Prachi, ‖ Artificial Intelligence: Building Intelligent Systems‖, PHI, 2015.
5. Peter Jackson, ―Introduction to Expert Systems‖, Third Edition, Pearson Addison Wesley, 1998

Web Resources:

1. https://nptel.ac.in/courses/106106126
2. https://www.coursera.org/learn/ai-for-everyo

20ITC24 **EMBEDDED SYSTEMS AND IOT**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the embedded systems, control-driven Architectures
2. To understand the fundamental of IoT and appreciate the importance of communication between machines with reference to IoT.
3. See the design methodology and mechanism of IoT and acquire knowledge of Raspberry Pi device, its interfaces
4. To understand, appreciate and develop ability to use various contemporary IOT applications.
5. To understand the software systems for Industrial IoT and the utilities of IoT through case studies.

Course Outcomes:

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

1. Develop and design for Embedded computing using 8051 Microcontroller.
2. Describe the role of things and Internet in IoT and determine the IoT levels designing an IoT Systems.
3. Learn the methodology for IoT system design and interface with Raspberry Pi.
4. Design and Develop IoT computing and its applications.
5. Implement standard IoT to build large systems for industries.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	2	3	0	1	1	1	1	1	3	3	3
CO2	2	1	2	1	2	0	3	0	0	0	2	0	2	0	3
CO3	2	1	2	2	2	3	0	0	0	0	2	0	3	0	3
CO4	2	1	1	1	2	0	3	2	0	0	1	1	2	3	3
CO5	2	1	1	1	1	0	0	2	0	0	0	1	1	0	3

UNIT-I

Embedded Computing: Introduction Embedded System Design Process, Characteristics and Challenges of Embedded Systems. **The 8051 Architecture**: Introduction, 8051 Micro controller Hardware. Data Transfer and Logical Instructions, Arithmetic Operations, Decimal Arithmetic, Jump and Call Instructions Applications: Interfacing with Keyboards, Displays, D/A and A/D Conversions.

UNIT-II

Introduction to Internet of Things: Definitions & Characteristics of IoT, Physical Design of IOT- Things in IoT, IoT Protocols, Logical Design of IOT-IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IOT Enabling Technologies-Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IOT Levels & Deployment Templates.

UNIT-III

IoT Platforms Design Methodology: Introduction, IoT Design Methodology Steps-Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Application Development, Case Study on IoT System for Weather Monitoring.
IoT Physical Devices and End Points: Basic building blocks of an IoT device, Raspberry Pi About the board, Raspberry Pi interfaces-Serial, SPI, I2C. Python Web Application Framework: Django Framework-Roles of Model, Template and View.

UNIT-IV

Domain Specific IOTs: Various types of IoT Applications in Home Automation- smart lighting, Smart appliance, smoke and gas detectors, Cities, Environment, Energy, Retail, Logistics Agriculture, Industry, Health & Life Style-Wearable Electronics. **IoT and M2M –** Introduction, M2M, Differences between IoT and M2M, Software Defined Networking, Network Function Virtualization.

UNIT-V

Industrial IoT: Introduction to Industrial IoT, IIoT Communication**,** Industry 4.0 Globalization and Emerging Issues, The Fourth Revolution, Security and Fog Computing.

Real case studies:

Case study - I : Milk Processing and Packaging Industries

Case study - II: Manufacturing Industries

Text Books:

1. Wayne Wolf, "Computers as Components", 1st Edition, Academic press, 2001.
2. Kenneth J.Ayala, "The 8051 Microcontroller", 3rd Edition, Thomson, 2014.
3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2014.
4. Misra, C. Roy, and A. Mukherjee, 2020 "Introduction to Industrial Internet of Things and Industry 4.0". CRC Press.

Suggested Reading:

1. Raj Kamal, "Embedded Systems", 2nd Edition, McGraw Hill, 2015.
2. Samuel Greengard, "The Internet of Things", 1st Edition, MIT Press, 2015.
3. Peter Waher, Pradeeka Seneviratne, Brian Russell, Drew Van Duren, "IoT: Building Arduino-Based Projects", 1st Edition, Packt Publishing Ltd, 2016.
4. Jeeva Jose, "Internet of Things", Khanna Book Publishing Company,

Web resources:

1. http://ee.sharif.edu/~sakhtar3/books/The%208051%20Microcontroller%20Ayala/The%208051%20Microcontroller%20Architecture,%20Programming%20and%20Applications%201991.pdf
2. https://slideplayer.com/slide/3944480/.
3. https://nptel.ac.in/noc/individual_course.php?id=noc17-cs05.
4. https://slideplayer.com/slide/5740917/.
5. https://onlinecourses.nptel.ac.in/noc20_cs69/preview

20ITC19 **OPERATING SYSTEMS**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To familiarize students with various services provided by an operating system.
2. To introduce the concepts of process, process synchronization and process scheduling.
3. To deal with different approaches of memory management.
4. To facilitate understanding of the structure and organization of the file system.
5. To provide understanding of Protection and security aspects of operating systems

Course Outcomes:

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

1. Demonstrate operating system services, inter process communication and multithreaded Programming.
2. Apply suitable process scheduling, deadlocks handling algorithms and solve process-synchronization.
3. Make use of advanced techniques such as paging, segmentation and virtual memory for memory management.
4. Illustrate file system interfaces and its implementation.
5. Identify the Operating System Security problems and Threats.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO3	PSO2	PSO1
CO1	2	2	3	1	1	-	-	-	1	1	1	1	3	3	3
CO2	2	1	2	1	2	-	-	-	-	-	1	-	3	-	2
CO3	2	1	2	2	1	-	-	-	-	-	-	-	3	-	3
CO4	2	1	1	1	1	-	-	-	-	-	-	1	3	-	1
CO5	2	1	1	1	1	-	-	-	-	-	-	1	3	-	1

UNIT–I

Introduction: Definition of Operating System, Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments, Open-Source Operating Systems. **Operating System Structures**: Operating-System Services, User and Operating-System Interface, System Calls, Types of System Calls, System Programs, Operating-System Design and Implementation, Operating-System Structure, System Boot. **Process:** Process Concept, Process Scheduling, Operations on Processes, Inter process Communication **Threads:** Overview, Multicore Programming, Multithreading Models, Threading Issues.

UNIT–II

Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling. **Synchronization:** Background, The Critical-Section Problem, Peterson ‘s Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors. **Deadlocks:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

UNIT–III

Memory Management Strategies: Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table. **Virtual Memory Management:** Background, Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory.

UNIT–IV

File-System: File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing Protection. **Implementing File Systems:** File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance. **Mass-Storage Structure:** Overview of Mass-Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap-Space Management.

UNIT–V

System Protection: Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of the Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems **System Security:** The Security Problem, Program Threats, System and Network Threats, Cryptography as a Security Tool, User Authentication.

Text Book:

1. Abraham Silberschatz, Peter Galvin, Greg Gagne, ―Operating System Concepts, 10th Edition, John Wiley and Sons Pvt Ltd, 2018.

Suggested Reading:

1. A.Tanenbaum, ―Modern Operation Systems‖, 3rd Edition, Pearson Education, 2008.
2. William Stallings, ―Operating Systems‖, 5th Edition, Pearson Education, 2005.
3. Ida M.Flynn, ―Understanding Operating Systems‖, 6th Edition, Cengage, 2011.
4. D.M.Dhamdhere,‖Operating systems a concept-based approach‖, 2nd Edition, McGraw-Hill, 2007.

Web Resources:

1. https://www.os-book.com/OS10/
2. http://nptel.ac.in/downloads/106108101/
3. http://www2.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/
4. http://www.cs.kent.edu/~farrell/osf03/oldnotes/

20ADC07 **FULL STACK DEVELOPMENT**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To provide knowledge about web pages design and development.
2. To understand how the HTML, CSS and JavaScript components of Bootstrap work.
3. To explore the basic architecture of a React application and develop applications in agile mode
4. To gain the basics of frond-end and back-end application development using Node Js.
5. To understand the basics of MongoDB and its Data Model

Course Outcomes:

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

1. Create web pages with good aesthetic sense of design using HTML and CSS
2. Create real-world React web applications and related tools.
3. Become an agile practitioner with the ability to quickly complete projects
4. Build an end-to-end application from scratch using NODE JS
5. Understand and build logical relationships between documents using MongoDB

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	1	1	-	-	-	1	1	1	1	3	2	3
CO2	2	1	2	1	2	-	-	-	-	-	1	-	2	2	3
CO3	2	1	2	2	1	-	-	-	-	-	-	-	3	2	3
CO4	2	1	1	1	1	-	-	-	-	-	-	1	1	2	3
CO5	2	1	1	1	1	-	-	-	-	-	-	1	1	2	3

UNIT-I

Introduction: Web Fundamentals, **HTML 5.0:** basic tags, Images, Tables, Lists, Forms, Layout, Graphics, span and div tags. **Introduction to Cascading Style Sheets:** Types of CSS**, text and font, color,** CSS Selectors, CSS BOX Model, CSS Positioning, and CSS floating.

UNIT-II

Java Script: Data Types & Type Conversion, JSON, Events, String and Date Functions, Object Oriented Programming (OOP) in JS, Document Object Model, JavaScript Regular Expressions. **Bootstrap:** Introduction of Bootstrap, Container and Container-fluid, Connectivity of Bootstrap in page. **Bootstrap Component**: Jumbotron, Button, Grid, Table, Form, Alert, Panels, Image, Progress Bar, Tabs/Pill, Navbar, Modals

UNIT-III

React Js: Basics, State, Props, Components, Lifecycle, Events, Router, Forms, Tables, Portals, ES6, CSS, Hook, and Back End Integration. **Express JS:** The model-view-controller pattern, Defining EJS template Engine Building a front-end controller, defining routes, creating actions, Configuring Express to use EJS, Using REST, Reading POST data Adding middleware

UNIT-IV

Node JS Modules: Functions, Buffer, Module, Modules Types, Core Module, Local Modules and Modules Exports **Node Package Manager:** What is NPM? Installing Packages Locally, installing package globally, adding dependency in package Json and Updating packages. **Creating Web Server:** Creating Web Server, Sending Requests and Handling HTTP requests. **File System:** Read File, writing a File, opening a File Deleting a File, Writing a file asynchronously and Other I/O Operations. **Events:** Event Emitter class, Inheriting Events and Returning event emitter

UNIT-V

MongoDB: Introduction, Importance of NoSQL databases, JSON features, Data types and examples. CRUD Operations, Data Modelling & Schema Design, Indexing and Aggregation, Mongo Import/Export and Master/Slave Replication.

Text Books:

1. Vasan Subramanian, "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node", second Edition, Apress Publications, 2019.
2. David Hows, Peter Membrey, EelcoPlugge – "MongoDB Basics", Apress, 2014.

Suggested Reading:

1. Ethan Brown, "Web Development with Node and Express", Oreilly Publishers, First Edition, 2014.

Web Resources:

1. https://web.stanford.edu/class/cs142/index.html
2. https://nodejs.org/en/docs/
3. https://www.mongodb.com/
4. https://reactjs.org/
5. https://getbootstrap.com/docs/5.0/utilities/api/
6. https://edu.anarchocopy.org/Programming%20Languages/Node/Pro%20MERN%20Stack,%202nd%20Edition.pdf

20ITC20 **COMPUTER NETWORKS**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Familiarize students with the basics of Layering of services, data transmission, transmission media, data Communications System and its components.
2. Provide state-of-the-art knowledge on Network Layer issues including Routing, Addressing.
3. Give an overview of how Networks differ and how they can be interconnected.
4. Introduce IP based transport protocols TCP and UDP.
5. Give an insight into the working principles of popular Internet Applications including Email, Domain Name System, WWW, Streaming audio and video.

Course Outcomes:

Upon successful completion of this course, student will be able to

1. Summarize functions of each layer in the OSI and TCP/IP reference models and demonstrate the systematic understanding of data communication Techniques.
2. Solve problems related to Addressing, Routing, Interoperability among heterogeneous networks.
3. Identify issues in Internetwork Routing issues and Congestion in computer networks.
4. Appraise the functions and performance of Internet Transport Protocols TCP and UDP.
5. Analyze the operating principles of Domain Name System and Electronic Mail, WWW.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	2	3	3	3
CO2	3	3	2	1	-	-	-	-	-	-	-	2	3	3	2
CO3	3	3	2	1	-	-	-	-	-	-	-	2	3	3	3
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	3	2
CO5	3	3	2	2	-	-	-	-	-	-	-	2	3	3	3

UNIT-I

Introduction: Concept of layering, Reference models- The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models, **The Data Link Layer**: Framing, Error Control – Flow Control, Error Detection and Correction – Error-Correcting Codes – Error Detecting Codes, Sliding WindowProtocols. **Channel allocation methods:** Assumptions for dynamic channel allocation, Carrier Sense Multiple access protocols, Collision free protocols. **Ethernet:** MAC Sublayer Protocol, Switched Ethernet, Fast Ethernet, Gigabit Ethernet, 10-Gigabit Ethernet

UNIT-II

Network layer Routing Algorithms: Design Issues, Routing Algorithms-Shortest path, Flooding, Flow based Distance vector, Link state Routing. **The Network Layer in The Internet**: The IP Version 4 Protocol, IP Addresses, IP Version 6, Internet Control Protocols, Label Switching and MPLS, Internet Multicasting, **Internetworking:** Different networks, Connection of networks, Tunneling, Packet Fragmentation

UNIT-III

The Transport Layer: Berkeley Sockets, Elements of transport protocols – Addressing, Connection Establishment, Connection Release, Error Control and Flow Control, Multiplexing, Crash Recovery, **Congestion Control**: Desirable Bandwidth Allocation, Regulating the Sending Rate.

UNIT-IV

The Internet Transport Protocols: UDP: Introduction to UDP. **The Internet Transport Protocols: TCP-** Introduction to TCP, The TCP Service Model, The TCP Protocol, The TCP Segment Header, TCP Connection Establishment, TCP Connection Release, TCP Connection Management Modeling, TCP Sliding Window, TCP Timer Management, TCP Congestion Control.

UNIT-V

Application Layer: DNS—The Domain Name System, The DNS Name Space, Domain Resource Records, Name Servers. **Electronic MAIL:** Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery. **The World Wide Web** - Architectural Overview. **Streaming Audio and Video:** Streaming Stored Media, Streaming Live Media. Content Delivery.

Text Books:

1. Andrew S. Tanenbaum, David J. Wetherall, "Computer Networks", 5th Edition, Pearson Education, 2014.
2. W. Richard Stevens, Unix Network Programming, Prentice Hall/Pearson Education, 2009.

Suggested Reading:

1. Chwan-Hwa (John) Wu, J. David Irwin, "Introduction to Computer Networks and Cyber Security", CRC Press, 2013.
2. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", 5th Edition, Addison-Wesley, 2012.

Web Resources:

1. https://nptel.ac.in/courses/117105148
2. https://www.ibm.com/docs/en/i/7.1?topic=communications-socket-programming

20ADE03 **NATURAL LANGUAGE PROCESSING**

(Professional Elective #2)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To understand the steps involved in Natural language processing
2. To learn about the lexical, syntactic and semantic analysis of natural language processing
3. To explore the various parsing techniques for natural languages
4. To understand the statistical models for Natural language processing
5. To learn about the various applications involved in Natural language processing

Course Outcomes:

Upon completing this course, students will be able to:

1. Justify the various steps necessary for processing natural language
2. Suggest appropriate semantic modeling and sequence labeling techniques for a particular application.
3. Apply appropriate neural network-based models for a contextual application
4. Analyze existing encoder-decoder models and information extraction techniques.
5. Identify the significance of word net and analyze the applications of Natural Language Processing such as Question Answering and chatbots.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	1	1	-	-	-	1	1	1	1	3	2	3
CO2	2	1	2	1	2	-	-	-	-	-	1	-	2	1	3
CO3	2	1	2	2	1	-	-	-	-	-	-	-	3	2	3
CO4	2	1	1	1	1	-	-	-	-	-	-	1	1	1	3
CO5	2	1	1	1	1	-	-	-	-	-	-	1	1	2	3

UNIT-I

Introduction Regular Expressions, Text Normalization, Edit Distance**, N-gram Language Models:** N-Grams, Evaluating Language Models, Sampling sentences from a language model, Generalization and Zeros, Smoothing, Kneser-Ney Smoothing

UNIT-II

Vector Semantics and Embeddings: Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity, **TF-IDF:** Weighing terms in the vector, Pointwise Mutual Information (PMI), Applications of the tf-idf or PPMI vector models, Word2vec, Visualizing Embeddings, Semantic properties of embeddings, Bias and Embeddings, Evaluating Vector Models. **Sequence Labeling for Parts of Speech and Named Entities:** English Word Classes, Part-of-Speech Tagging, Named Entities and Named Entity Tagging, HMM Part-of-Speech Tagging, Conditional Random Fields (CRFs), Evaluation of Named Entity Recognition.

UNIT-III

Deep Learning Architectures for Sequence Processing: Language Models Revisited, Recurrent Neural Networks, RNNs as Language Models, RNNs for other NLP tasks, Stacked and Bidirectional RNN architectures, The LSTM, Self-Attention Networks: Transformers, Transformers as Language Models, Contextual Generation and Summarization. Case study in NLP. **Machine Translation and Encoder-Decoder Models:** Language Divergences and Typology, The Encoder-Decoder Model, Encoder-Decoder with RNNs, Attention, Beam Search, Encoder-Decoder with Transformers, Some practical details on building MT systems, MT Evaluation, Bias and Ethical Issues

UNIT-IV

Constituency Grammars-Constituency, Context-Free Grammars, Some Grammar Rules for English. Some Grammar Rules for English, Grammar Equivalence and Normal, Lexicalized Grammars. **Constituency Parsing**-Ambiguity**,** CKY Parsing: A Dynamic Programming Approach, Span-Based Neural Constituency Parsing, Evaluating Parsers, Partial Parsing, CCG Parsing. **Dependency Parsing**-Dependency Relations, Dependency Formalisms, Dependency Treebanks, Transition-Based Dependency Parsing, Graph-Based Dependency Parsing, Evaluation

UNIT-V

Word Senses and WordNet: Word Senses, Relations Between Senses, WordNet: A Database of Lexical Relations, Word Sense Disambiguation, Alternate WSD algorithms and Tasks, Using Thesauruses to Improve Embeddings, Word Sense Induction. **Question Answering:** Information Retrieval, IR-based Factoid Question Answering, Entity Linking, Knowledge-based Question Answering, Using Language Models to do QA, Classic QA Models, Evaluation of Factoid Answers. **Introduction to Chatbots-Chatbots, GUS:** Simple Frame-based Dialogue Systems, The Dialogue-State Architecture, Evaluating Dialogue Systems, Dialogue System Design

Text Books:

1. Jurafsky Daniel, Martin James, "Speech and Language Processing", Third Edition, Pearson Education, 2021.
2. Christopher Manning, Schutze Heinrich, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.

Suggested Reading:

1. Allen James, "Natural Language Understanding", Second Edition, Benjamin Cumming, 1995.
2. Charniack Eugene, "Statistical Language Learning", MIT Press, 1993.

Web Resources:

1. http:// archive.nptel.ac.in/courses/106/105/106105158/
2. http://archive.nptel.ac.in/courses/106/106/106106211/

20ADE04 **NO SQL DATABASES**
(Professional Elective #2)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems.
2. Understand the architectures and common features of Key Value databases.
3. Understand the architectures and common features of Document databases.
4. Understand the architectures and common features of column-family stores, graph databases
5. Understand the architectures and common features of graph databases and discuss the criteria that decision makers should consider when choosing between different NoSQL databases that best addresses specific use cases.

Course Outcomes:

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

1. Define, compare and use the four types of NoSQL Databases.
2. Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Key-Value Pair NoSQL databases.
3. Explain the detailed architecture, define objects, load data, query data and performance tune Document-oriented NoSQL databases.
4. Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases.
5. Explain the detailed architecture, define objects, load data, query data and performance tune Graph NoSQL databases.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	1	-	-	-	1	-	-	1	2	3	-
CO2	2	1	1	-	1	-	-	-	-	-	-	1	1	3	-
CO3	2	2	1	-	-	-	-	-	-	-	2	2	2	3	2
CO4	2	1	-	-	-	-	-	-	-	-	-	2	2	3	3
CO5	2	1	-	-	-	-	-	-	1	-	-	2	2	3	3

UNIT-I

Why NoSQL: The Value of Relational Databases, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL, Motivations for Not Just/NoSQL Databases. **Variety of NoSQL Databases**: Data Management with Distributed Databases, ACID and BASE, Types of NoSQL Databases.

UNIT–II

Key-Value Databases: Introduction to Key-Value Databases From Arrays to Key-Value Databases, Essential Features of Key-Value Databases,Keys, Values, Key-Value Database Data Modeling Terms, Key-Value Architecture Terms, Key-Value Implementation Terms. **Designing for Key-Value Databases:** Key Design and Partitioning Keys Designing Structured Values, Limitations of Key-Value Databases Comparable to SQL for Relational Databases Design Patterns for Key-Value Databases, Case Study: Key-Value Databases for Mobile Application Configuration.

UNIT–III

Document Databases: Introduction to Document Databases, what is a Document? Avoid Explicit Schema Definitions, Basic Operations on Document Databases, **Document Database Terminology:** Document and Collection Terms, Types of Partitions, Data Modeling and Query Processing. **Designing for Document Databases**:

Normalization, Denormalization, and the Search for Proper Balance Planning for Mutable Documents, The Goldilocks Zone of Indexes, Modeling Common Relations, Case Study: Customer Manifests.

UNIT–IV

Column Family Databases: Introduction to Column Family Databases in the Beginning, There Was Google Big-Table Differences and Similarities to Key-Value and Document Databases, Architectures Used in Column Family Databases, When to Use Column Family Databases, **Column Family Database Terminology:** Basic Components of Column Family Databases, Structures and Processes: Implementing Column Family Databases, Processes and Protocols. **Designing for Column Family Databases:** Guidelines for Designing Tables, Guidelines for Indexing, Tools for Working with Big Data. Case Study: Customer Data Analysis.

UNIT-V

Graph Databases: Introduction to Graph Databases: What Is a Graph, Graphs and Network Modeling, Advantages of Graph Databases. **Graph Database Terminology:** Elements of Graphs Operations on Graphs, Properties of Graphs and Nodes, Types of Graphs. **Designing for Graph Databases** Getting Started with Graph Design, Querying a Graph, Tips and Traps of Graph Database Design. Case Study: Optimizing Transportation Routes. **Choosing your database:** Programmer Productivity, Data-Access Performance, Sticking with the Default.

Text Books:

1. Sullivan. NoSQL for Mere Mortals, 1st ed. Addison-Wesley Professional, 2015.
2. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications,1st Edition ,2012.

Suggested Reading:

1. Meier & Kaufmann. SQL & NoSQL Databases: Models, Languages, Consistency Options and Architectures for Big Data Management, 1st ed. Springer, 2019

Web Resources:

1. https://www.ibm.com/cloud/learn/nosql-databases
2. https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRN
3. https://www.geeksforgeeks.org/introduction-to-nosql/
4. https://www.javatpoint.com/nosql-databa

20ITE13 **COMPUTER VISION**
(Professional Elective # 2)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites
Image Processing (20ITE01), Data Analysis and Visualization (20ADE01)

Course Objectives:
1. To understand the Fundamental Concepts related to Computer Vision and Image formation
2. To understand Feature Extraction algorithms.
3. To define the structure of an image based on motion.
4. To provide knowledge about object recognition and scene recognition algorithms.
5. To impart the knowledge about 3D Reconstruction techniques.

Course Outcomes:
Upon successful completion of this course, students will be able to:
1. Summarize the fundamentals of Image formation and describe the Geometric primitives and Transformations.
2. Describe different approaches to recognition of objects.
3. Inspect algorithms for feature detection and feature alignment.
4. Analyze images and videos for problems such as tracking and structure from motion.
5. Design recovered 3D structure for ill-posed scenes.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	-	-	-	-	-	-	2	2	3	3
CO2	3	3	2	2	2	-	-	-	-	-	-	2	3	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	2	3	3	3
CO4	3	3	2	3	2	-	-	-	-	-	-	2	3	3	2
CO5	3	3	2	3	2	-	-	-	-	-	-	2	3	3	3

UNIT-I

Introduction to Computer Vision and Image Formation: Introduction, Photometric image formation, Digital Camera image formation. **Image Processing**: Point operators, Linear filtering, More neighborhood operators, Fourier transforms, Pyramids and wavelets, Geometric transformations.

UNIT-II

Feature detection and matching: Points and patches, Edges, Lines. Segmentation: Active contours, Split and merge, Mean shift and mode finding, Normalized cuts. **Feature-based alignment:** 2D and 3D feature-based alignment, Pose estimation.

UNIT-III

Structure from motion: Triangulation, Two-frame structure from motion, Factorization, Bundle adjustment, Constrained structure and motion. **Dense motion estimation:** Translational alignment, Parametric motion, Spline-based motion, Optical flow, Layered motion.

UNIT-IV

Recognition: Object detection-Face detection,Pedestrian detection, Face recognition : Eigenfaces, Active appearance and 3D shape models,Application: Personal photo collections, Instance recognition : Geometric alignment, Large

databases,Application: Location recognition, Category recognition : Bag of words,Part-based models, Recognition with segmentation,Application: Intelligent photo editing, Context and scene understanding : Learning and large image collections, Application: Image search.

UNIT-V

3D Reconstruction: Shape from X: Shape from shading and photometric stereo, Shape from texture,Shape from focus, Active range finding: Range data merging,Application: Digital heritage, Surface representations: Surface interpolation,Surface simplification,Geometry images, Point-based representations, volumetric representations: Implicit surfaces and level sets , Model-based reconstruction: Architecture,Heads and faces,Application: Facial animation, Recovering texture maps: Estimating BRDFs, Application: 3D photography

Text Book:

1. Richard Szeliski "Computer Vision: Algorithms and Applications", Springer-Verlag London Limited, 2011.

Suggested Reading:

1. Robert J. Schallkoff, "Pattern Recognition: Statistical. Structural and Neural Approaches", John Wiley and Sons; 1992+.
2. D. A. Forsyth and J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003.
3. R. Hartley and A. Zisserman, "Multiple View geometry", Cambridge university Press, 2002.
4. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", Second Edition, Cambridge University Press, March 2004.
5. K. Fukunaga; "Introduction to Statistical Pattern Recognition", Second Edition, Academic Press, Morgan Kaufmann, 1990.

Web Resources:

1. CV online: http://homepages.inf.ed.ac.uk/rbf/CVonline
2. Computer Vision Homepage: http://www2.cs.cmu.edu/afs/cs/project/cil/ftp/html/vision.html

20ITE08 **CYBER SECURITY**
(Professional Elective #2)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To present basic concepts of Cybercrime and Cyberattacks.
2. To impart knowledge on Tools and Methods used in Cybercrime.
3. To familiarize the legal perspectives and Organizational implications of Cyber Security.
4. To present fundamentals concepts in Cyber Forensics.
5. To familiarize about regulatory framework for Cybersecurity.

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

1. Describe legal frameworks to handle cybercrimes.
2. Identify the functioning of different kinds of malware used in cybercrimes.
3. Examine the legal perspectives of cybercrimes in Indian and international context.
4. Describe the need of Digital Forensics and the importance of digital evidence in prosecution
5. Interpret the commercial activities in the event of significant information security incidents in the Organization.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	-	3	-	3	-	-	2	-	3	3	1
CO2	2	3	1	2	3	3	-	3	-	-	-	-	3	3	1
CO3	2	2	1	-	-	3	-	3	-	-	-	-	3	3	1
CO4	2	3	1	2	3	3	-	3	-	-	-	-	3	3	1
CO5	2	1	1	2	-	-	-	3	-	-	2	-	3	3	1

UNIT–I

Introduction to Cybercrime: Definition and origins of the word, Cybercrime and Information security, Classification of Cybercrimes, Legal Perspectives, Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

UNIT-II

Cyber offenses: Introduction, How Criminals plan the attacks, Social Engineering, CyberStalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector.
Tools and Methods Used in Cybercrime: Introduction, Proxy servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDos Attacks, SQL Injection, Buffer Overflow,

UNIT-III

Cyber Security: The Legal Perspectives: Cyber Crime and the Legal Landscape around the World, Need of Cyber laws: the Indian Context, The Indian IT Act, Challenges to Indian Law and Cyber Crime Scenario in India, Digital Signatures and the Indian IT Act, Cyber Crime and Punishment, Cyber Law, Technology and Students: The Indian Scenario.

UNIT-IV

Understanding Cyber Forensics: Introduction, Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Cyber Forensics Investigation, Challenges in Computer Forensics

UNIT-V

Cyber Security: Organizational Implications: Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Text Books:

1. Nina Godbole, Sunit Belapure, "Cyber Security Understanding Cyber Crimes, Computer forensics and Legal Perspectives", Wiley India Pvt.Ltd., 2013.
2. Harsh Bothra, "Hacking Be A Hacker with Ethics", Khanna Publishers 2017.

Suggested Reading:

1. John R Vaca "Computer Forensics: Computer crime scene Investigation " 2017.
2. Ferrera, Reder, Bird, Darrow, Aresty, Klosek, Lichtenstein " Cyber Laws Text & Cases" 3rd edition.
3. Tony Sammes Brian Jenkinson "Forensic Computing: A practitioner's Guide", Second Edition Springer International Edition.
4. Bill Nelson, Amelia Phillips, Christopher Steuart "Guide to Computer Forensics and Investigations" Fourth Edition.

Web Resources:

1. https://www.nist.gov/
2. https://www.sans.org/
3. https://www.udemy.com/the-complete-cyber-security-course-end-point-protection/

20ADE05 **COMPILER DESIGN**
(Professional Elective #2)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Data Structures and Algorithms, Theory of Automata.

Course Objectives:

1. To Analyze the basic steps involved in converting a source language to target code.
2. To Design Scanner and Parsers.
3. To Develop Intermediate code and generate code for target machines.
4. To impart knowledge in generation of target code.
5. To apply machine independent optimizations and error recovery strategies.

Course Outcomes:

Upon successful completion of this course, the students should be able to

1. Identify the concepts related to translator, tokens, bootstrapping, porting and phases of the compiler and develop Lexical-Analyzer for Source Language.
2. Construct Top-down parsers and Bottom-up parsers.
3. Develop Syntax Directed Translation scheme and Generate Intermediate code for a language.
4. Translate Intermediate code into Target code.
5. Understand Data flow Analysis and apply the optimization techniques.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	3	3	-	1	-	-	-	1	1	3	-	3
CO2	2	3	2	3	3	-	-	-	1	-	-	1	3	-	2
CO3	2	3	2	3	1	-	-	-	-	-	-	1	3	-	2
CO4	2	2	2	2	1	-	1	-	-	-	-	-	2	-	2
CO5	2	2	1	2	1	-	1	-	-	-	-	-	2	-	2

UNIT-I

Introduction: Programs related to compilers, Translation process, Major data structures, Other issues in compiler structure, Bootstrapping and porting. **Lexical analysis**: The role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, The Lexical-Analyzer Generator LEX.

UNIT-II

Syntax Analysis: Introduction, Context-Free Grammars, writing a Grammar, Top-Down parsing, Bottom-Up parsing, Introduction to LR Parsing, more powerful LR parsers, Using Ambiguous Grammars, Parser Generators.

UNIT-III

Syntax Directed Translation: Syntax Directed Definitions, Evaluation Orders for SDDs, Applications of Syntax Directed Translation.
Intermediate code generation: Variants of Syntax Trees, Three-Address Code, Types and Declarations, Translation of Expressions, Type Checking, Control Flow.

UNIT-IV

Runtime Environments: Storage Organization, Stack Allocation of Space, Access to Non local Data on the Stack, Heap Management, Introduction to Garbage Collection.
Code Generation: Issues in the Design of a Code Generator, The Target Language, Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Peephole Optimization, Register Allocation and Assignment.

UNIT-V

Machine Independent Optimizations: The Principal Sources of Optimizations, Introduction to data flow analysis, Foundation of data flow analysis.

Text Books:

1. Alfred V Aho, Monica S Lam, Ravi Sethi, Jeffrey D Ullman, "Compilers: Principles, Techniques &Tools", Pearson Education, Second Edition, 2014.
2. Kenneth C Louden, "Compiler Construction: Principles and Practice", Cengage Learning.

Suggested Reading:

1. Keith D Cooper & Linda Torczon, "Engineering a Compiler", Morgan Kafman, Second Edition.
2. Dick Grune, Kees van Reeuwijk, Henri E. Bal , Ceriel J.H. Jacobs, Koen Langendoen ," Modern Compiler Design", Springer, Second Edition.

Web Resources:

1. http://nptel.ac.in/courses/106108113
2. https://web.stanford.edu/class/archive/cs/cs143/cs143.1128/
3. http://en.wikibooks.org/wiki/Compiler_Construction
4. http://dinosaur.compilertools.net/
5. http://epaperpress.com/lexandyacc/

20 ITE07 **AUGMENTED AND VIRTUAL REALITY**
(Professional Elective #2)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To familiarize the students with the fundamentals of Virtual Reality.
2. To impart the knowledge of 3D orientation for understanding the behavior of VR system with the environment.
3. To deal with the Development Tools and Frameworks in Virtual Reality.
4. To introduce the applications of Virtual Reality Systems.
5. To introduce technology and features of augmented reality

Course Outcomes:

After successful completion of the course, student will be able to:

1. Describe the basic concepts of Virtual Reality and 3D Computer Graphics.
2. Apply 3D manipulation techniques in Virtual Reality.
3. Analyze Development Tools and Frameworks in Virtual Reality.
4. Develop a Virtual Reality application.
5. Evaluate Augmented Reality Systems

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	-	2	2	-	-	-	1	-	1	3	-	1
CO2	2	2	1	1	2	2	-	-	-	1	-	1	3	-	2
CO3	2	1	1	-	1	2	-	-	1	1	-	1	3	-	1
CO4	2	2	1	2	3	2	-	-	1	1	-	1	3	-	1
CO5	2	2	1	2	3	-	-	-	1	1	-	1	3	-	1

UNIT-I

Introduction to VR and AR: History of VR and AR, Technology and Features of Augmented Reality, Comparison of AR and VR, Challenges with AR, AR Systems and Functionality, Human factors, Human visual system, Perception of depth, color, contrast, resolution, Stereo Rendering, VR Hardware: Head-coupled displays etc. VR Software, Geometric Modelling: From 2D to 3D, 3D space curves, 3D boundary representation. The Graphics Pipeline and OpenGL, Overview and Transformations, Rotation, translation, scaling, mode view matrix, projection matrix, Lighting and Shading, OpenGL Shading Language (GLSL), GLSL vertex and fragment shaders.

UNIT-II

Visual computation in virtual reality: 3D Interaction Techniques: 3D Manipulation Techniques and Input Devices, 3D Travel Tasks, Travel Techniques, Theoretical Foundations of Wayfinding, Types of Centred-Wayfinding Support, Evaluating Wayfinding Aids, System Control, Classification, Graphical Menus, Voice Commands, Gestrual Commands, Tools, Muti-modal System Control Techniques,Case Study: Mixing System Control Methods, Symbolic Input Tasks.

UNIT-III

Framing using 3D virtual reality: Development Tools and Frameworks in Virtual Reality: VR. X3D Standard; Vega, MultiGen, Virtools etc., World Space, World Coordinate, World Environment, Objects - Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and other attributes, VR Environment - VR Database, Tessellated Data, LODs, Graphical User Interface, Control Panel, 2D Controls.

UNIT-IV

VR applications: Pose Tracking I, Tracking with light house, Pose Tracking II, Advanced positional tracking, Panoramic Imaging and Cinematic, VR Spatial Sound and the Vestibular System, VR Engines and Other Aspects of

VR, Latency, eye tracking, post-rendering warp. The Future: Virtual environment, modes of interaction Application of VR in Digital Entertainment: VR Technology in Film & TV Production. VR Technology in Physical Exercises and Games, Demonstration of Digital, Entertainment by VR

UNIT- V

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

Text Books:

1. LaValle "Virtual Reality", Cambridge University Press, 2016.
2. John Vince, "Virtual Reality Systems ", Pearson Education Asia, 2007.

Suggested Reading:

1. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013
3. Ange Anderson, Virtual Reality, Augmented Reality and Artificial Intelligence in Special Education, 2019

Web Resource:

1. https://nptel.ac.in/courses/106/106/106106138/
2. https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-ge08/
3. https://www.coursera.org/learn/ar?
4. https://www.coursera.org/specializations/virtual-reality

20ADC08 **ARTIFICIAL INTELLIGENCE LAB**

Instruction	2 Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. Familiarize with Uninformed and Informed search strategies.
2. Understand the game search to solve real-life problems.
3. Introduce logic programming concepts through Prolog.
4. Learn probabilistic reasoning on uncertain data.
5. Outline the Q-learning algorithm.

Course Outcomes:

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

1. Understand the types of informed and uninformed problems and apply search strategies to solve them.
2. Demonstrate Basic Prolog programming
3. Solve real-life problems using AI techniques like game search.
4. Apply probabilistic reasoning on data.
5. Analyze the Q-learning Algorithm.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	-	-	2	3	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	2	3	3	2
CO3	3	2	3	3	-	-	-	-	-	-	-	2	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	2	3	3	2
CO5	3	3	2	2	-	-	-	-	-	-	-	2	3	3	3

List of Programs

1. Implementation of Breadth First Search uninformed search technique.
2. Implementation of Depth First Search technique.
3. Implementation of Uniform Cost Search technique.
4. Implementation of Iterative Deepening DFS Search technique.
5. Implementation of Bidirectional Search technique.
6. Implementation of Best First Search technique.
7. Implementation of A* Search technique.
8. Implementation of Hill Climbing Algorithm.
9. Implementation of game search Algorithm.
    a. Mini-Max Algorithm
    b. Alpha-beta pruning
10. Installation of prolog and implementation of the basic programs in Prolog.
11. Design of a Bayesian network from given data.
    a. Monty Hall Problem
    b. Burglary and earthquake alarm program
12. Implementation of Q-learning Algorithm.

Text Books:

1. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.
2. Russell, Norvig, ―Artificial intelligence - A Modern Approach‖, Pearson Education, 3rd Edition, 2015.

Suggested Reading:

1. Rich, Knight, Nair: ―Artificial intelligence‖, Tata McGraw Hill, 3rd Edition, 2009.
2. Nicole Bauerle, Ulrich Rieder, ―Markov Decision Process with Applications to Finance‖, Springer, 2011.
3. Nilsson, N., ―Artificial Intelligence: A New Synthesis‖, Morgan Kaufmann, 1st Edition, 1998.

Web Resources:

1. https://ai.berkeley.edu/project_overview.html
2. http://aima.cs.berkeley.edu

20ITC26 **EMBEDDED SYSTEMS AND IoT LAB**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

1. Understanding Raspberry Pi / Arduino fundamentals.
2. On-Boarding Raspberry Pi / Arduino.
3. Programming with Raspberry Pi Pins / Arduino Pins.
4. Make students to do simple Applications.
5. Understand about IoT Applications using smart sensors.

Course Outcomes:

Upon completing this course, students will be able to:

1. Program using Raspberry Pi.
2. Develop python programs that run on Raspberry Pi/Arduino
3. Write basic IoT Programs using Raspberry Pi/Arduino.
4. Implement Applications using Raspberry Pi / Arduino.
6. Develop simple IoT systems of different Case studies.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	3	3	-	-	-	-	-	-	2	3	2
CO2	2	1	1	2	3	3	-	-	-	-	-	-	2	3	3
CO3	2	1	-	2	3	3	-	-	-	-	-	-	2	3	3
CO4	2	1	-	2	3	3	2	1	1	1	2	1	2	3	3
CO5	2	1	1	2	3	3	2	1	1	1	1	1	-	-	3

LIST OF PROGRAMS

1. Interface Input-Output and other units such as: Relays, LEDs, Switches, Stepper Motors using 8051 Micro controllers.
2. Study and Configure Raspberry Pi.
3. Write programs using Raspberry Pi to blink LED.
   a. using loops b. using conditional & control statements
4. Write program using Raspberry Pi to interface LEDs, Switch and Buzzer.
5. Interface different Sensors using Raspberry Pi.
   a. Temperature & Humidity b. PIR c. GAS d. LDR d. Rain
   e. Soil moisture.
6. Write a program to monitor temperature and humidity using DHT (Digital Humidity and Temperature) sensor using Raspberry Pi / Arduino.
7. Uploading and reading the Cloud data using Thingspeak platform.
8. Study the Use Cases:
   a. Home Automation (e.g., Smart Lighting),
   b. City Applications (e.g., Smart Parking, Traffic Lighting)
   c. Environment (e.g., Pollution Monitoring, Weather Monitoring)
   d. Agriculture (e.g., Smart Irrigation) etc.

Text Books:

1. Kenneth J.Ayala, “The 8051 Microcontroller”, 3 rd Edition, Thomson, 2014.
2. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-on Approach”, Universities Press, 2014.
3. Misra, C. Roy, and A. Mukherjee, 2020 “Introduction to Industrial Internet of Things and Industry 4.0”. CRC Press.

Suggested Reading:

1. Raj Kamal, “Embedded Systems”, 2 nd Edition, McGraw Hill, 2015.
2. Samuel Greengard, “The Internet of Things”, 1st Edition, MIT Press, 2015.
3. Peter Waher, Pradeeka Seneviratne, Brian Russell, Drew Van Duren, “IoT: Building Arduino-Based Projects”, 1st Edition, Packt Publishing Ltd, 2016.
4. Jeeva Jose, “Internet of Things”, Khanna Book Publishing Company

20ADC09 **MINOR PROJECT-I**
(Full Stack Development)

Instruction	3 Hours per Week
Duration of SEE	-
SEE	-
CIE	50 Marks
Credits	1.5

Course Objectives:

1. To enable students to learn by doing.
2. To develop capability to analyze and solve real world problems.
3. To inculcate innovative ideas of the students.
4. To impart team building and management skills among students.
5. To instill writing and presentation skills for completing the project.

Course Outcomes:

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

1. Interpret Literature with the purpose of formulating a project proposal.
2. Plan, analyze, Design and implement a project.
3. Find the solution of identified problem with the help of modern Technology and give priority to real time scenarios.
4. Plan to work as a team and to focus on getting a working project done and submit a report within a stipulated period of time.
5. Prepare and submit the Report and deliver a presentation before the departmental Committee.

Minor Project is aimed to enable the students to develop a product/application based on the course **FULL STACK DEVELOPMENT** with course code- **20ADC07**. The student has to implement and present the project as per the given schedule. During the implementation of the project, Personnel Software Process (PSP) has to be followed. Report of the project work has to be submitted for evaluation.

SCHEDULE

S No	Description	Duration
1.	Problem Identification / Selection	1 week
2.	Preparation of Abstract	1 week
3.	Design the Web Pages using advanced HTML Form tags input–date, time, number, email, HTML5 Header and Footer, spell check and editable areas.	1 week
4.	Demonstrate the CSS tags Inline, Internal and External Style sheets using advanced CSS in web pages	1 week
5.	Demonstrate JavaScript to perform validation and Bootstrap in Front-End Design.	1 week
6.	Implement React JS, MVC Pattern and Node JS Features in the application.	2 weeks
7.	Implement CRUD operations/DB Replication in MongoDB.	2 weeks
8.	Implementation and inferences	2 weeks
9.	Documentation and Project Presentation	2 weeks

Guidelines for the Award of marks

S No	Description	Max. Marks
Final Assessment		
1.	PPT Preparation	10
2.	Technical Content	10
3.	Question and Answers	5
4.	Report Preparation	5
Total		**30**

Final Minor Project demonstration and PPT presentation is to be evaluated for the entire class together by the entire faculty handling Minor Project for that class.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instruction of VI Semester of B.E. – Artificial Intelligence and Data Science as per AICTE Model Curriculum, with effective from 2022-23

SEMESTER – VI

S.No	Course code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1.	20ITC13	Software Engineering	3	-	3	40	60	3
2.	20ADC10	Deep Learning	3/1		3	40	60	4
3.	20ADC11	Data Science with R	3	-	3	40	60	3
4.	20ITC25	Cloud Computing	3		3	40	60	3
5.		Professional Elective – 3	3	-	3	40	60	3
PRACTICALS								
6.	20ITC16	Software Engineering Lab	-	3	3	50	50	1.5
7.	20ADC12	Deep Learning Lab	-	3	3	50	50	1.5
8.	20ADC13	Minor Project -II (Data Science)	-	3	-	50	-	1.5
9.	20EGC03	Employability Skills	-	2	-	50	50	1
TOTAL			**16**	**11**	**21**	**400**	**450**	**21.5**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE – Continuous Internal Evaluation SEE - Semester End Examination

Professional Elective #3	Micro Services with Springboot 20ADE06	Explainable AI 20ADE07	Applied Predictive Analytics 20ITE14	Fundamentals of Block Chain Technology 20ITE16	Agile Project Management 20ADE08	Social Network Analytics 20ADE09

20ITC13 **SOFTWARE ENGINEERING**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Describe the various software life cycle models.
2. Explain the concepts of Agile software development concepts.
3. Define the basic structural modeling concepts in UML.
4. Enable the students with UML notations.
5. Acquaint the students with Risk management and Product metrics.

Course Outcomes:

Upon completing this course, students will be able to:

1. Identify the minimum requirements for the development of application.
2. Build a system, component, or process to meet desired needs of a customer.
3. Involve in analysis and design of UML models for various case studies.
4. Acquire thorough knowledge of standard UML notations.
5. Know the risks, formulate and implement software projects.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	1	-	-	-	1	-	-	1	1	-	-
CO2	2	1	1	-	1	-	-	-	-	-	-	1	-	2	-
CO3	1	1	1	-	-	-	-	-	-	-	2	1	1	-	-
CO4	2	1	0	-	-	-	-	-	-	-	-	-	1	-	-
CO5	2	1	1	-	-	-	1		1	-	-	1	-	-	2

UNIT-I

Software and Software Engineering: The Nature of Software, Software Engineering. The Software Process, Software Engineering Practice. **A Generic view of Process:** Software Engineering -A Layered Technology, A Process framework, Process Models- Waterfall model, spiral model, The Unified Process, Product and Process, Process Assessment and Improvement, The CMMI, Introduction to Agile Development-Extreme programming. **Understanding Requirements:** Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Building the Requirements Model, Negotiating Requirements, Validating Requirements. **Requirements Modeling:** Requirements Analysis, Scenario-Based Modelling, Problem Analysis, Software Requirement and specifications.

UNIT-II

UML Introduction: Why we Model, Introducing the UML, Elements of UML-Things Relationships and Diagrams. **Basic Behavioural Modelling**: Interactions, Use Cases, Use Case Diagrams, Interaction Diagrams-Sequence diagrams-components of Sequence diagrams, collaboration diagrams-Components of Collaboration diagrams, Activity Diagrams-components of activity diagrams, swim lane diagrams, Case studies on Use Case diagrams, Interaction diagrams. **Advanced Behavioural Modelling**: State Chart Diagrams-components of statechart diagrams, Case studies on State chart diagrams.

UNIT-III

Basic Structural Modelling: Classes, Relationships, Diagrams, Class Diagrams. **Advanced Structural Modelling**: Advanced Classes, Advanced Relationships, Interfaces, Components, Case studies on class diagrams. **Quality Concepts:** Software Quality, Achieving Software Quality. **Software Quality Assurance:** Background Issues, Elements of Software Quality Assurance, SQA Tasks, The ISO 9000 Quality Standards.

UNIT-IV

Software Testing Strategies: A Strategic Approach to Software Testing, Strategic Issues, Validation Testing, System Testing. Testing Tools–Rational functional tester, Selenium software testing tool. **Testing Conventional Applications:** Software Testing Fundamentals, White-Box Testing, Basis Path Testing, Black– Box Testing, Alpha testing, Beta testing.

UNIT-V

Product Metrics: A Framework for Product Metrics, Size Metrics like LOC, Function points, **Risk Management:** Software Risks, Reactive versus Proactive Risk Strategies, Risk Mitigation, Monitoring, and Management, The RMMM Plan.

Text Books:

1. Roger S.Pressman, "Software Engineering: A Practitioner's Approach", 7th edition, McGrawHill, 2017.
2. Grady Booch, James Rumbaugh, Ivor Jacobson, "The Unified Modelling Language-User Guide (Covering UML 2.0)", Third Edition, Pearson Education, India, 2017.
3. Pankaj Jalote "An Integrated Approach to Software Engineering ", 3rd edition, Narosa Publishing house, 2008.

Suggested Reading:

1. Martin Fowler, Kendall Scott , "UML Distilled: A Brief Guide to the Standard Object Modelling Language" Addison Wesley, 4th Edition, 2011.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, "Fundamentals of Software Engineering", PHI, 2nd edition.
3. James F.Peters, WitoldPedrycz, "Software Engineering-An engineering Approach".

Web Resources:

1. SEweb - Software Engineering Education Home Page: http://tuvalu.cs.flinders.edu.au/seweb/se-ed/
2. IBM Rational http://www-306.ibm.com/software/rational/uml/
3. Practical UML - A Hands-On Introduction for Developers, http://www.togethersoft.com/services/practical_guides/umlonlinecou rse

20ADC10 **DEEP LEARNING**

Instruction	4 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Course Objectives:

1. To impart knowledge on the basic concepts of Neural Networks and Deep learning.
2. To familiarize various neural network architectures
3. To learn usage of neural networks for problem solving.
4. To familiarize various deep learning models.
5. To facilitate usage of deep learning applications in societal context.

Course Outcomes:

Upon completing this course, students will be able to:

1. Explain the basic principles of neural networks and deep learning.
2. Implement simple neural network algorithms.
3. Compare modeling aspects of various neural network architectures.
4. Evaluate Convolutional Neural Network models on real data sets.
5. Analyze and optimize Recurrent Neural Network models for various applications.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	-	-	-	-	-	-	1	1	2	3	2
CO2	2	2	2	2	1	-	-	-	-	-	1	1	2	3	2
CO3	2	2	1	1	1	-	-	-	-	-	1	-	2	-	2
CO4	2	2	2	2	1	-	-	-	-	-	1	1	2	3	2
CO5	-	1	1	1	1	-	-	-	-	-	-	-	2	-	2

UNIT-I

Introduction to Artificial Neural Networks: From Biological to Artificial Neurons, Implementing MLP, Fine-Tuning Neural Network Hyper parameters, Training Deep Neural Networks: The Vanishing/Exploding Gradients Problems, Reusing Pre trained Layers, Faster Optimizers and Avoiding Overfitting through Regularization.

UNIT-II

Linear Neural Networks: Linear Regression, Linear Regression Implementation from Scratch, Concise Implementation of Linear Regression, Softmax Regression, The Image Classification Dataset, Implementation of Softmax Regression from Scratch, Concise Implementation of Softmax Regression.

UNIT-III

Deep Learning Computation: Layers and Blocks, Parameter Management, Deferred Initialization, Custom Layers, File I/O, GPUs Convolutional Neural Networks: From Fully-Connected Layers to Convolutions, Convolutions for Images, Padding and Stride, Multiple Input and Multiple Output Channels, Pooling, Convolutional Neural Networks (LeNet).

UNIT-IV

Modern Convolutional Neural Networks: Deep Convolutional Neural Networks (AlexNet), Networks Using Blocks (VGG), Network in Network (NiN), Networks with Parallel Concatenations (GoogLeNet), Batch Normalization, Residual Networks (ResNet), Densely Connected Networks (DenseNet), **Recurrent Neural Networks:** Sequence Models, Recurrent Neural Networks, Implementation of Recurrent Neural Networks from Scratch, Concise Implementation of Recurrent Neural Networks.

UNIT-V

Modern Recurrent Neural Networks: Gated Recurrent UNITs (GRU), Long Short-Term Memory (LSTM), Deep Recurrent Neural Networks, Bidirectional Recurrent Neural Networks, Machine Translation and the Dataset, Encoder-Decoder Architecture, Sequence to Sequence Learning. **Optimization Algorithms:** Optimization and Deep Learning, Convexity, Gradient Descent, Stochastic Gradient Descent.

Text Books:

1. Aurélien Géron , "Hands-on Machine Learning with Scikit-Learn, Keras & TensorFlow", Orielly, 2nd edition,2019.
2. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, "Dive into Deep Learning", d2l.ai, 2021

Suggested Reading:

1. Levitin A, "Introduction to the Design And Analysis of Algorithms", Pearson Education, 2008.
2. Ian Goodfellow,Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
3. Indra den Bakker, "Python Deep Learning Cookbook", PACKT publisher, 2017
4. Wei Di, Anurag Bhardwaj, Jianing Wei, "Deep Learning Essentials" , Packt publishers, 2018

Web Resources:

1. http://nptel.ac.in/courses

20ADC11 **DATA SCIENCE WITH 'R'**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce Data Science with R.
2. To impart knowledge on the concepts of Exploring and Cleaning data.
3. To familiarize Supervised and Unsupervised Techniques.
4. To introduce documentation and deployment using R
5. To familiarize text mining with R.

Course Outcomes:

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

1. Explore data operations on files and databases using R programming.
2. Understand deployment of models on different datasets.
3. Apply supervised, unsupervised, ensembling and NLP models on different datasets.
4. Perform Sentiment analysis.
6. Build and evaluate the models.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	1	-	-	-	-	1	3	-	-
CO2	3	3	2	3	2	-	1	-	-	-	-	1	3	-	-
CO3	3	3	2	3	3	-	1	-	-	-	1	1	3	3	2
CO4	3	3	2	3	3	-	1	1	-	-	1	1	3	3	2
CO5	3	3	2	3	3	-	1	-	-	-	1	1	3	3	2

UNIT-I:

Introduction to data science: The Data Science Process: Roles in a data science project, Stages of a data science project, Setting expectations. **Starting with R and data:** Starting with R,working with data from files, Working with relational databases. **Exploring data:** Using Summary Statistics to spot problems, Spotting problems with graphics and visualization.

UNIT-II

Managing data: cleaning data, Data transformations, Sampling for modeling and validation. **Choosing and evaluating models:** Mapping problems to machine learning tasks, evaluating models, Local interpretable model-agnostic explanations (LIME) for explaining model predictions.

UNIT-III

Supervised Learning: Using Linear Regression, Using Logistic Regression. **Unsupervised methods:** Cluster Analysis, Association rules. **Exploring Advanced Methods**: Using bagging and random forest, using generalized additive models, using kernel methods to increase data separation.

UNIT-IV

Documentation and Deployment: Predicting buzz, Using R markdown to produce milestone documentation, Using comments and version control for running documentation, Deploying models. **Text Mining with R: The tidy text format:** Contrasting tidy text with other data structures, the unnest_tokens function, tidying the works of Jane Austen, Word Frequencies.

UNIT-V

Sentiment analysis with Tidy data: The sentiments datasets, Comparing the three sentiment dictionaries, Most common positive and negative words, Word clouds, Looking at units beyond just words, **Analyzing word and document frequency:** tf-idf, Term frequency in Jane Austen's novels, Zipf's law, The bind_tf_idf() function.

Text Books:

1. Zumel, N., Mount, J., &Porzak, J., "Practical data science with R", 2nd edition. Shelter Island, NY: Manning, 2019.
2. Julia Silge and David Robinson. "Text Mining with R: A Tidy Approach", 1st. edition. O'Reilly Media, Inc., 2017

Suggested Reading:

1. Garrett Grolemund and Hadley Wickham,"R for data science: import, tidy, transform, visualize, and model data" O'Reilly Media, Inc., 2016.
2. Roger D. Peng, "R programming for data science*"* (pp. 86-181). Lean pub, 2016.

Web Resources:

1. https://blog.rstudio.com/
2. https://r4ds.had.co.nz/index.html
2. https://www.dataquest.io/blog/learn-r-for-data-science/

With effect from the Academic Year 2022-23

20ITC25 **CLOUD COMPUTING**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Learn the fundamentals of cloud computing paradigm.
2. Learn various deployment and development models.
3. Learn various security concerns related to cloud.
4. Learn about various offerings of cloud service providers.

Course Outcomes:

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

1. Understand the basic ideas of Cloud Computing and its services.
2. Analyze the architecture, deployment models, and infrastructure models of Cloud Computing.
3. Realize distributed storage and performance for implementing virtualization.
4. Analyze cloud computing security, federation, presence, identity, and privacy.
5. Use IaaS / PaaS service offered by cloud service providers

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3													
CO2	3	3	3											3	
CO3	3	3	3	3	3						3			3	3
CO4	3	3	3	3		3				3				3	
CO5	3	3	3	3	3				3	3	3			3	3

UNIT-I

Introduction to Cloud Computing: Cloud Computing in a Nutshell, Roots of Cloud Computing, Layers and Types of Cloud, Features of a cloud, Software-as-a-Service, Platform-as-a-Service, Infrastructure-as-a- Service, Challenges and Risks. **Cloud Computing Platforms:** Infrastructure as service: Amazon EC2, Platform as Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing.

UNIT-II

Service and Deployment Models: The promise of the cloud, the cloud service offerings and Deployment model, Challenges in the cloud, **Broad Approaches to Migrating into Cloud:** Why Migrate? Deciding on cloud migration. **The Seven Step Model of Migration into Cloud:** Migration Risks and Mitigation. **Managing Cloud Services:** Organizational Issues **Administering Cloud Services:** Service Level Agreements (SLA) and Monitoring Support, Billing and Accounting, Technical Interface, Managing Cloud Resources, Maintaining Connections.

UNIT-III

Web Services: SOAP/WSDL web services, REST web services, SOAP v/s REST **AJAX:** Asynchronous 'rich' interfaces **Mashups:** user interface services **Cloud Technologies:** Study of Hypervisor **Virtualization Technology:** Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization **Multitenant Software:** Multi-entity support, multi-schema approach, multi-tenance using cloud data stores, Data access control for enterprise applications.

UNIT-IV

Cloud Security Fundamentals: Vulnerability assessment tool for cloud, Privacy and Security in cloud **Cloud Computing Security Architecture:** Architectural Considerations- General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro-architectures; Identity Management and Access control Identity management, Access control, Autonomic Security **Cloud Computing Security Challenges:** Virtualization security management virtual threats, VM Security Recommendations, VM-Specific Security techniques.

UNIT-V

Enterprise Cloud Computing Ecosystem: Introduction, Public Cloud Providers, Cloud Management Platforms and Tools, Tools for **Building** Private Cloud: IaaS using Eucalyptus, PaaS on IaaS –AppScale. **Roadmap for Enterprise Cloud Computing:** Introduction, Quick wins using Public Clouds, Future of Enterprise Cloud Computing: Commoditization of the data center, Inter-operating Virtualized Data Centers, Convergence of private and public clouds, Generalized 'cloud' services.

Text Books:

1. RajkumarBuyya, "Cloud Computing: Principles and Paradigms", John Wiley & Sons, First Edition
2. Gautam Shroff, "Enterprise Cloud Computing: Technology, Architecture, Applications", Cambridge University Press, First Edition

Suggested Reading:

1. Barrie Sosinsky, "Cloud Computing Bible", Wiley India, First Edition
2. Tim Malhar, S.Kumaraswammy, S.Latif, "Cloud Security & Privacy", O'Really Publications, First Edition

20ADE06 **MICROSERVICES WITH SPRING BOOT**

(Professional Elective –3)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have a good understanding of the Java programming language and SQL

Course Objectives:

1. To Understand the basic concepts of the Spring Framework
2. To provide basic knowledge of Web Application Development with Spring Boot and Restful APIs
3. To explore data access with Spring's DAO Module
4. To acquire Knowledge of Spring transaction management
5. To study Spring's unit testing framework and Introduce Spring Security with Rest API

Course Outcomes:

Upon completing this course, students will be able to:

1. Gain the basic concepts of the Spring Framework
2. Interact with databases using Spring's support for JDBC and JPA.
3. Build spring boot applications using Dependency Injection concept
4. Apply Transaction Management concepts of spring in Enterprise Application Development and develop the Spring-MVC based Applications to solve the real-world problems.
5. Use Spring Unit testing framework and configure security on Spring MVC Applications

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	1	1	-	-	-	1	1	1	1	3	-	3
CO2	2	1	2	1	2	-	-	-	-	-	1	-	2	-	3
CO3	2	1	2	2	1	-	-	-	-	-	-	-	3	-	3
CO4	2	1	1	1	1	-	-	-	-	-	-	1	1	-	3
CO5	2	1	1	1	1	-	-	-	-	-	-	1	1	-	3

UNIT-I

Spring Overview: Introduction to Spring Framework, The DI Container, Evolution of Spring Framework **Java Configuration:** Java configuration and the Spring application context, @Configuration and @Bean annotations, @Import: working with multiple configuration files, defining bean scopes, launching a Spring Application and obtaining Beans, External properties & Property sources, Environment abstraction, Using bean profiles, Spring Expression Language (SpEL) **Annotation and Component Scanning:** Component scanning, Autowiring using @Autowired, Java configuration versus annotations mixing Lifecycle annotations: @PostConstruct and @PreDestroy, Stereotypes and meta-annotations

UNIT-II

Web Applications with Spring Boot: Introduction to Spring MVC and request processing, Controller method signatures, Using @Controller, @RestController and @GetMapping annotations and Configuring Spring MVC with Spring Boot. **RESful Application with Spring Boot:** An introduction to the REST architectural style, Controlling HTTP response codes with @ResponseStatus, Implementing REST with Spring MVC, @RequestMapping, @RequestBody and @ResponseBody, Spring MVC's HttpMessageConverters and automatic content negotiation and Jakson library

UNIT-III

Spring Boot Feature Introduction: Introduction to Spring Boot Features, Value Proposition of Spring Boot and Creating a simple Boot application using Spring Initializer website **Spring Boot – Dependency Management:**

Dependency management using Spring Boot starters, how auto-configuration works, Configuration properties, overriding auto-configuration and Using CommandLineRunner

UNIT-IV

JDBC Simplification with JdbcTemplate: How Spring integrates with existing data access technologies, Spring's JdbcTemplate and DataAccessException hierarchy **Spring Boot – Spring Data JPA:** Quick introduction to ORM with JPA, Benefits of using Spring with JPA, JPA configuration in Spring, Configuring Spring JPA using Spring Boot, Spring Data JPA dynamic repositories **Transaction Management with Spring:** Transaction overview, Transaction management with Spring, Transaction propagation and rollback rules and Transactions and integration testing

UNIT-V

Testing a Spring-based Application: Spring and Test-Driven Development, Spring 5 integration testing with JUnit 5, Application context caching and the @DirtiesContext annotation, Profile selection with @ActiveProfiles, Easy test data setup with @Sql **Securing REST Application with Spring Security:** What problems does Spring Security solve? , Configuring authentication, implementing authorization by intercepting URLs, Authorization at the Java method level, Understanding the Spring Security filter chain and Spring security testing. **Actuators, Metrics and Health Indicators:** Exposing Spring Boot Actuator endpoints, Custom Metrics, Health Indicators, Creating custom Health Indicators and External monitoring systems

Text Books:

1. Mark Heckler, "Spring Boot Up and Running, 1st Edition", Oreilly, 2021.
2. Iuliana Cosmina, Rob Harrop, Chris Schaefer, Clarence Ho " Pro String 5", Fifth Edition, Apress, 2019

Suggested Reading:

1. Raja CSP Raman, Ludovic Dewailly, "Building A RESTful Web Service with Spring 5", Packt Publishing, 2018.

Web Resources:

1. https://spring.io/guides/gs/spring-boot/
2. https://docs.spring.io/spring-framework/docs/current/reference/html/index.html

20ADE07 **EXPLAINABLE ARTIFICIAL INTELLIGENCE**
(Professional Elective #3)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To Understand the concepts within Explainable AI and interpretable machine learning
2. To Demonstrate comprehension of current techniques for generating explanations from black-box machine learning methods
3. To Demonstrate the ability to select and assess Explainable AI methods
4. To Demonstrate comprehension of current ethical, social and legal challenges related to Explainable AI

Course Outcomes:

Upon completing this course, students will be able to:

1. Describe the context of the machine learning application and why explainability would help, but also scrutinize which kind of explainability technique is necessary.
2. Understand the concepts that are important in model validation, evaluation, and performance visualization for both supervised and unsupervised learning.
3. Install and set up one or more post hoc explain ability techniques through a self-chosen set of programming platforms.
4. Critically reflect on the results from Explainable deep learning techniques and suggest how it helps the problem context.
5. Demonstrate comprehension of challenges and future related to Explainable AI

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
CO2	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
CO3	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
CO4	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
CO5	2	2	2	2	1	1	1	1	1	1	1	2	2	2	2

UNIT-I

Introduction: Black-Box problem, Goals, Brief History, Purpose, Societal Impact, Types of Explanations, Trade-offs, Taxonomy, Flowchart for Interpretable and Explainable Techniques. **Pre-model Interpretability and Explainability:** Data Science Process and EDA, Exploratory Data Analysis, Feature Engineering

UNIT-II

Model Visualization Techniques and Traditional Interpretable Algorithms: Model Validation, Evaluation, and Hyperparameters, Model Selection and Visualization, Classification Model Visualization, Regression Model Visualization, Clustering Model Visualization, Interpretable Machine Learning Properties, Traditional Interpretable Algorithms

UNIT-III

Model Interpretability: Advances in Interpretable Machine Learning: Interpretable vs. Explainable Algorithms, Tools and Libraries, Ensemble-Based, Decision Tree-Based, Rule-Based Techniques, Scoring System. **Post-Hoc Interpretability and Explanations:** Tools and Libraries, Visual Explanation, Feature Importance, Example-Based

UNIT-IV

Explainable Deep Learning: Applications, Tools and Libraries, Intrinsic, Perturbation, Gradient / Backpropagation

UNIT-V

Explainability: Time Series Forecasting, Natural Language Processing, and Computer Vision **XAI: Challenges:** Properties of Explanation, Categories of Explanation, Taxonomy of Explanation Evaluation. **XAI: Future:** Formalization of Explanation Techniques and Evaluations, Adoption of Interpretable Techniques, Human-Machine Collaboration, Collective Intelligence from Multiple Disciplines, Responsible AI (RAI), XAI and Security, Causality and XAI

Text Books:

1. Uday Kamath and John Liu "Explainable Artificial Intelligence: An Introduction to Interpretable Machine Learning", Springer Cham, First Edition, 2021.

Suggested Reading:

1. Leonida Gianfagna and Antonio Di Cecco, "Explainable AI with Python", Springer International Publishing, First Edition, 2021.
2. Denis Rothman, "Hands-On Explainable AI (XAI) with Python", Packt Publishing, First Edition, 2020

Web Resources:

1. https://www.ibm.com/in-en/watson/explainable-ai
2. https://sites.google.com/view/explainable-ai-tutorial
3. https://cloud.google.com/explainable-ai

20ITE14 **APPLIED PREDICTIVE ANALYTICS**

(Professional Elective #3)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce Predictive Modeling.
2. To familiarize Regression and Classification Techniques.
3. To impart knowledge on the concepts of Support vector machines and Neural Networks.
4. To explore tree-based classifiers and ensemble methods
5. To introduce Topic modeling.

Course Outcomes:

Upon completing this course, students will be able to:

1. Comprehend predictive modeling and assess the performance
2. Apply regression techniques and analyze the performance
3. Demonstrate Support Vector Machines and build an efficient networking model
4. Analyze ensemble methods by choosing Tree based classifiers
5. Select appropriate probabilistic Graphical models and identify topics through topic modeling

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
CO2	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
CO3	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
CO4	3	3	3	3	3	2	2	2	2	2	2	2	3	3	2
CO5	2	2	2	2	1	1	1	1	1	1	1	2	2	2	2

UNIT-I

Gearing Up for Predictive Modeling: Models**, Types of models :** Supervised, unsupervised, semi-supervised, and reinforcement learning models, Parametric and nonparametric models, Regression and classification models, Real-time and batch machine learning models, **The process of Predictive Modeling:** Defining the model's objective, Collecting the data, Picking a model, Preprocessing the data, Exploratory data analysis, Feature transformations, Encoding categorical features, Missing data, Outliers, Removing problematic features, Feature engineering and dimensionality reduction, Training and assessing the model, Repeating with different models and final model selection, Deploying the model, **Performance metrics:** Assessing regression models, Assessing classification models, Assessing binary classification models.

UNIT-II

Linear Regression: Introduction to linear regression, Simple linear regression, Multiple linear regression, Assessing linear regression models, Problems with linear regression, Feature selection, Regularization, Ridge regression**.**

Logistic Regression: Classifying with linear regression, Assessing logistic regression models, Regularization with the lasso, Classification metrics, Extensions of the binary and Multinomial logistic classifier

UNIT-III

Support Vector Machines: Maximal margin classification, Support vector classification, Inner products**,** Kernels and support vector machines, Cross-validation.

Neural Networks: Stochastic gradient descent**:** Gradient descent and local minima, The perceptron algorithm, Linear separation, The logistic neuron, **Multilayer perceptron networks:** Training multilayer perceptron networks.

UNIT-IV

Tree-based Methods: The intuition for tree models, Algorithms for training decision trees-
Classification and regression trees, CART regression trees, Tree pruning, Missing data, Regression model trees CART classification trees, C5.0, Predicting complex skill learning, Variable importance in tree models, **Ensemble Methods: Bagging -** Margins and out-of-bag observations, Predicting heart disease with bagging, Limitations of bagging, **Boosting –** AdaBoost, Limitations of boosting, **Random forests-** The importance of variables in random forests

UNIT-V

Probabilistic Graphical Models: A little graph theory, Bayes' Theorem, Conditional independence, Bayesian networks, The Naïve Bayes classifier. Hidden Markov models- Predicting letter patterns in English words.**Topic Modeling:** An overview of topic modeling, Latent Dirichlet Allocation, The Dirichlet distribution, The generative process, Fitting an LDA model, Modeling the topics of online news stories, Model stability, Finding the number of topics, Topic distributions, Word distributions, LDA extensions.

Text Books:

1. Rui Miguel Forte, "Mastering Predictive Analytics with R", Packt Publishing Ltd, 2015.
2. Roger D. Peng, "R Programming for Data Science", Lean Publishing, 2015.

Suggested Reading:

1. Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Dean Abbott, 2014, Wiley.
2. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking, Tom Fawcett, O′Reilly, 1st edition, 2013.

Web Resources:

1. https://data-flair.training/blogs/r-predictive-and-descriptive-analytics/
2. https://www.littlemissdata.com/blog/predictive-analytics-tutorial-part-1
3. http://uc-r.github.io/mars
4. https://www.coursera.org/learn/design-thinking-predictive-analytics-data-products
5. https://www.coursera.org/learn/meaningful-predictive-modeling

20ITE16 **FUNDAMENTALS OF BLOCK CHAIN TECHNOLOGY**
(Professional Elective #3)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To Familiarize the basic concepts of blockchain.
2. To provide the significance of the bitcoin ecosystem.
3. To Explore the consensus mechanisms and technologies that support ethereum.
4. To introduce Hyperledger Fabric and its architecture.
5. To familiarize blockchain use cases in various domains.

Course outcomes:

Upon completing this course, students will be able to

1. Describe the concepts of distributed systems and blockchain properties.
2. Identify the significance of the bitcoin ecosystem.
3. Examine the consensus mechanisms and technologies that support ethereum.
4. Inspect Hyperledger Fabric and its architecture.
5. Analyze blockchain use cases in various domains.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	-	-	-	-	-	1	3	3	3
CO2	3	3	2	2	3	-	-	-	-	-	1	1	3	3	2
CO3	3	2	2	3	2	2	1	-	-	-	-	-	3	3	3
CO4	2	2	2	3	2	1	1	-	-	-	1	-	3	3	2
CO5	3	2	2	3	3	3	1	-	-	-	-	-	3	3	3

UNIT I

Introduction: Overview of distributed systems, Introduction to Blockchain, Generic elements of a blockchain, Features of Blockchain, Applications of Blockchain.
Cryptocurrency And Blockchain : Hash Functions and Merkle Trees, Components of Blockchain Ecosystem, Cryptography and Consensus Algorithms; Types of Blockchain, Blockchain Platforms.

UNIT II

Bitcoin Platform: Bitcoin definition, Keys and addresses , Public keys and Private keys in bitcoin, The transaction life cycle, The transaction structure, Bitcoin payments, Bitcoin investment and buying and selling bitcoins. Consensus mechanism in bitcoin
Wallets: Wallet types, Non-deterministic wallets, Deterministic wallets, Alternative Coins- Namecoin, Litecoin, Zcash
.

UNIT III

Smart contracts and Ethereum: Introducing Smart Contracts, Ethereum blockchain , The Ethereum stack, Ethereum virtual machine (EVM), Consensus mechanism in Ethereum, The Ethereum network, Ethereum Development, Setting up a development environment, Development tools and clients, Applications developed on Ethereum

UNIT IV

Hyperledger Fabric: Introduction to Hyperledger Fabric, Hyperledger Fabric architecture, Membership services Blockchain services, Hyperledger Projects- Fabric, Sawtooth lake, Iroha , Components of the Fabric, Peers or nodes, Applications on Blockchain, Alternate Blockchains- Ripple, Corda

UNIT V

Applications of Blockchain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade — Trade Finance Network, Supply Chain Financing, Identity on Block chain

Text Books:

1. Imran Bashir "Mastering Blockchain" 2nd Edition Packt Publishers, 2018.
2. Melanie Swan, "Block Chain: Blueprint for a New Economy", 1stEdition O'Reilly, 2018.

Suggested Reading:

1. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", 1stEdition, Apress, 2017.
2. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to BuildSmart Contracts for Ethereum and BlockChain", Packt Publishing, 2019.

Web Resources:

1. https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html
2. https://www.hyperledger.org/projects/fabric
3. https://www.packtpub.com/big-data-and-business-intelligence/hands-blockchain-hyperledger
4. https://www.amazon.com/Hands-Blockchain-Hyperledger-decentralized-applications/dp/1788994523
5. https://github.com/HyperledgerHandsOn/trade-finance-logistics

20ADE08 **AGILE PROJECT MANAGEMENT**

(Professional Elective #3)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course objectives:

1. To familiarize with Agile Life cycle models.
2. To provide insight into the Agile waterfall model and develop scope for requirements.
3. To explore the planning and scheduling mechanisms for Agile project development.
4. To introduce Quality principles in Agile space.
5. To familiarize with matrix management in Agile development.

Course outcomes:

Upon completing this course, students will be able to

1. Describe the Agile Life cycle models.
2. Identify the scope and requirements for Agile project development
3. Appraise the Agile Planning and scheduling mechanisms for an enterprise Agile project.
4. Describe the Quality Principles in the Agile space.
5. Analyze Matrix Management in the Agile Space

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	-	1	-	1	1	1	1	3	3	3
CO2	3	3	2	1	3	-	2	-	1	2	2	1	3	3	2
CO3	3	3	2	1	3	-	2	-	2	1	2	2	2	3	3
CO4	3	3	2	2	2	-	1	-	1	2	1	2	1	2	2
CO5	3	3	2	2	3	-	2	-	1	2	2	1	3	1	3

UNIT I

Agile Manifesto: Agile Principles,Traditional Lifecycle, Agile Lifecycle,Scaling for Enterprise Agile,Four Agile Methodologies-Representative Agile Methods,Advantages and Disadvantages of Agile Methods.
The Agile Business Case-Adding Value with the Business Case,Business Value Models Models for the Business Case,Building the Business Case by Levels

UNIT II

Agile in the Waterfall-First Principles and Requisite Conditions,The Black Box, Interfaces, and Connectivity,Milestone Planning, Monitoring, and Controlling, Change Management, Risk Management. **Developing the Scope and Requirements-**Agile Scope ,Evolving, Emerging, and Adaptive,Scope as a Best Value,Envisioning , Process for Requirements.

UNIT III

Planning and Scheduling-Planning in the Enterprise Context,Agile Planning Portfolio, Scheduling-Rhythm of the Schedule,Time Box Timelines and Calendars, Other Plans in the Enterprise Agile Project -Planning for Architecture and Nonfunctional Deliverables,Planning for Uncertainty.

UNIT IV

Quality in the Agile Space-Quality Values and Principles,Quality: Values, Principles, and Practices,Quality Values and Principles Are Planned into Agile Methods. **Sampling for Quality Validation-**Sampling, Process Limits and Benchmarks,Quality Measures from Users

UNIT V

Groups as the Genesis of Teams-Teams from Groups ,Principles of Successful Teams, Operating Model of the Agile Team,Managing the Team Network ,Team-of-Teams. **Matrix Management in the Agile Space-**Matrix Attributes,Matrix as an Agile Management Tool,Agile Teams Recruit Their Members

Text Books:

1. John C. Goodpasture, "Project Management the Agile Way -Making it Work in the Enterprise" **,** 2nd edition , JRoss Publishers 2016.
2. Alistair Cockburn, Agile Software Development: The Cooperative Game, Addison Wesley 2017.

Suggested Readings:

1. Robert C. Martin, "Agile Software Development, Principles, Patterns and Practices", Prentice Hall,2015.
2. Mike Cohn, "User Stories Applied: For Agile Software", Addison Wesley,2015.

Web Resources:

1. https://www.scrum.org/
2. https://www.udemy.com/course/agile-with-scrum-from-beginner-to-advanced-project-management-agile
3. https://www.coursera.org/learn/agile-project-management
4. https://www.coursera.org/learn/agile-atlassian-jira

20ADE09 **SOCIAL NETWORK ANALYSIS**
(Professional Elective #3)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To Describe about the current web development and emergence of social web
2. To Design modeling, aggregating and knowledge representation of semantic web
3. To Describe Association rule mining algorithms
4. To Summarize knowledge on extraction and analyzing of social web
5. To know the application in real time systems.

Course Outcomes:

Upon completing this course, student will be able to:

1. Understand the basics of social network analysis.
2. Analyze Ontology representation of social network data.
3. Apply supervised and unsupervised algorithms on social networks.
4. Interpret the semantic content of social media data.
5. Build social network model for real time applications.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	-	-	-	-	-	-	1	1	2	3	2
CO2	2	2	2	2	1	-	-	-	-	-	1	1	2	3	2
CO3	2	2	1	1	1	-	-	-	-	-	1	-	2	-	2
CO4	2	2	2	2	1	-	-	-	-	-	1	1	2	3	2
CO5	2	1	1	1	1	-	-	-	-	-	-	-	2	-	2

UNIT-I

INTRODUCTION: Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

UNIT-II

MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION: Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modeling and aggregating social network data: State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.

UNIT-III

ALGORITHMS AND TECHNIQUES: Association Rule Mining, Supervised Learning, Unsupervised Learning, Semi-supervised Learning, Markov models, K-Nearest Neighboring, Content-based Recommendation, Collaborative Filtering Recommendation, Social Network Analysis, Detecting Community Structure in Networks, the Evolution of Social Networks.

UNIT-IV

EXTRACTING AND ANALYZING WEB SOCIAL NETWORKS: Extracting Evolution of Web Community from a Series of Web Archive, Temporal Analysis on Semantic Graph using Three-Way Tensor, Decomposition, Analysis of Communities and their Evolutions in Dynamic Networks.

UNIT- V

APPLICATIONS: A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection.

Text Books:

1. Peter Mika, "Social Networks and the Semantic Web", Springer, 1st edition, 2007.
2. Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", Springer, 1st edition, 2012.
3. Przemyslaw Kazienko, Nitesh Chawla,"Applications of Social Media and Social Network Analysis", Springer,2015.

Suggested Reading:

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2012
2. Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 1 st edition, 2011
3. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2014
4. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.

Web Resource:

1. https://swayam.gov.in/nd1_noc19_cs66/preview

20ITC16 **SOFTWARE ENGINEERING LAB**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

1. Describe use case models that capture requirements of a software system.
2. Illustrate Dynamic models of a software system.
3. Build class diagrams that model a software system.
4. Acquaint with Activity and swimlane models.
5. Familiarize with analysis and design models.

Course Outcomes:

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

1. Interpret user requirements using the UML notation.
2. Illustrate Dynamic models of a software system.
3. Analyze and develop class diagrams that model a software system.
4. Develop Activity and swimlane models.
5. Outline analysis and design models.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	-	-	-	-	-	-	1	1	2	3	2
CO2	2	2	2	2	1	-	-	-	-	-	1	1	2	3	2
CO3	2	2	1	1	1	-	-	-	-	-	1	-	2	-	2
CO4	2	2	2	2	1	-	-	-	-	-	1	1	2	3	2
CO5	2	1	1	1	1	-	-	-	-	-	-	-	2	-	2

List of Programs

1. Construct Use case diagrams for the following
   a. Diagram editor.
   b. Library information system.
   c. Banking system.
2. Construct Sequence diagrams for the following.
   a. Mobile phone.
   b. Use case student register for a course.
   c. Diagram editor.
3. Construct Collaboration diagrams for the following
   a. Use case librarians issue books to students.
   b. Mobile phone.
   c Diagram editor.
4. Construct class diagrams for the following
   a. Diagram editor.
   b. Library information system.
   c. Banking system
5. Construct Activity diagrams for the following.
   a. ATM transaction.
   b. Ticket machine.
   c. Sales order processing.
6. Construct Swim lane diagrams for the following.
   d. Account.
   e. CD player.
   c. ATM machine
7. Case Studies**:**
   Prepare SRS, develop Analysis and design models for
   f. Passport automation system

g. Credit card processing
h. BPO management system
i. E-book management system
j. Recruitment system

8 Study of selenium web testing tools.
k. Selenium IDE
l. Selenium RC

9 Creating test cases for GUI based desktop applications.

Text Books:

1. Grady Booch, RobertA. Maksimchuk, "Object - Oriented Analysis and Design with Applications", Addision-Wesley, 3 rd Edition, ISBN No: 9780201895513, 2007.
2. Martina Seidl , Marion Scholz , Christian Huemer, GertiKappel "UML @ Classroom: An Introduction to Object-Oriented Modeling", Springer; 2015th edition, ISBN-10: 3319127411, (March 9, 2015)

Suggested Reading:

1. Martin Fowler, Kendall Scott, "UML Distilled**:** A Brief Guide to the Standard Object Modeling Language" Addison Wesley, 4th Edition, 2011.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli,"Fundamentals of Software Engineering", PHI,2nd Edition.
3. Unmesh Gundecha , Carl Cocchiaro ," Learn Selenium: Build data-driven test frameworks for mobile and web applications with Selenium Web Driver 3", ISBN : 183898304X, Packt Publishing (July 18, 2019)

Web Resources:

1. SEweb - Software Engineering Education Home Page:http://tuvalu.cs.flinders.edu.au/seweb/se-ed/
2. IBM Rationalhttp://www-306.ibm.com/software/rational/uml/
3. Practical UML - A Hands-On Introduction for Developers http://www.togethersoft.com/services/practical_guides/umlonlinec ourse
4. https://www.udemy.com/course/selenium-automation-testing-for-beginner

20ADC12 **DEEP LEARNING LAB**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

1. To impart knowledge on image data representation techniques.
2. To introduce the concept of Regression.
3. To familiarize with MLP and CNNs.
4. To familiarize with various CNN architectures.
5. To introduce the concept of RNNs.

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Preprocess the data to train on Neural Networks
2. Design and Implement Multilayer Perceptron Networks.
3. Identify suitable Neural Network topology to solve a problem.
4. Evaluate and Tune the Convolutional Neural Network models on real dataset(s)
5. Analyze and Tune the Recurrent Neural Network models on real dataset(s)

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	1	-	-	-	-	-	-	-	1	-	2
CO2	1	1	1	1	1	-	-	-	-	-	-	-	1	-	2
CO3	-	2	2	2	1	-	-	-	-	-	-	1	3	3	2
CO4	2	3	3	3	2	-	-	-	-	-	-	1	3	3	2
CO5	2	3	3	3	2	-	-	-	-	-	-	1	3	3	2

List of Programs

1. Implement Linear Regression, Softmax Regression
2. Implement Multilayer Perceptron Networks
3. Train and Model the Deep Convolutional Neural Networks (AlexNet)
4. Use Networks - Blocks in Networks(VGG)
5. Use Networks with Parallel Concatenations in GoogLeNet
6. Apply Batch Normalization in LeNet.
7. Implement Residual Networks (ResNet)
8. Model the Densely Connected Networks (DenseNet)
9. Use LSTM on document dataset
10. Use Encoder-Decoder on speech recognition dataset

Text Books:

1. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, “Dive into Deep Learning”, d2l.ai, 2021
2. Aurelien Geron, “Hands-on Machine Learning with Scikit-Learn, Keras, and Tensor Flow”, O’Reilly Media, 2nd Edition, 2019.

Suggested Reading:

1. Ian Goodfellow, Yoshua Bengio, Aaron , Courville, “Deep Learning”, MIT Press, 2016
2. Indra den Bakker, “Python Deep Learning Cookbook”, PACKT publisher, 2017
3. Wei Di, Anurag Bhardwaj, Jianing Wei, “Deep Learning Essentials”, Packt publishers, 2018

Datasets:

1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007

Web Resources:

1. https://www.coursera.org/specializations/machine-learning
2. http://nptel.ac.in/courses

20ADC13 **MINOR PROJECT-II**
(Data Science)

Instruction	3 Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1.5

Course Objectives:

1. To enable students learning by doing.
2. To develop capability to analyse and solve real world problems.
3. To apply innovative ideas of the students.
4. To learn the ability to build a data science project
5. To impart team building and management skills among students and instill writing and presentation skills for completing the project.

Course Outcomes:

Upon completing this course, students will be able to:

1. Interpret Literature with the purpose of formulating a project proposal.
2. Develop the ability to identify and formulate problems by applying diverse technical knowledge skills.
3. Apply the fundamental knowledge gained in the curriculum to model, design and implement a Data Science project.
4. Build a prototype by choosing appropriate technologies to meet the identified requirements.
5. Plan to work as a team and to focus on getting a working project done and submit a report within a stipulated period of time to the departmental Committee.

Minor Project is aimed to enable the students to develop a product/application based on the course Data Science with R, Course code - 20ADC11. The student has to implement and present the project as per the given schedule. During the implementation of the project, Personnel Software Process (PSP) has to be followed. Report of the project work has to be submitted for evaluation.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	3	3	3	2	2	2	3	3	2	-	3
CO2	3	3	3	3	3	3	3	2	2	2	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	2	2	3	3	3	3	3
CO4	3	3	2	3	3	3	3	2	3	3	3	3	3	3	3
CO5	1	2	2	2	3	3	-	-	3	3	-	2	1	-	-

Schedule

S No	Description	Duration
1.	Problem Identification / Selection	2 weeks
2.	Preparation of Abstract	1 week
3.	Data Collection and exploratory data analysis	2 weeks
4.	Data Modeling Techniques	3 weeks
5.	Implementation and inferences	2 weeks
6.	Documentation and Project Presentation	3 weeks

Guidelines for the Award of marks

S. No.	Description	Max. Marks
Final Assessment		30
1.	PPT Preparation	10
2.	Technical Content	10
3.	Question and Answers	5
4.	Report Preparation	5

- The CIE evaluation is based on the rubrics for evaluation on weekly basis.
- Final Minor Project demonstration and PPT presentation is to be evaluated for the entire class together by the entire faculty handling Minor Project for that class.

20EGC03 **EMPLOYABILITY SKILLS**

Instruction	2 Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Course Objectives:

1. To Learn the art of communication, participate in group discussions and case studies with confidence and to make effective presentations.
2. To With- resume packaging, preparing them to face interviews.
3. To Build an impressive personality through effective time management, leadership qualities, self-confidence and assertiveness.
4. To Understand professional etiquette and to make them learn academic ethics and value system.
5. To be competent in verbal aptitude.

Course Outcomes:

Upon completing this course, students will be able to

1. Become effective communicators, participate in group discussions with confidence and be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals, learn to manage time effectively and deal with stress.
4. Mak**e** the transition smoothly from campus to work, use media with etiquette and understand the academic ethics.
5. Enrich their vocabulary, frame accurate sentences and comprehend passages confidently.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	2	2	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	2	-	-	-	-	-	2		-	2	-	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-

UNIT 1

Verbal Aptitude: Error Detection, Articles, Prepositions, Tenses, Concord and Transformation of Sentences-Jumbled Words/Sentences- Vocabulary, Synonyms, Antonyms, One Word Substitutes, Idioms and Phrases, Word/Sentence/Text Completion- Reading Comprehension.

UNIT 2

Group Discussion & Presentation Skills: Dynamics of Group Discussion-Case Studies- Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Accuracy, Coherence. Elements of Effective Presentation – Structure of a Presentation – Presentation tools – Body language - Preparing an Effective PPT

UNIT 3

Behavioural Skills: Personal strength analysis-Effective Time Management- Goal Setting- Stress management- **Corporate Culture** – Grooming and etiquette-Statement of Purpose (SOP).

UNIT 4

Mini Project: Research-Hypothesis-Developing a Questionnaire-Data Collection-Analysis-General and Technical Report - Writing an Abstract –Technical Report Writing-Plagiarism-Project Seminar.

UNIT 5

Interview Skills: Cover Letter and Résumé writing – Structure and Presentation, Planning, Defining the Career Objective, Projecting ones Strengths and Skill-sets – Interviews: Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Mock Interviews.

Suggested Reading:

1. Leena Sen, "Communication Skills", Prentice-Hall of India, 2005
2. Dr. Shalini Verma, "Body Language - Your Success Mantra", S Chand, 2006
3. Edgar Thorpe and ShowickThorpe , "Objective English", 2nd edition, Pearson Education, 2007
4. Ramesh, Gopalswamy, and Mahadevan Ramesh, "The ACE of Soft Skills", New Delhi: Pearson, 2010
5. Gulati and Sarvesh, " Corporate Soft Skills", New Delhi: Rupa and Co. , 2006
6. Van Emden, Joan, and Lucinda Becker, "Presentation Skills for Students", New York: Palgrave Macmillan, 2004
7. A Modern Approach to Verbal & Non-Verbal Reasoning by R S Aggarwal, 2018
8. Covey and Stephen R, "The Habits of Highly Effective People", New York: Free Press, 1989

With effect from the Academic Year 2022-23

R-20
B.E. (AI&DS)
Scheme and Syllabus of
VII-VIII Semesters
w.e.f. 2022-23

With effect from the Academic Year 2022-23

1.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instruction of VII Semester of B.E. – Artificial Intelligence and Data Science as per AICTE Model Curriculum, with effective from 2022-23

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER –VII

S. No	Course code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	20ADC14	Big Data Analytics	3		3	40	60	3
2		Professional Elective – 4	3	-	3	40	60	3
3		Open Elective – 1	3	-	3	40	60	3
4	20EGM03	Universal Human Values II: Understanding Harmony	3	-	3	40	60	3
5	20EGMO4	Gender Sensitization	2	-	2	-	50	NC
PRACTICALS								
1	20ADC15	Big Data Analytics Lab		3	3	50	50	1.5
2	20ADC16	Project Part – 1	-	4	-	50	-	2
3		Internship	4-6 Weeks 135 Hours		-	-	-	3
TOTAL			**14**	**7**	**17**	**260**	**340**	**18.5**

L: Lecture **T: Tutorial** **D: Drawing** **P: Practical**
CIE – Continuous Internal Evaluation **SEE - Semester End Examination**

Professional Elective #4	Unmanned Aerial Vehicles 20ITE15	Robotic Process Automation 20ADE10	Business Intelligence 20ADE11	Server Less Computing 20ADE12	Digital Forensics 20ITE26	Reinforcement Learning 20ADE13

Open Elective- 1 (VII Semester)		
S.No.	**Course Code**	**Course Name**
1.	20MEO03	Research Methodologies
2.	20MEO12	3D Printing
3.	20ME O15	Principles of Industry 4.0
4.	20ECO14	Neural Networks and Fuzzy Logic
5.	20EGO01	Technical Writing Skills

With effect from the Academic Year 2022-23

20ADC14 **BIG DATA ANALYTICS**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce the importance of big data, role of Hadoop framework in analyzing large datasets by writing mapper and reducer for a given problem.
2. To familiarize writing queries in Pig and Hive to process big data
3. To present latest big data frameworks and applications using Spark and Scala.
4. To discuss the concept and writing applications using SparkSQL
5. To provide the concepts of NoSQL databases and study the working mechanisms of MongoDB.

Course Outcomes:

Upon completing this course, students will be able to:

1. Understand the processing large datasets in Hadoop framework and Apply MapReduce architecture to solve real world problems.
2. Develop scripts using Pig over large datasets and query using Hive.
3. Understand the fundamentals of Spark and the Scala programming.
4. Expertise in using Resilient Distributed Datasets (RDD) for creating applications in Spark and query using SparkSQL.
5. Understand NoSQL databases and Develop data models using MongoDB.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	-	-	-	2	3	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	2	3	3	2
CO3	3	3	2	2	-	-	-	-	-	-	-	2	3	3	3
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	3	2
CO5	3	3	2	2	-	-	-	-	-	-	-	2	3	3	3

UNIT-I

What is Big Data? Why is Big Data Important: When to consider a Big data solution, Big Data use cases **The Hadoop Distributed Files system:** The Design of HDFS, HDFS Concepts, HDFS Federation, HDFS High Availability, Basic File system Operations, Hadoop File systems, Anatomy of a File Read, Anatomy of a File Write. **Map Reduce:** What is Map reduce, Architecture of map reduce. **How Map Reduce Works**: Anatomy of a Map Reduce Job Run, Failures in Map Reduce. **Map Reduce Types and Formats:** Map Reduce Types, The Default Map Reduce Job, Input Formats, Input Splits and Records, Text Input, Output Formats, Text Output, Developing a Map Reduce Application

UNIT-II

Pig: Installing and Running Pig, an Example, Generating Examples, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators, Pig in Practice. **Hive:** Installing Hive, The Hive Shell, An Example, Running Hive, Comparison with Traditional Databases, Hive QL, Tables, Querying Data, User-Defined Functions, Writing a User Defined Functions, Writing a User Defined Aggregate Function

UNIT-III

Introduction to Spark: What is Apache Spark, History of Spark, The Present and Future of Spark, Running Spark, Spark's Basic Architecture Spark Applications Spark's Language APIs Spark's APIs Starting Spark, The Spark Session Data Frames, Partitions, Transformations, Lazy Evaluation, Actions, Spark UI, An End-to-End Example, Data Frames and SQL. **Spark's Toolset:** Running Production Applications, Datasets: Type-Safe Structured APIs, Structured Streaming, Machine Learning and Advanced Analytics, Lower-Level APIs, Spark R, Spark's Ecosystem and Packages.

UNIT-IV

Spark SQL: What Is SQL?, Big Data and SQL: Apache Hive, Spark SQL, Spark's Relationship to Hive, How to Run Spark SQL Queries, Catalog, Tables, Views, Databases, Select Statements, **Datasets**: When to Use Datasets, Creating Datasets, Actions, Transformations **Resilient Distributed Datasets**: Introduction to RDDs, Creating RDDs, Manipulating RDDs, Transformations, Actions, Saving Files, Caching, Check pointing, Pipe RDDs to System Commands

UNIT-V

No SQL Databases: Review of traditional Databases, Need for NoSQL Databases, Columnar Databases, Failover and reliability principles, CAP Theorem, Differences between SQL and NoSQL databases, **Working mechanisms of Mongo DB**: Overview, Advantages, Environment, Data Modelling, Create Database, Drop Database, Create collection, Drop collection, Data types, Insert, Query, Update and Delete operations, Limiting and Sorting records, Indexing, Aggregation.

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. Bill Chambers, Matei Zaharia, "Spark: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2018

Suggested Reading:

1. Thilinagunarathne Hadoop MapReduce v2 Cookbook – 2nd Edition, Packet Publishing, 2015.
2. Chuck Lam, Mark Davis, Ajit Gaddam, "Hadoop in Action", Manning Publications Company, 2016.
3. Alex Holmes," Hadoop in Practice", Manning Publications Company, 2012.
4. Alan Gates, "Programming Pig", O'Reilly Media Inc, 2011.
5. Edward Capriolo, Dean Wampler, and Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, October 2012.

Web Resources:

1. http://www.planetcassandra.org/what-is-nosql
2. http://www.iitr.ac.in/media/facspace/patelfec/16Bit/index.html
3. https://class.coursera.org/datasci-001/lecture
4. http://bigdatauniversity.com

Unit 2: 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.

Unit 3: 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 fulfilment to ensure mutual happiness; Trust and Respect as the foundational values ofrelationship
- Understanding the meaning of Trust; Difference between intention andcompetence
- 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 HumanGoals
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Unit 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

- Understanding the harmony in theNature
- Interconnectedness and mutual fulfilment among the four orders of nature - recyclability and self- regulation innature
- Understanding Existence as Co-existence of mutually interacting units in all - pervasivespace
- Holistic perception of harmony at all levels ofexistence.

Unit 5: 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

Assessment:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self- assessment, peer assessment etc. will be used in evaluation. Example:
Assessment by faculty mentor: 10
marks Self-assessment/Assessment
by peers: 10 M
Socially relevant project/Group Activities/Assignments: 20
marks Semester End Examination: 60 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

Text Books

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Valuesand Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1 The teacher's manual
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. ISBN978-93-87034-53-2

Reference Books

1. A Nagaraj Jeevan Vidya: EkParichaya, Jeevan Vidya Prakashan, Amar kantak,1999.
2. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi,2004.
3. Cecile Andrews, Slow isBeautiful
4. Gandhi - Romain Rolland (English)
5. Dharampal, "Rediscovering India"
6. E. FSchumacher. "Small isBeautiful"
7. J. C. Kumarappa "Economy ofPermanence"
8. Pandit Sunderlal "Bharat Mein AngrejiRaj"
9. Mohandas Karamchand Gandhi "The Story of My Experiments withTruth"
10. 10.Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
11. Maulana Abdul Kalam Azad, India Wins Freedom-
12. Vivekananda - Romain Rolland(English)
13. The Story of Stuff(Book)

With effect from the Academic Year 2022-23

20EGMO4 **GENDER SENSITIZATION**

Instruction	3 Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	--

Course Objectives

This course will introduce the students to:

1. Sensibility regarding issues of gender in contemporary India.
2. A critical perspective on the socialization of men and women.
3. Popular debates on the politics and economics of work while helping them reflect critically on gender violence.

Course Outcomes

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

1. Understand the difference between "Sex" and "Gender" and be able to explain socially constructed theories of identity.
2. Recognize shifting definitions of "Man" and "Women" in relation to evolving notions of "Masculinity" and "Femininity".
3. Appreciate women's contributions to society historically, culturally and politically.
4. Analyze the contemporary system of privilege and oppressions, with special attention to the ways gender intersects with race, class, sexuality, ethnicity, ability, religion, and nationality.
5. Demonstrate an understanding ofpersonal life, the workplace, the community and active civic engagement through classroom learning.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	2	2	-	2	-	-	-

UNIT – I

Understanding Gender:
Gender: Why Should We Study It? (*Towards a World of Equals*: Unit -1)
Socialization: Making Women, Making Men (*Towards a World of Equals*: Unit -2)
Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

UNIT – II

Gender And Biology:
Missing Women: Sex Selection and Its Consequences (*Towards a World of Equals*: Unit -4)
Declining Sex Ratio. Demographic Consequences.
Gender Spectrum: Beyond the Binary (*Towards a World of Equals*: Unit -10)
Two or Many? Struggles with Discrimination.

UNIT – III

Gender andLabour:
Housework: the Invisible Labour (*Towards a World of Equals*: Unit -3)
"My Mother doesn't Work." "Share the Load."
Women's Work: Its Politics and Economics (*Towards a World of Equals*: Unit -7)
Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

UNIT-IV

Issues Of Violence
Sexual Harassment: Say No! (*Towards a World of Equals*: Unit -6)
Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "*Chupulu".*
Domestic Violence: Speaking Out (*Towards a World of Equals*: Unit -8)
Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading: New Forums for Justice. Thinking about Sexual Violence (*Towards a World of Equals*: Unit -11)
Blaming the Victim-"I Fought for my Life…." - Additional Reading: The Caste Face of Violence.

UNIT – V

Gender: Co - Existence
Just Relationships: Being Together as Equals (*Towards a World of Equals*: Unit -12)
Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers.
Additional Reading: Rosa Parks-The Brave Heart.

Textbook:

1. A. Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote,VasudhaNagaraj, AsmaRasheed, GoguShyamala, DeepaSreenivas and Susie Tharu "Towards a World of Equals: A Bilingual Textbook onGender" published by Telugu Akademi, Hyderabad,Telangana State, 2015.

Suggested Reading:

1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
2. AbdulaliSohaila. "I Fought For My Life…and Won."Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

Web Resources:

1. https://aifs.gov.au/publications/gender-equality-and-violence-against-women/introduction
2. https://theconversation.com/achieving-gender-equality-in-india

With effect from the Academic Year 2022-23

20ADC15 **BIG DATA ANALYTICS LAB**

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

Course Objectives:

This course is introduced to

1. To provide the knowledge to set up a Hadoop Cluster and implement applications using MapReduce.
2. To introduce Pig, PigLatin and HiveQL to process big data.
3. To get familiarized with the latest big data frameworks and writing applications using Spark and Scala.
4. To learn querying large datasets with SparkSQL.
5. To gain knowledge to work with NoSQL databases.

Course Outcomes:

After successful completion of the course, student will be able to:

1. Explain Hadoop working environment and develop applications using MapReduce framework.
2. Develop scripts using Pig to solve real world problems and query the datasets using Hive.
3. Develop applications in Spark environment using RDDs.
4. Query real time data using SparkSQL.
5. Query large datasets using NoSQL.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	2	-	-	-	-	-	3	-
CO3	-	-	-	1	-	2	-	2	-	-	-	-	-	3	-
CO4	-	-	-	2	3	-	-	-	-	-	-	-	-	3	-
CO5	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-

List of Programs:

1. Exploring and using basic HDFS commands.
2. Implement following applications using Mapreduce on single node cluster
   (i) Word Count Application
   (ii) Analysis of Weather Dataset
   (iii) Uber Data Analysis
   (iv) Web Log Analysis
3. Working with Pig Latin Script and HiveQL.
4. Understanding the processing of large dataset on Spark framework and working with Spark SQL.
5. Designing and modeling NOSQL databases with MongoDB.

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. Bill Chambers, Matei Zaharia, “Spark: The Definitive Guide”, 4th Edition, O'Reilly Media Inc, 2018
3. Tanmay Deshpande, “Hadoop Real-World Solutions Cookbook”, 2nd Edition, Packt Publishing, 2016.

Suggested Reading:

1. Edward Capriolo, Dean Wampler, and Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, October 2012.
2. VigneshPrajapati, "Big data Analytics with R and Hadoop", Packt Publishing, November 2013.

Web Resources:

1. https://parthgoelblog.wordpress.com/tag/hadoop-installation
2. http://www.iitr.ac.in/media/facspace/patelfec/16Bit/index.html
3. https://class.coursera.org/datasci-001/lecture
4. http://bigdatauniversity.com

With effect from the Academic Year 2022-23

20ADC16 **PROJECT PART–I**

Instruction	4 Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Prerequisite: Knowledge of core engineering courses, Capable of searching for suitable literature, Problem Identification and Solving.

Course Objectives:

1. The student takes up investigative study in the broad field of Engineering / Technology, involving both theoretical and practical knowledge.
2. Motivate student(s) towards Research & Development with creative problem solving.

Course Outcomes:

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

1. Identify problem from literature survey in his/her area of interest
2. Formulate possible solutions for the selected problem and compare with existing ones
3. Prepare synopsis of the selected problem
4. Gather the required information to set up the environment for the implementation of preliminary experimentation
5. Communicate the work effectively in both oral and written forms

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	1	-	3	1	1	3	3	3	2
CO2	3	3	2	1	1	-	1	-	3	2	1	3	3	3	2
CO3	3	3	3	3	3	-	1	-	3	3	2	3	3	3	3
CO4	3	3	2	3	3	-	1	-	3	3	2	3	3	3	3
CO5	3	2	2	2	1	-	1	2	3	3	2	3	3	3	3

The work shall include:

1. Survey and study of published literature on the assigned topic
2. Preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for Presentation to the Department;
5. Final Seminar, as oral Presentation before a Departmental Research Committee.

With effect from the Academic Year 2022-23

20MEO03 **RESEARCH METHODOLOGIES**

(Open Elective-1)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To make the students to formulate the research problem.
2. To identify various sources for literature review and data collection.
3. To prepare the research design.
4. To equip the students with good methods to analyze the collected data.
5. To explain how to interpret the results and report writing.

Course Outcomes:

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

1. Define research problem.
2. Review and assess the quality of literature from various sources.
3. Understand and develop various research designs.
4. Analyze problem by statistical techniques: ANOVA,F-test,Chi-square.
5. Improve the style and format of writing a report for technical paper/Journal report.

UNIT – I

Research methodology: Objectives and motivation of research, types of research- descriptive vs. analytical, applied vs. fundamental, quantitative vs. qualitative, conceptual vs. empirical, research approaches, significance of research, research methods vs. methodology, research process, criteria of good research, problems encountered by researchers in India, technique involved in defining a problem.

UNIT–II

Literature survey: Importance of literature survey, sources of information-primary, secondary, tertiary, assessment of quality of journals and articles, information through internet.

UNIT – III

Research design: Meaning of research design, need of research design, feature of a good design important concepts related to research design, different research designs, basic principles of experimental design, steps insample design.

UNIT – IV

Data collection: Collection of primary data, Secondary data, measures of central tendency-mean, mode, median, measures of dispersion- range, mean deviation, standard deviation, measures of asymmetry (skewness), important parametric tests -z, t, F, Chi-Square, ANOVA significance.

UNIT – V

Research report formulation and presentation: Synopsis, dissertation, technical paper and journal paper, writing research grant proposal, making presentation with the use of visual aids, writing a proposal for research grant.

Text Books*:*

1. C.R Kothari, Research Methodology Methods & Technique, New Age International Publishers, 2004.
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011.
3. Vijay Upagade and AravindShende, Research Methodology, S. Chand &Company Ltd., Ne Delhi, 2009.

Suggested Reading:

1. G. Nageswara Rao, Research Methodology and Quantitative methods, BS Publications, Hyderabad, 2012.
2. Naval Bajjai, Business Research Methods, Pearson Education,2011.

With effect from the Academic Year 2022-23

20ECO14 **NEURAL NETWORKS AND FUZZY LOGIC**
(Open Elective-1)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Probability knowledge is required

Course Objectives:
1. Learn various types of neural networks
2. Learn the concepts of Fuzzy systems
3. Study the applications of neural networks and Fuzzy controllers.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the principles of Neural Networks and Fuzzy Logic fundamentals.
2. Apply the basic concepts to model the Neural Networks and Fuzzy Logic systems.
3. Compare the Neural Network based systems and Fuzzy Logic based systems.
4. Analyze Fuzzy Logic controllers and its applications.
5. Explain the concepts of Fuzzy target tracing control systems.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	1	1	1	1	1	-	-	-	-	-	-	2	2	1	1
CO2	3	3	2	2	1	-	-	-	-	-	-	2	3	1	1
CO3	2	2	2	1	1	-	-	-	-	-	-	1	2	1	1
CO4	2	2	3	2	1	-	-	-	-	-	-	2	3	1	1
CO5	1	1	2	1	2	-	-	-	-	-	-	1	2	1	1

UNIT-I
Introduction: Introduction to ANS (Artificial Neural systems) Technology, ANS simulation, Types of Neural Networks: Hopfield, perceptron and related models, Adaline and Madaline: Adaline and the Adaptive Linear Combiner, the Madaline and simulating the Adaline.

UNIT-II
Probabilistic Models, Fuzzy ARTMAP and Recurrent Networks:Probabilistic Neural Networks, General Regression Neural Networks, Fuzzy ARTMAP, Recurrent Back propagation Neural Networks.

UNIT-III
Application of Neural Networks: - Design and optimization of Systems: Non-Linear optimization, Inverse design problems, Pattern Recognition Applications: Control Chart pattern Recognition, Recognition of Machine-Cells in a group technology layout. Complex pattern Recognition tasks: Pattern mapping, pattern variability.

UNIT-IV
Introduction to Fuzzy systems, Fuzzy sets and operations on Fuzzy sets, Basics of Fuzzy relations, Fuzzy measures, Fuzzy integrals, Transform Image coding with Adaptive Fuzzy systems.

UNIT-V
Fuzzy Target Tracking control systems, Fuzzy and Math Model Controllers, Real Time Target Tracking, Fuzzy Controller, Fuzzified CMAC and RBF – Network based self-learning Controllers.

Text Books:

1. James A. Freeman and David M. Skapura, "Neural Networks: Algorithms Applications and Programing Techniques", Pearson Education, India, 2008.
2. James A. Anderson, "An introduction to Neural Networks", PHI, 2003.

Suggested Readings:

1. B. Yegnanarayana, "Artificial Neural Networks", PHI Publications, India, 2006.
2. M.AnandaRao and J.Srinivas, "Neural Networks:Algorithms and Applications", Narosa Publications, 2009

With effect from the Academic Year 2022-23

20EGO01 **TECHNICAL WRITING SKILLS**

(Open Elective-1)

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 marks
CIE	40 marks
Credits	3

Course Objectives:

1. Process of communication and channels of communication in general writing and technical writing in particular.
2. Learn Technical Writing including sentence structure and be able to understand and use technology specific words.
3. Write business letters and technical articles.
4. Write technical reports and technical proposals.
5. Learn to write agenda, record minutes of a meeting, draft memos. Understand how to make technical presentations.

Course Outcomes:

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

1. Communicate effectively, without barriers and understand aspects of technical communication.
2. Differentiate between general writing and technical writing and write error free sentences using technology specific words
3. Apply techniques of writing in business correspondence and in writing articles.
4. Draft technical reports and technical proposals.
5. Prepare agenda and minutes of a meeting and demonstrate effective technical presentation skills.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	2	2	-	-	-	-
CO2	-	-	-	-	-	-	-	-		2	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	2	-	-	-	-	-	2	-	-	2	-	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-

UNIT-I

Communication – Nature and process. **Channels of Communication** – Downward, upward and horizontal communication. Barriers to communication.**Technical Communication** – Definition, oral and written communication. Importance and need for Technical communication. Nature of Technical Communication. Aspects and forms of Technical communication. Technical communication Skills – Listening, Speaking, Reading & Writing.

UNIT-II

Technical Writing – Techniques of writing. Selection of words and phrases in technical writing. Differences between technical writing and general writing. Abstract and specific words. Sentence structure and requisites of sentence construction. Paragraph length and structure.

UNIT-III

Business correspondence – Sales letters, letters of Quotation, Claim and Adjustment letters. **Technical Articles** : Nature and significance, types. Journal articles and Conference papers, elements of technical articles.

UNIT-IV

Technical Reports : Types, significance, structure, style and writing of reports. Routine reports, Project reports

Technical Proposals : Definition, types, characteristics, structure and significance.

UNIT-V

Mechanics of Meetings : Preparation of agenda, participation, chairing and writing minutes of a meeting. Memorandum. Seminars, workshops and conferences.

Technical Presentations : Defining purpose, audience and locale, organizing content, preparing an outline, use of Audio Visual Aids, nuances of delivery, importance of body language and voice dynamics.

Text Books :

1. Meenakshi Raman & Sangeeta Sharma, **"Technical Communications-Principles and Practice",** Oxford University Press, Second Edition, 2012.
2. 1.M Ashraf Rizvi, **"Effective Technical Communication",** Tata McGraw Hill Education Pvt Ltd, 2012.

Suggested Reading :

1. Kavita Tyagi & Padma Misra, **"Basic Technical Communication",** PHI Learning Pvt Ltd, 2012.
2. R.C Sharma & Krishna Mohan, **"Business Correspondence and Report Writing",** Tata McGraw Hill, 2003

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18_mg13/preview
2. https://www.technical-writing-training-and-certification.com/
3. https://academy.whatfix.com/technical-writing-skills

With effect from the Academic Year 2022-23

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Scheme of Instruction of VIII Semester of B.E. – Artificial Intelligence and Data Science as per AICTE Model Curriculum, with effective from 2022-23

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

SEMESTER –VIII

S.No	Course code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1		Open Elective – 2	3	-	3	40	60	3
2		Open Elective – 3	3		3	40	60	3
PRACTICALS								
3	20ADC17	Technical Seminar	-	2	-	50	-	1
4	20ADC18	Project Part -2	08 Hours per week /180 Hours Industry		-	100	100	4
TOTAL			**6**	**2**	**6**	**230**	**220**	**11**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE – Continuous Internal Evaluation SEE - Semester End Examination

Open Elective- 2 (VIII Semester)			Open Elective- 3 (VIII Semester)		
S.No.	**Subject Code**	**Subject Name**	**S.No.**	**Subject Code**	**Subject Name**
1	20MEO04	Principles of Entrepreneurship	1	20MTO03	Quantum Computing
2	20BTO04	Bioinformatics	2	20MEO07	Intellectual Property Rights
3	20MEO10	Introduction to Operations Research	3	20ECO01	Remote Sensing and GIS
4	20ECO06	Principle of VLSI	4	20CEO02	Disaster Risk Reduction and Management
5	20EEO04	Energy Conservation	5	20BTO05	Cognitive Neuro Science

With effect from the Academic Year 2022-23

20ADC17 **TECHNICAL SEMINAR**

Instruction	4 Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state of the art topics in a broad area of his/her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

Course Outcomes:

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

1. Collect Organize, Analyze and Consolidate information about emerging technologies from the literature.
2. Exhibit effective communication skills, stage courage, and confidence.
3. Demonstrate intrapersonal skills.
4. Explain new innovations/inventions in the relevant field.
5. Prepare Seminar Report in a prescribed format.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	3	3	1	2	2	2	3	3	3	3
CO2	0	2	2	1	1	3	3	1	1	3	2	3	2	0	1
CO3	3	2	2	2	1	3	3	0	1	2	1	3	3	3	3
CO4	3	2	2	2	1	3	3	0	1	2	1	3	2	0	1
CO5	3	2	1	1	2	3	3	0	1	3	2	3	2	0	1

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule shall be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall be preferably from any peer reviewed recent journal publications.

Guidelines for awarding marks		
S. No.	Description	Max Marks
1.	Contents and Relevance	10
2.	Presentation Skills	10
3.	Preparation of PPT slides	05
4.	Questions and Answers	05
5.	Report in a prescribed format	20

With effect from the Academic Year 2022-23

20MEO04 **PRINCIPLES OF ENTREPRENEURSHIP**

(Open Elective-2)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Concept and procedure of idea generation.
2. The nature of industry and related opportunities and challenges.
3. Elements of business plan and its procedure.
4. Project management and its techniques.
5. Behavioral issues and Time management.

Course Outcomes:

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

1. Understand the concept and essence of entrepreneurship.
2. Identify business opportunities and nature of enterprise.
3. Analyze the feasibility of new business plan.
4. Apply project management techniques like PERT and CPM for effective planning and execution of projects.
5. Use behavioral, leadership and time management aspects in entrepreneurial journey

UNIT-I

Entrepreneurship: Definition, functions of entrepreneurship, qualities of entrepreneurs, identification and characteristics of entrepreneurs, entrepreneur vs. intrapreneur, first generation entrepreneurs, women entrepreneurs, conception and evaluation of ideas and their sources.

UNIT-II

Indian industrial environment: Competence, opportunities and challenges, entrepreneurship and economic growth, small scale industry in India, objectives, linkage among small, medium and heavy industries, types of enterprises, corporate social responsibility.

UNIT-III

Business plan: Introduction, elements of business plan and its salient features, business model canvas, technical analysis, profitability and financial analysis, marketing analysis, feasibility studies, executive summary, selection of technology and collaborative interactions.

UNIT-IV

Project management: During construction phase, project organization, project planning and control using CPM, PERT techniques, human aspects of project management, assessment of tax burden.

UNIT-V

Behavioral aspects of entrepreneurs: Personality, determinants, attributes and models, leadership concepts and models, values and attitudes, motivation aspects, time management: approaches of time management, their strengths and weaknesses. time management matrix and the urgency addiction .

Text Books:

1. Vasant Desai, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, 1997.
2. Prasanna Chandra, Project-Planning, Analysis, Selection, Implementation and Review, Tata Mcgraw- Hill Publishing Company Ltd, 1995.
3. S.S. Khanka, Entrepreneurial Development, S. Chand & Co. Pvt. Ltd., New Delhi, 2015.

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, Entrepreneurship, 5th edition, Tata Mc Graw Hill Publishing Company Ltd., 2005.
2. Stephen R. Covey and A. Roger Merrill, First Things First, Simon and Schuster Publication,1994.

With effect from the Academic Year 2022-23

20EEO04 **ENERGY CONSERVATION**

(Open Elective-2)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Students should have prior knowledge on Fundamentals of power systems, electrical machines, and power electronics.

Course Objectives:

1. To know the concept of Energy conservation
2. To understand the formulation of efficiency for various engineering systems
3. To explore the different ways to design various technologies for efficient engineering systems.

Course Outcomes:

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

1. Know the current energy scenario and importance of energy conservation.
2. Understand the concepts of energy conservation.
3. Evaluate the performance of existing engineering systems.
4. Explore the methods of improving energy efficiency in different engineering systems.
5. Understanding different energy efficient devices.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2		2									
CO2	3	2		3		1									
CO3	3	3	2	3	2	2							2	1	
CO4	3	2	2	2	2	1							2	1	
CO5	2	2	1	2	2	1									

UNIT-I

Basics of Energy and its various forms: Overview of engineering elements, Solar energy, electricity generation methods using solar energy, PV cell, elements of wind energy, electricity generation using wind energy, elements of bioenergy, biomass energy conservation, sources of chemical energy, fuel cells, Energy Scenario in India.

UNIT-II

Energyconservation-1: Domestic Sector: Energy conservation needs and objectives, energy conservation strategies in domestic sector, energy conservation tips in the kitchen, other energy saving tips in the domestic house, energy conservation measures in office, energy conservation processes/activities for a building. HVAC (heating, ventilation, air conditioning), components of HVAC, energy conservation opportunities in HVAC systems.

UNIT-III

Energy conservation-2: Industrial Sector: Energy conservation in Indian industrial sector, energy saving potential in industry: boiler, furnaces, air compressors, refrigeration systems, heat exchanger, heat pump, turbines, electric drives, pumps, cooling towers, fans and blowers.

Energy conservation in agriculture sector: Energy conservation opportunities in pumps used in agriculture sector, summary.

UNIT-IV

Energy Efficient Technologies-I: Importance of energy efficiency for engineers, Energy efficient technology in mechanical engineering: Heating, ventilation and air-conditioning, boiler and steam distribution systems. Energy efficient technology in civil engineering: future of roads, harnessing road and transport infrastructure; Energy efficient technology in agriculture: IoT and Drone Technology.

UNIT-V

Energy Efficient Technologies-II: Energy efficient technology in electrical engineering: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors; Energy efficient technology in chemical engineering: green chemistry, low carbon cements, recycling paper. Green buildings concept.

Text Books:

1. Umesh Rathore, "Energy management", Kataria publications, 2nd ediiton,2014.
2. Guide books for National Certification Examination for Energy Manager/EnergyAuditorsBook-1, General Aspects
3. Hargroves,K., Gockowiak,K., Wilson,K., Lawry,N., and Desha,C. (2014) "An Overview of Energy Efficiency" , opportunities in Mechanical/civil/electrical/chemical Engineering, The University of Adelaide and Queensland University of Technology.

With effect from the Academic Year 2022-23

20MTO03 **QUANTUM COMPUTING**

(Open Elective-3)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To learn Quantum bits and compute mathematical foundation
2. To understand the evaluation of the quantum bits.
3. To learn Quantum operations by building blocks of Quantum programming
4. To know the basics of Quantum logic gates and circuits
5. To learn Quantum Algorithms by various Techniques.

Course Outcomes:

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

1. Compute basic mathematical operations on Quantum bits.
2. Will be able to execute Quantum operations of Quantum computing
3. To built quantum programs
4. Develop quantum Logical gates and circuits.
5. Develop the quantum algorithm

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	0	-	-	-	-	-	-	-	-	-	-	2	-
CO2	2	2	0	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	2	0	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	2	-	-	-	-	-	2	-	-	-	2	2
CO5	2	2	2	2	-	-	-	-	-	2	2	-	-	2	2

UNIT-I:

Math Foundation for Quantum Computing: Introduction of Vector Space, Subspaces, Basis and Finite Dimensions. Vectors and orthogonality, inner product and Outer product and Hilbert Spaces. Formation of Matrices by Linear Transformation. Linear Independent and dependent Vectors. Unitary operators and projectors, Eigen values and Eigen Vectors.

UNIT-II:

Introduction to Quantum Computing: Quantum Mechanics (Huygens wave theory ,Photo electric effect De-Broglie hypothesis and Heisenberg's uncertainty Principle), Origin of Quantum Computing, Overview of major concepts in Quantum Commuting ,Qubits and multi-qubits states, Bra-ket notation, Quantum Superposition Motivation for Studying Quantum Computing, Major players in the industry (IBM, Microsoft, Rigetti, D-Wave.

UNIT-III:

Building Blocks for Quantum Program: Block sphere representations, Multi-qubits, Inner and outer product of Multiple of qubits, Tensor product, Quantum Entanglement, Quantum Teleporation (EPR Model) and Bell State.

UNIT-IV:

Quantum Logical gates and Circuits: Pauli, Hadamard, Phase shift, controlled gates, AND, OR and NAND gate, C-Not, CCNOT gate Introduction of Fourier Transform and Discrete Fourier transform.

UNIT-V:

Quantum Algorithms: Z-Transform. Basic techniques exploited by quantum algorithms (Amplitude amplification, Quantum Fourier Transform, Quantum Phase estimation, Quantum walks), Major Algorithms (Shore's Algorithm, Grover's Algorithm, Deutsch's Algorithm, Deutsch-Jozsa Algorithm).

Text Books:

1. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.
2. David McMahon, "Quantum Computing Explained", Wiley.

UNIT-V

Process of GIS and Geospatial analysis: Data sources, encoding raster data, encoding vector data, encoding attribute data, linking spatial and attribute data, Geospatial data analysis methods database query, geospatial measurement, overlay operations, network analysis and surface analysis. Integration of GIS and remote sensing.

Text Books:

1. Basudeb Bhatta, "Remote Sensing and GIS", 2/e, Oxford University Press, 2012.
2. Lillesand T.M., and Kiefer R.W. "Remote Sensing and Image Interpretation", 6/e, John Wiley &Sons, 2000.

Suggested Reading:

1. James B. Campbell and Randolph H. Wynne, "Introduction to Remote Sensing", the Guilford Press, 2011.
2. Michael N DeMers, "Fundamentals of GIS", 2/e, John Wiley, 2008.

With effect from the Academic Year 2022-23

20CEO02 DISASTER RISK REDUCTION AND MANAGEMENT

(Open Elective-3)

Instruction	3 Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Outcomes:

Upon completion of this course, the student will be able to,

1. Identify and understand the concepts of hazards, causes and impacts of disasters.
2. Develop a critical capacity to evaluate the principles and practices of disaster risk reduction and management.
3. Develop a deep awareness of disaster resilience, risk mitigation, and recovery policies as they arise from natural hazards around the globe.
4. Apply knowledge about existing global frameworks and existing agreements and role of community in successful Disaster Risk Reduction.
5. Evaluate DM study including data search, analysis and presentation as a case study.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	2	2	2	1	2	2	2	1	1	1	1
CO2	1	1	2	2	2	3	3	1	2	1	1	1	1	1	
CO3	2	2	2	2	2	2	3	2	1	1	2	1	1		
CO4	2	2	2	2	3	2	1	1	1	1	1	1			
CO5	2	1	2	1	2	3	1	2	2	2	2	1	1	1	1

UNIT-I

- Hazard and disaster-concepts, vulnerability and risk
- Hazard and disaster type – Natural, Water- related, Pandemic and Human induced hazards disasters
- Causes and Impacts of disasters – Impacts on natural eco systems: physical, psychological and social impact
- Disaster and financial resilience
- GIS and remote sensing
- Disaster vulnerability profile of India –Specific to geographical regions and states (as per regional significance)

UNIT-II

- Disaster Management Cycle –Rescue, Relief, Rehabilitation, Prevention, Mitigation and Preparedness
- Disaster risk reduction {DRR) –Community based DRR, institutions concerned with safety, disaster mitigation and construction techniques as per Indian standards
- Early warning systems

UNIT-III

- Trauma and stress management
- First aid and emergency procedures
- Awareness generation strategies for the community on safe practises in disaster (as per regional significance)

UNIT-IV

- Components of disaster management –preparedness of rescue and relief, mitigation, rehabilitation &reconstruction
- Institutional frame work of disaster management in India (NDMA-SDMA, NDRF, Civic volunteers, NIDM)
- Phases of disaster/risk management and post-disaster responses
- Compensation and insurance
- Applications of remote sensing &GIS in disaster management

UNIT-V

- Capacity building for disaster/damage mitigation (structural and non structural measures).
- Disaster risk reduction strategies and national disaster management guidelines
- Disaster management Act -2005
- Regional issues as per regional requirement/university can take minimum two topics as per high powered committee

Text Books:

1. Singh, R. (2017), "Disaster management Guidelines for Earth quakes, Landslides, Avalanches and Tsunami". Horizon Press publications.
2. Taimpo (2016), "Disaster managementand preparedness". CRC Press Publications
3. Nidhi, G.D. (2014), "Disaster management preparedness" .CBS Publications Pvt. Ltd.
4. Gupta, A.K.,Nair, S.S., Shiraz, A. and Dey, S. (2013), "Flood Disaster Risk Management-CBS Publications Pvt Ltd.
5. Singh, R. (2016), "Disaster management Guidelines for Natural Disasters" Oxford University Press Pvt. Ltd.

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

AICTE Model Curriculum (with effect from 2020-21)

M.Tech. (Artificial Intelligence and Data Science)

SEMESTER– I

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1		Program Core-1	3	-	3	40	60	3
2		Program Core-2	3	-	3	40	60	3
3		Program Elective-1	3	-	3	40	60	3
4		Program Elective-2	3	-	3	40	60	3
5	20MEM103	Research Methodology and IPR	2	-	3	40	60	2
6		Audit Course-1	2	-	2	-	50	Non-Credit
PRACTICALS								
7		Laboratory-1 (Based on Core-1)	-	2	-	50	-	1
8		Laboratory-2 (Based on Core-2)	-	2	-	50	-	1
9		Laboratory-3 (Based on Elective-2)	-	4	-	50	-	2
TOTAL			**16**	**08**	**17**	**350**	**350**	**18**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE-Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum (with effect from 2020-21)

M.Tech. (Artificial Intelligence and Data Science)

SEMESTER-II

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1		Program Core-3	3	-	3	40	60	3
2		Program Core-4	3	-	3	40	60	3
3		Program Elective-3	3	-	3	40	60	3
4		Program Elective-4	3	-	3	40	60	3
5		Audit Course-2	2	-	2	-	50	Non-Credit
PRACTICALS								
6		Laboratory-4 (Based on Core-3)	-	2	-	50	-	1
7		Laboratory-5 (Based on Core-4)	-	2	-	50	-	1
8		Laboratory-6 (Based on Elective-4)	-	4	-	50	-	2
9	20ITC107	Mini Project with Seminar	-	4	-	50	-	2
TOTAL			**14**	**12**	**14**	**360**	**290**	**18**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE-Continuous Internal Evaluation SEE-Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum (with effect from 2020-21)

M.Tech. (Artificial Intelligence and Data Science)

SEMESTER–III

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1		Program Elective-5	3	-	3	40	60	3
2		Open Elective	3	-	3	40	60	3
PRACTICALS								
3	20ITC108	Dissertation/Phase-I	-	20	-	100	-	10
TOTAL			6	20	6	180	120	16

SEMESTER–IV

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
PRACTICALS								
1	20ITC109	Dissertation/Phase-II	-	32	Viva-Voce	100	100	16
TOTAL			-	32	-	100	100	16

L: Lecture T: Tutorial D: Drawing P: Practical
CIE-Continuous Internal Evaluation SEE-Semester End Examination

Total No. of Credits: 68

LIST OF COURSES

S.No	Code	Course	Credits
Program Core Courses			
1.	20MTC101	Mathematical Foundations of Data Science	3
2.	20ITC101	Artificial Intelligence	3
3.	20ITC102	Introduction to Data Science	3
4.	20ITC103	Machine Learning	3
Mandatory Courses			
5.	20MEM103	Research Methodology and IPR	2
Program Elective-1, Elective-3 and Elective-5 Courses (without Lab)			
6.	20ITE101	Soft Computing	3
7.	20ITE102	Cloud Computing	3
8.	20ITE103	Information Retrieval Systems	3
9.	20ITE104	Time Series Analysis & Forecasting	3
10.	20ITE105	Social Network Analytics	3
11.	20ITE106	Block Chain Technology	3
12.	20ITE107	Intelligent Bio Informatics	3
13.	20ITE108	Recommender Systems	3
14.	20ITE109	Reinforcement Learning	3
15.	20ITE110	GPU Computing	3
16.	20ITE111	Scalable Algorithms and Systems for Data Analysis	3
Program Elective-2 and Elective-4 Courses (with Lab)			
17.	20ITE112	Digital Image Processing and Analysis	3
18.	20ITE113	Cyber Security	3
19.	20ITE114	Big Data Analytics	3
20.	20ITE115	Augmented and Virtual Reality	3
21.	20ITE116	Predictive Analytics with R	3
22.	20ITE117	Natural Language Processing	3
23.	20ITE118	Robotic Process Automation	3
24.	20ITE119	Deep Learning	3
25.	20ITE120	Internet of Things	3
26.	20ITE121	Advanced Algorithms	3
Audit Course – 1 and 2			
27.	20EGA101	English for Research Paper Writing	0
28.	20CEA101	Disaster Mitigation and Management	0
29.	20EEA101	Sanskrit for Technical Knowledge	0
30.	20ECA101	Value Education	0
31.	20EGA102	Indian Constitution and Fundamental Rights	0
32.	20ITA101	Pedagogy Studies	0
33.	20EGA103	Stress Management by Yoga	0
34.	20EGA104	Personality Development Through Life's Enlightenment Skills	0
Open Elective Courses			
35.	20CSO101	Business Analytics	3
36.	20MEO102	Introduction to Optimization Techniques	3
37.	20CEO101	Cost Management of Engineering Projects	3
38.	20MEO101	Industrial Safety	3
39.	20MEO103	Composite Materials	3
40.	20EEO101	Waste to Energy	3
Labs, Seminars & Projects			
Laboratory-1 and Laboratory-3 (Based on Core Courses)			
41.	20MTC102	Mathematical Foundations of Data Science Lab	1
42.	20ITC104	Artificial Intelligence Lab	1
43.	20ITC105	Introduction to Data Science Lab	1
44.	20ITC106	Machine Learning Lab	1

Laboratory-2 and Laboratory-4 (Based on Elective-2 and Elective-4 Courses)*			
45.	20ITE122	Digital Image Processing and Analysis Lab	2
46.	20ITE123	Cyber Security Lab	2
47.	20ITE124	Big Data Analytics Lab	2
48.	20ITE125	Augmented and Virtual Reality Lab	2
49.	20ITE126	Predictive Analytics in R Lab	2
50.	20ITE127	Natural Language Processing Lab	2
51.	20ITE128	Robotic Process Automation Lab	2
52.	20ITE129	Deep Learning Lab	2
53.	20ITE130	Internet of Things Lab	2
54.	20ITE131	Advanced Algorithms Lab	2
Seminar and Projects			
55.	20ITC107	Mini Project with Seminar	2
56.	20ITC108	Dissertation Phase-I	10
57.	20ITC109	Dissertation Phase-II	16

*** Lab courses for Laboratory-2 and Laboratory-4 must be in one-to-one correspondence with the Elective courses opted in Program Elective-2 and Program Elective-4, respectively.**

20MTC101 **MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE**

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To discuss vector space and sub space.
2. To explain the linear transformation.
3. To discuss about the stochastic process
4. To explain different estimates
5. To discuss the least squares approximation for fitting**.**

Course Outcomes:

Upon completing this course, students will be able to:

1. Identify the Basis and Dimension of vector space.
2. Calculate the Rank and Nullity of linear transformation.
3. Determine the stochastic measures for the process.
4. Infer the estimation of the statistical observations.
5. Analysing appropriate model for the raw data.

UNIT I

General Vector Spaces: Introduction to General Vector Spaces, Subspace of a Vector Space, Linear Independence and Basis, Dimension, Properties of a Matrix, solutions to a non-homogeneous system of linear equations

UNIT II

Linear Transformations: Introduction to Linear Transformations, Kernel and Range of a Linear Transformation, Rank and Nullity, Inverse Linear Transformations, The Matrix of a Linear Transformation, Composition and Inverse Linear Transformations.

UNIT III:

Expectation: Introduction, Moments, Expectation Based on Multiple Random Variables, Transform Methods, Moments and Transforms of Some Distributions (Weibul and Exponential), Computation of Mean Time to Failure. **Stochastic Process:** Classification of Stochastic Processes, the Bernoulli Process, the Poisson Process andthe normal process.

Unit – IV

Concepts of Inference: Point Estimation, Maximum Likelihood Estimation, Confidence Interval Estimation, Hypothesis Testing, Likelihood Ratio Tests; **Inferences for Single Samples:** Inferences on Mean (Large Samples), Inferences on Mean (Small Samples), Inferences on Variance.

Unit – V

The least squares Approximation: The least squares method, The model for simple linear regression, Fitting a line, goodness of fit, Statistical inference with the simple linear regression model, perdition and confidence intervals, Regression diagnostics. Multiple linear regression, The model for multiple linear regression, Goodness of fit, multiple correlation coefficient, Statistical inference for multiple regression, ANOVA tables.

Text Books.

1. Kishor S. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications, John Wiley & Sons, 2016:
2. Randall Pruim, Foundations and Applications of Statistics (An Introduction Using R), American Mathematical Society, 2010.
3. Kuldeep Singh, Linear Algebra Step by Step, Oxford University Press,2014.

Reference Books:

1. William M. Mendenhall Terry L. Sincich, STATISTICS for Engineering and the Sciences, SIXTH EDITION, CRC Press Taylor & Francis Group,2016.
2. David.Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/ Cole, 2005.

20ITC101 **ARTIFICIAL INTELLIGENCE**

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To learn basics of AI and concept of Intelligent Agent.
2. To learn the various Searching techniques
3. To learn first order and second order predicate Logic to infer knowledge
4. To learn classical and real world planning approaches
5. To learn uncertainty and probabilistic reasoning models

Course Outcomes:

Upon completing this course, students will be able to:

6. Understand the basics of AI and concept of Intelligent Agent.
7. Compare the Searching techniques
8. Understand and apply the first order and second order predicate Logic to infer the knowledge
9. Analyze classical and real world planning approaches
10. Understand the uncertainty and apply the probabilistic reasoning models

Unit – I

Introduction: AI Definition, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art ; **Intelligent Agents :** Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents; **Solving Problems by Searching:** Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions

Unit - II

Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments, **Adversarial Search:** Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions, Stochastic Games, Partially Observable Games, State-of-the-Art Game Programs; Alternative Approaches; **Constraint Satisfaction Problems:** Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs , Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.

Unit - III

Logical Agents : Knowledge-Based Agents, the Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic; **First-Order Logic:** Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic; **Inference in First-Order Logic:** Propositional Vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

Unit - IV

Classical Planning: Definition of Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Analysis of Planning Approaches; **Planning and Acting in the Real World:** Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multiagent Planning; **Knowledge Representations:** Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information, The Internet Shopping World.

Unit - V

Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use, The Wumpus World Revisited; **Probabilistic Reasoning:** Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient

Representation of Conditional Distributions, Exact Inference in Bayesian Networks, **Probabilistic Reasoning over Time:** Time and Uncertainty, Inference in Temporal Models, Hidden Markov Models

Text Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Edition, 4th Edition.

Suggested Reading:

1. Rich, Knight, Nair: "Artificial intelligence", Tata McGraw Hill, Third Edition, 2009.
2. Nilsson, N., "Artificial Intelligence: A New Synthesis", San Francisco, Morgan Kaufmann, 1998.
3. Kulkarni, Parag, Joshi, Prachi , "Artificial Intelligence : Building Intelligent Systems", PHI, 2015.
4. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs19/
2. https://www.coursera.org/learn/ai-for-everyone

20ITC102 **INTRODUCTION TO DATA SCIENCE**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce the fundamentals of Data Science.
2. To familiarise with Numpy, Pandas and handle large data.
3. To facilitate learning of data pre-processing.
4. To introduce plotting and visualisation.
5. To present grouping and aggregate operations

Course Outcomes:

Upon completing this course, students will be able to:

1. Comprehend the process of Data Science.
2. Understand machine learning and handle large unstructured data.
3. Make use of the packages Numpy, Pandas and interact with Web API and databases.
4. Choose suitable pre-processing techniques to process raw data.
5. Interpret the data from visualisations.
6. Apply appropriate group and aggregation operations.

UNIT-I

Data science in a big data world: Benefits and uses of data science and big data, Facets of data, The data science process, **The data science process:** Overview of the data science process, Don't be a slave to the process, Defining research goals and creating a project charter, Retrieving data, Cleansing, integrating, and transforming data, Exploratory data analysis, Build the models, Presenting findings and building applications on top of them

UNIT-II

Machine learning: machine learning, The modeling process, Types of machine learning, Semi-supervised learning, **Handling large data on a single computer:** The problems you face when handling large data, General techniques for handling large volumes of data, General programming tips for dealing with large data sets, Introduction to NoSQL

UNIT-III

Graph databases: Introducing connected data and graph databases, **Text mining and text analytics:** Text mining in the real world, Text mining techniques. **NumPy Basics:** The NumPy ndarray, Universal Functions: Fast Element-Wise ArrayFunctions, **Getting Started with Pandas:** Introduction to pandas data structures, Essential functionality

UNIT-IV

Data Loading, Storage, and File Formats: Reading and writing data in text format, Binary data formats, Interacting with Web APIs, Interacting with Databases, **Data Cleaning and Preparation:** Handling missing data, Data transformation, **Data Wrangling: Join, Combine, and Reshape**: Hierarchical Indexing, Combining and Merging Datasets, Reshaping: Reshaping with hierarchical indexing

UNIT-V

Plotting and Visualization: Matplotlib primer, Plotting with pandas and seaborn, **Data Aggregation and Group Operations**: GroupBy Mechanics, Data Aggregation, Apply: General split-apply-combine, Pivot Tables and Cross-Tabulation.

Text Books:

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science: Big Data, Machine Learning, and more, using Python Tools", Manning Publications, 2016

2. William McKinney, "Python for Data Analysis Data Wrangling with Pandas, NumPy and IPython", Second Edition, O'Reilly Media, 2017.

Suggested Reading:

1. Joel Grus, "Data Science from Scratch-First Principles with Python", O'Reilly Media, 2015
2. John V. Guttag, "Introduction to Computation and Programming Using Python– with Application to Understanding Data", Second Edition, The MIT Press, 2016.
3. Alberto Boschetti, Luca Massaron, "Python Data Science Essentials: A Practitioner's Guide Covering Essential Data Science Principles, Tools, and Techniques", Third Edition, 2018.
4. Allen B. Downey, "Think Python How to Think Like a Computer Scientist", Second Edition, O'Reilly, 2016.

Web Resources:

1. https://www.kaggle.com
2. https://www.dataschool.io/
3. https://www.analyticsvidhya.com/blog/2018/05/24-ultimate-data-science-projects-to-boost-your-knowledge-and-skills/
4. https://www.linkedin.com/in/randylaosat

20ITC103 **MACHINE LEARNING**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To impart knowledge on the basic concepts underlying machine learning.
2. To acquaint with the process of selecting features for model construction.
3. To familiarize different types of machine learning techniques.
4. To facilitate understanding of neural networks, artificial neural networks and genetic algorithms
5. To provide basic knowledge analytical learning and reinforcement learning.

Course Outcomes:

After successful completion of the course, student will be able to:

1. Understand the concepts of Machine learning and Concept learning
2. Build classification algorithms and artificial neural networks and evaluate the accuracy.
3. Examine the Bayesian classifier and its variants for predicting the probabilities.
4. Design solutions based on optimization using genetic algorithms.
5. Develop search control knowledge by inductive and analytical learning
6. Understand reinforcement learning and choose the best learning mechanism to the problem.

UNIT-I

Introduction: Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning, types of Machine Learning.

Concept learning and the general to specific ordering: Introduction, A concept learning task, Concept learning as search, Find-S: finding a maximally specific hypothesis, Version spaces and the candidate elimination algorithm, Remarks on version spaces and candidate elimination, Inductive bias.

Decision Tree learning: Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

UNIT-II

Artificial Neural Networks: Introduction, Neural network representation, Appropriate problems for neural network learning, Perceptrons, Multilayer networks and the back propagation algorithm, Remarks on the back propagation algorithm, An illustrative example face recognition, Advanced topics in artificial neural networks.

Evaluating Hypotheses: Motivation, Estimation hypothesis accuracy, Basics of sampling theory, A general approach for deriving confidence intervals, Difference in error of two hypotheses, Comparing learning algorithms.

UNIT-III

Bayesian learning: Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities, Minimum description length principle, Bayes optimal classifier, Gibbs algorithm, Naïve Bayes classifier, An example learning to classify text, Bayesian belief networks The EM algorithm.

Instance-Based Learning: Introduction, k -Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning.

UNIT-IV

Genetic Algorithms: Motivation, Genetic Algorithms, An illustrative Example, Hypothesis Space Search, Genetic Programming, Models of Evolution and Learning, Parallelizing Genetic Algorithms

Analytical Learning: Introduction, Learning with Perfect Domain Theories: Prolog-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge.

UNIT- V

Combining Inductive and Analytical Learning: Motivation, Inductive-Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis, Using Prior Knowledge to Alter the Search Objective, Using Prior Knowledge to Augment Search Operators

Reinforcement Learning: Introduction, The Learning Task, Q Learning, Non-Deterministic, Rewards and Actions, Temporal Difference Learning, Generalizing from Examples, Relationship to Dynamic Programming

Text Books:

1. Tom Mitchel "Machine Learning", Tata McGraW Hill, 2017.
2. Giuseppe Bonaccorso, "Machine Learning Algorithms", 2nd Edition, Packt, 2018,

Suggested Reading:

1. Ethem Alpaydin, "Introduction to Machine Learning", PHI, 2004
2. StephenMarshland, "Machine Learning: An Algorithmic Perspective",CRC PressTaylor & Francis, 2nd Edition, 2015
3. Abhishek Vijavargia "Machine Learning using Python", BPB Publications, 1st Edition, 2018
4. ReemaThareja "Python Programming", Oxford Press, 2017
5. Yuxi Liu, "Python Machine Learning by Example", 2nd Edition, PACT, 2017

Web Resource:

1. https://nptel.ac.in/courses/106/106/106106139/
2. https://www.geeksforgeeks.org/machine-learning/
3. https://www.guru99.com/machine-learning-tutorial.htm
4. https://www.tutorialspoint.com/machine_learning_with_python/index.htm

20MTC102 MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE LAB

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. Setting up programming environment.
2. Develop Programming skills to solve problems.
3. Use of appropriate R programming constructs to implement algorithms.
4. Identification and rectification of coding errors in program.
5. Develop applications in R statistical packages.
6. Manage data using files.

Course Outcomes:

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

1. Identify and setup program development environment.
2. Implement the algorithms using R programming language constructs.
3. Identify and rectify the syntax errors and debug program for semantic errors.
4. Solve problems in a statistical approach using functions.
5. Implement file operations.

List of Programs

1. Execution of Eigen values and Eigen vectors
2. Solution of non homogenous system of linear equations
3. Inverse matrix of linear transformation
4. Verification of MTTF for the continuous Distributions.
5. Likely Hood Ratio Test by Hypothesis Testing.
6. F-Test by Hypothesis Testing.
7. Compute the significance level (P value).
8. Linear Predicted Model.
9. Multiple Regression Model.
10. ANOVA for Multiple Regression)

Reference Books:

1. R For Statistics by Cornillon Pierre Andre Et Al , T and F India,January 2015
2. An Introduction to Statistical Learning: with Applications in R,Springer; 2017.R Statistics Cookbook, Francisco Jureting, Packt publishing ltd,2019.

20ITC104 **ARTIFICIAL INTELLIGENCE LAB**

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. To familiarize with search and game playing strategies.
2. To introduce logic programming concepts through Prolog.
3. To learn probabilistic reasoning on uncertain data.
4. To learn knowledge representation and inference
5. To learn building AI Systems

Course Outcomes:

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

1. Solve AI problems through Python Programming
2. Demonstrate an intelligent agent
3. Evaluate Search algorithms
4. Build knowledge representation system and infer knowledge from it.
5. Apply probabilistic reasoning on data.

List of Programs

1. Implementation of uninformed search techniques.
2. Implementation of informed search techniques.
3. Implementation of game search.
4. Implementation of a program to represent knowledge
5. Implementation of a program to construct a Bayesian network from given data.
6. Implementation of a program to infer from the Bayesian network.
7. Installation of Prolog and demonstration of basic operations.
8. Mini Project work

Text Books:

1. Russell, Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education, Third Edition, 2015
2. Allen B. Downey, "Think Python How to Think Like a Computer Scientist", Second Edition, O'Reilly, 2016.

Suggested Reading:

1. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.
2. Rich, Knight, Nair: "Artificial intelligence", Tata McGraw Hill, Third Edition, 2009.
3. Nicole Bauerle, Ulrich Rieder, "Markov Decision Process with Applications to Finance", Springer, 2011.
4. Nilsson. N., "Artificial Intelligence: A New Synthesis", First Edition, Morgan Kaufmann, 1998.
5. Trivedi, M.C., "A Classical Approach to Artificial Intelligence", Khanna Publishing House, Delhi.

Web Resources:

1. https://ai.berkeley.edu/project_overview.html
2. http://aima.cs.berkeley.edu/

20ITC105 **INTRODUCTION TO DATA SCIENCE LAB**

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. To introduce data structures in Python.
2. To familiarise with data types and file formats.
3. To gain knowledge on data pre processing and data visualization.
4. To acquaint with supervised and unsupervised learning algorithms.
5. To explore various case studies.

Course Outcomes:

Upon completing this course, students will be able to:

1. Identify appropriate data structures for storing and processing the data.
2. Choose suitable data type to handle real time data and explain file formats.
3. Apply pre processing techniques on raw data
4. Interpret the data from visualisations.
5. Build supervised and unsupervised models to solve real world problems.

List of Programs

1. Implementation of Python programs using Functions, Conditionals, Recursion, Iteration, Strings.
2. Demonstrate the usage of Python data structures. (List, Tuples, Sets, Dictionaries, Strings)
3. Explore various kinds of data like time series, text, etc.
4. Implement file handling operations in Python for various file formats.
5. Implementation of pre processing techniques on any two datasets.
6. Visualise data using packages matplotlib, seaborn, etc., and provide your inference.
7. Build Classifiers and perform prediction.
8. Demonstrate various Clustering Techniques.
9. Predict the price of a house (Boston Housing Dataset).

Text Books:

1. Allen B. Downey, “Think Python How to Think Like a Computer Scientist”, Second Edition, O'Reilly, 2016.
2. William McKinney, “Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython”, Second Edition, O’Reilly Media, 2017.
3. Samir Madhavan, “Mastering Python for Data Science”, Packt Publishing, 2015.

Suggested Reading:

1. Joel Grus, “Data Science from Scratch-First Principles with Python”, O’Reilly Media, 2015.
2. Rachel Schutt, Cathy O’Neil, “Doing Data Science, Straight Talk from the Frontline”, O’Reilly, 2014.

Datasets:

1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007
3. https://archive.ics.uci.edu/ml/index.php

Web Resources:

1. https://www.analyticsvidhya.com/blog/2018/05/24-ultimate-data-science-projects-to-boost-your-knowledge-and-skills/
2. https://www.learndatasci.com/tutorials/data-science-statistics-using-python/
3. https://www.kaggle.com/getting-started
4. https://www.datacamp.com/community/tutorials

20MEM103 **RESEARCH METHODOLOGY AND IPR**

Instruction	2 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Course Objectives:

To make the students to

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

Course Outcomes:

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

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

UNIT - I

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT - II

Literature Survey Report writing: Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT - III

Research Design: Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT - IV

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, Ftest, z-test

UNIT - V

Patents and Copyright: Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

Text Books:

1. C.R Kothari, "Research Methodology, Methods & Technique"; New Age International Publishers, 2004
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011
3. Y.P. Agarwal, "Statistical Methods: Concepts, Application and Computation", Sterling Publs., Pvt., Ltd., New Delhi, 2004

Suggested Reading:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications"; Macmillan India ltd , 2006
2. B. L.Wadehra; "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications"; Universal law Publishing Pvt. Ltd., India 2000.
3. P. Narayanan; "Law of Copyright and Industrial Designs"; Eastern law House, Delhi 2010

20ITC106 **MACHINE LEARNING LAB**

Instruction	2 Hours per week
CIE	50 Marks
Credits	1

Course Objectives:

1. To impart knowledge on the basic concepts underlying machine learning.
2. To acquaint with the process of selecting features for model construction.
3. To familiarize different types of machine learning techniques.
4. To facilitate understanding of neural networks, artificial neural networks and genetic algorithms
5. To provide basic knowledge analytical learning and reinforcement learning.

Course Outcomes:

After successful completion of the course, student will be able to:

1. Build classification algorithms and artificial neural networks and evaluate the accuracy.
2. Examine the Bayesian classifier and its variants for predicting the probabilities.
3. Design solutions based on optimization using genetic algorithms.
4. Implement k-means, k-nearest and SVM algorithms.
5. Understand reinforcement learning and choose the best learning mechanism to the problem.

List of Programs

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples of .csv file.
2. For a given set of training data examples stored in a .csv file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Back propagation Algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .csv file. Compute the accuracy of the classifier, considering few test data sets.
6. Design genetic algorithm which reflects the process of natural selection where the fittest individuals are selected for reproduction in order to produce offspring of the next generation.
7. Demonstrate SVM algorithm used for character recognition task.
8. Apply EM algorithm to cluster a set of data stored in a .csv file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for the experiment and draw graphs.

Text Books:

1. Tom Mitchel "Machine Learning", Tata McGraW Hill, 2017.
2. Giuseppe Bonaccorso, "Machine Learning Algorithms", 2nd Edition, Packt, 2018,

Suggested Reading:

1. Ethem Alpaydin, "Introduction to Machine Learning", PHI, 2004
2. StephenMarshland, "Machine Learning: An Algorithmic Perspective",CRC PressTaylor & Francis, 2nd Edition, 2015
3. Abhishek Vijavargia "Machine Learning using Python", BPB Publications, 1st Edition, 2018
4. ReemaThareja "Python Programming", Oxford Press, 2017
5. Yuxi Liu, "Python Machine Learning by Example", 2nd Edition, PACT, 2017

Datasets:

1. https://www.kaggle.com/datasets
2. https://www.csie.ntu.edu.tw/~cjlin/libsvmtools/datasets/multilabel.html#siam-competition2007
3. https://archive.ics.uci.edu/ml/index.php

Web Resource:

1. https://nptel.ac.in/courses/106/106/106106139/
2. https://towardsdatascience.com/introduction-to-genetic-algorithms-including-example-code-e396e98d8bf3
3. https://www.geeksforgeeks.org/machine-learning/
4. https://www.guru99.com/machine-learning-tutorial.htm
5. https://www.tutorialspoint.com/machine_learning_with_python/index.htm

20ITE103 **INFORMATION RETRIEVAL SYSTEMS**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To familiarize with different Information Retrieval models.
2. To learn query languages for data retrieval.
3. To introduce various methods for efficient retrieval of information.
4. To impart knowledge on text operations.
5. To introduce Parallel and Distributed IR models.

Course Outcomes:

After successful completion of the course, student will be able to:

1. Understand different Information Retrieval models.
2. Evaluate the performance of queries for retrieval of data.
3. Analyze the methods for efficient information retrieval.
4. Perform text operations and build indices.
5. Analyze searching techniques and understand Parallel and Distributed IR models.

UNIT-I

Introduction: Basic concepts, Past, Present and Future of IR, The Retrieval Process.
Modeling: Introduction, A Taxonomy of IR Models, Retrieval: Adhoc and Filtering, A formal characterization of IR Models, Classic Information Retrieval, Alternative Set Theoretic Models, Alternative Algebraic Models, Alternative Probabilistic Models.

UNIT-II

Structured Text Retrieval Models, **Models for Browsing Retrieval Evaluation:** Introduction, Retrieval Performance Evaluation, Reference Collections **Query languages:** Introduction, Keyword-based querying, pattern Matching, Structural Queries, Query Protocols

UNIT-III

Query operations: Introduction, User Relevance Feedback, Automatic Local Analysis, Automatic Global Analysis
Text and Multimedia Languages and Properties: Introduction, Metadata, Text, Markup Languages, Multimedia

UNIT-IV

Text Operations: Introduction, Document Preprocessing, Document Clustering, Text Compression, Comparing Text Compression Techniques **Indexing:** Introduction, Inverted Files, Other Indices for Text, Boolean Queries

UNIT- V

Searching: Sequential Searching, Pattern Matching, Structural Queries, Compression
Parallel and Distributed IR: Introduction, Parallel IR, Distributed IR.

Text Book:

1. Ricardo, Baeza-yates, BerthierRibeiro-Neto, “Modern Information Retrieval”, Pearson Education, 2008.

Suggested Reading:

1. Christopher D. Manning, PrabhakarRaghavan, HinrichSchütze, “Introduction to Information Retrieval”, Cambridge University Press, 2009.
2. David A. Grossman, OphirFrieder, "Information Retrieval - Algorithms and Heuristics", Springer, 2nd Edition, 2004.
3. Gerald Kowalski, “Information Retrieval Systems: Theory and Implementation”, Springer.

4. William B. Frakes, Ricardo Baeza- Yates, “Information Retrieval – Data Structures & Algorithms”, Pearson Education, 2008.

Web Resources:

1. https://class.coursera.org/nlp/lecture
2. http://www.dcs.gla.ac.uk/Keith/Preface.html

20ITE105 **SOCIAL NETWORK ANALYSIS**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Describe about the current web development and emergence of social web
2. Design modeling, aggregating and knowledge representation of semantic web
3. Describe Association rule mining algorithms
4. Summarize knowledge on extraction and analyzing of social web
5. To know the application in real time systems.

Course Outcomes:

After successful completion of the course, student will be able to:

1. Understand the basics of social network analysis.
2. Analyze Ontology representation of social network data.
3. Apply supervised and unsupervised algorithms on social networks.
4. Interpret the semantic content of social media data.
5. Build social network model for real time applications.

UNIT-I

INTRODUCTION: Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

UNIT-II

MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION:
Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modeling and aggregating social network data: State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.

UNIT-III

ALGORITHMS AND TECHNIQUES: Association Rule Mining, Supervised Learning, Unsupervised Learning, Semi-supervised Learning, Markov models, K-Nearest Neighboring, Content-based Recommendation, Collaborative Filtering Recommendation, Social Network Analysis, Detecting Community Structure in Networks, the Evolution of Social Networks.

UNIT-IV

EXTRACTING AND ANALYZING WEB SOCIAL NETWORKS: Extracting Evolution of Web Community from a Series of Web Archive, Temporal Analysis on Semantic Graph using Three-Way Tensor, Decomposition, Analysis of Communities and their Evolutions in Dynamic Networks.

.

UNIT- V

APPLICATIONS:A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection.

Text Books:

1. Peter Mika, "Social Networks and the Semantic Web", Springer, 1st edition, 2007.
2. Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", Springer, 1st edition, 2012.
3. Przemyslaw Kazienko, Nitesh Chawla,"Applications of Social Media and Social Network Analysis", Springer,2015.

Suggested Reading:

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2012
2. Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 1 st edition, 2011
3. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2014
4. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.

Web Resource:

1. https://swayam.gov.in/nd1_noc19_cs66/preview

20ITE108 **RECOMMENDER SYSTEMS**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To learn basics of information retrieval and recommender systems.
2. To introduce the concepts of collaborative filtering and content based recommenders.
3. To impart knowledge on design approaches for hybrid recommendation system.
4. To evaluate the recommender systems to provide high quality recommendations.
5. To familiarise the recent developments of recommender systems

Course Outcomes:

After successful completion of the course, student will be able to:

1. Understand the fundamentals of information retrieval and recommender systems
2. Analyze collaborative filtering and model based recommenders.
3. Identify suitable content based recommenders and understand the concept of user profiling.
4. Design and apply hybrid recommendation system for a particular application.
5. Evaluate recommender systems by means of various measures in different application domains.

UNIT-I

Introduction: Overview of Information Retrieval, Retrieval Models, **Search and Filtering Techniques:** Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.

UNIT-II

Collaborative Filtering: User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems.

UNIT-III

Content-based Filtering: High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval.

UNIT-IV

Hybrid approaches: Opportunities for hybridization, **Monolithic hybridization design:** Feature combination, Feature augmentation, **Parallelized hybridization design:** Weighted, Switching, Mixed, **Pipelined hybridization design:** Cascade Meta-level, Limitations of hybridization strategies

UNIT- V

Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations. **Recent Developments of Recommender Systems:** Recommender systems in personalized web search, knowledge-based recommender system, Social tagging recommender systems, Trust-centric recommendations, Group recommender systems.

Text Books:

1. Jannach D., Zanker M. and FelFering A., "Recommender Systems: An Introduction", Cambridge University Press, 1st Edition, 2011.

Suggested Reading:

1. Charu C. Aggarwal, "Recommender Systems: The Textbook", Springer, 1st Edition, 2016.
2. Ricci F., Rokach L., Shapira D., Kantor B.P., "Recommender Systems Handbook", Springer, 1st edition, 2011.
3. Manouselis N., Drachsler H., Verbert K., Duval E., "Recommender Systems For Learning", Springer, 1st Edition, 2013.

Web Resources:

1. Coursera recommender systems specialization, https://www.coursera.org/specializations/recommender-systems
2. A Material on recommender systems, https://cse.iitkgp.ac.in/~pawang/courses/recSys.pdf

20ITE114 **BIG DATA ANALYTICS**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce big data and HDFS.
2. To impart knowledge on Mapper and Reducer.
3. To provide the concepts of NoSQL and MongoDB.
4. To introduce programming tools PIG and HIVE in Hadoop echo system.
5. To facilitate learning of Spark with machine learning applications.

Course Outcomes:

Upon completing this course, students will be able to:

1. Perform data analysis in Hadoop framework.
2. Build applications using MapReduce.
3. Model the data using NoSQL and MongoDB.
4. Perform analysis on large datasets using Pig and Hive.
5. Develop machine learning solutions in Spark.

.

UNIT-I

Introduction to Big Data: Big Data Important, Big Data Solution, Big Data Use Cases: IT for IT Log Analytics, the Fraud Detection Pattern, Social Media Pattern.

The Hadoop Distributed Files system: The Design of HDFS, HDFS Concepts, Blocks, Name nodes and Data nodes, Block Caching, HDFS Federation, HDFS High Availability, The Command-Line Interface, Basic File system Operations, Hadoop File systems, Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the File System API, Writing Data, Directories, Querying the File system, Deleting Data, Data Flow, Anatomy of a File Read, Anatomy of a File Write.

UNIT-II

MapReduce: Introduction, Architecture of map reduce, Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures, Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort, The Map Side, The Reduce Side, **MapReduce Types and Formats:** MapReduce Types, The Default MapReduce Job, Input Formats, Input Splits and Records, Text Input, Output Formats, Text Output, Developing a MapReduce Application.

Hadoop Ecosystem and YARN: Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features NameNode High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

UNIT-III

No SQL Databases: Review of traditional Databases, Need for NoSQL Databases, Columnar Databases, Failover and reliability principles, CAP Theorem, Differences between SQL and NoSQL databases, **Working Mechanisms of Mongo DB**: Overview, Advantages, Environment, Data Modelling, Create Database, Drop Database, Create collection, Drop collection, Data types, Insert, Query, Update and Delete operations, Limiting and Sorting records, Indexing, Aggregation

UNIT-IV

Pig: Generating Examples, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators, Pig in Practice.

Hive: Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User-Defined Functions, Writing a User Defined Functions, Writing a User Defined Aggregate Function.

UNIT-V

Spark: Spark and its Purpose, Components of the Spark Unified Stack, Batch and Real-Time Analytics with Apache Spark, Resilient Distributed Dataset, **Scala** (Object Oriented and Functional Programming)

Machine Learning with Spark: Designing a Machine Learning System, Obtaining, Processing and Preparing Data with Spark, Building a Recommendation Engine with Spark, Building a Classification Model with Spark, Building a Regression Model with Spark and Building a Clustering Model with Spark.

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", Fourth Edition, O'Reilly Media Inc, 2015.
2. Nick Pentreath, “Machine Learning with Spark”, First Edition, Packt Publishing, 2015.

Suggested Reading:

1. Thilinagunarathne, “Hadoop MapReduce v2 Cookbook”, Second Edition, Packet Publishing, 2015.
2. Chuck Lam, Mark Davis, Ajit Gaddam, “Hadoop in Action”, Manning Publications Company, 2016.
3. Alex Holmes, “Hadoop in Practice”, Manning Publications Company, 2012.
4. Alan Gates, "Programming Pig", O'Reilly Media Inc, 2011.
5. Edward Capriolo, Dean Wampler, Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, 2012.

Web Resources:

1. http://www.planetcassandra.org/what-is-nosql
2. https://stanford.edu/~rezab/sparkworkshop/slides/xiangrui.pdf
3. https://class.coursera.org/datasci-001/lecture

20ITE116 **PREDICTIVE ANALYTICS WITH 'R'**

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. To introduce Predictive Modeling.
2. To familiarize Regression and Classification Techniques.
3. To impart knowledge on the concepts of Support vector machines and Neural Networks.
4. To explore tree based classifiers and ensemble methods
5. To introduce Topic modeling.

Course Outcomes:

Upon completing this course, students will be able to:

1. Comprehend predictive modeling and assess the performance
2. Apply regression techniques and analyse the performance
3. Demonstrate Support Vector Machines and build an efficient networking model
4. Analyze ensemble methods by choosing Tree based classifiers
5. Select appropriate probabilistic Graphic models and identify topics through topic modeling

UNIT-I

Gearing Up for Predictive Modeling: Models**, Types of models :** Supervised, unsupervised, semi-supervised, and reinforcement learning models, Parametric and nonparametric models, Regression and classification models, Real-time and batch machine learning models, **The process of Predictive Modeling:** Defining the model's objective, Collecting the data, Picking a model, Preprocessing the data, Exploratory data analysis, Feature transformations, Encoding categorical features, Missing data, Outliers, Removing problematic features, Feature engineering and dimensionality reduction, Training and assessing the model, Repeating with different models and final model selection, Deploying the model, **Performance metrics:** Assessing regression models, Assessing classification models, Assessing binary classification models.

UNIT-II

Linear Regression: Introduction to linear regression, Simple linear regression, Multiple linear regression, Assessing linear regression models, Problems with linear regression, Feature selection, Regularization, Ridge regression**.**

Logistic Regression: Classifying with linear regression, Assessing logistic regression models, Regularization with the lasso, Classification metrics, Extensions of the binary and Multinomial logistic classifier

UNIT-III

Support Vector Machines: Maximal margin classification, Support vector classification, Inner products**,** Kernels and support vector machines, Cross-validation.

Neural Networks: Stochastic gradient descent**:** Gradient descent and local minima, The perceptron algorithm, Linear separation, The logistic neuron, **Multilayer perceptron networks:** Training multilayer perceptron networks.

UNIT-IV

Tree-based Methods: The intuition for tree models, Algorithms for training decision trees-
Classification and regression trees, CART regression trees, Tree pruning, Missing data, Regression model trees
CART classification trees, C5.0, Predicting complex skill learning, Variable importance in tree models,

Ensemble Methods: Bagging - Margins and out-of-bag observations, Predicting heart disease with bagging, Limitations of bagging, **Boosting –** AdaBoost, Limitations of boosting, **Random forests-** The importance of variables in random forests

UNIT-V

Probabilistic Graphical Models: A little graph theory, Bayes' Theorem, Conditional independence, Bayesian networks, The Naïve Bayes classifier. Hidden Markov models- Predicting letter patterns in English words.

Topic Modeling: An overview of topic modeling, Latent Dirichlet Allocation, The Dirichlet distribution, The generative process, Fitting an LDA model, Modeling the topics of online news stories, Model stability, Finding the number of topics, Topic distributions, Word distributions, LDA extensions.

Text Books:

1. Rui Miguel Forte, "Mastering Predictive Analytics with R", Packt Publishing Ltd, 2015.
2. Roger D. Peng,"R Programming for Data Science", Lean Publishing, 2015.

Suggested Reading:

1. Lantz Brett, "Machine Learning with R", 2nd Edition, Packt Publishing Limited.
2. SunilaGollapudi, "Practical Machine Learning", Packt Publishing Ltd.
3. EthemAlpaydin, "Introduction to Machine Learning", 2nd Edition, PHI, 2013.

Web Resources:

1. https://data-flair.training/blogs/r-predictive-and-descriptive-analytics/
2. https://www.littlemissdata.com/blog/predictive-analytics-tutorial-part-1
3. http://uc-r.github.io/mars

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives:

1. To provide the knowledge to setup a Hadoop Cluster.
2. To impart knowledge to develop programs using MapReduce
3. To introduce Pig, PigLatin and HiveQL to process big data
4. To introduce NoSQL databases
5. To introduce the latest big data frameworks and writing applications using Spark and Scala
6. Integrate Hadoop with R (RHadoop) to process and visualize.

Course Outcomes:

After successful completion of this course student will be able to

1. Understand Hadoop working environment
2. Work with big data applications in multi node clusters
3. Write scripts using Pig to solve real world problems.
4. Write queries using Hive to analyse the datasets
5. Use Spark working environment.

List of Programs

1. Understanding and using basic HDFS commands
2. Word count application using Map Reduce on single node cluster
3. Analysis of Weather Dataset on Multi node Cluster using Hadoop
4. Real world case studies on Map Reduce applications
5. Working with Hadoop file system: Reading, Writing and Copying
6. Writing User Defined Functions/Eval functions for filtering unwanted data in Pig
7. Working with HiveQL
8. Writing User Defined Functions in Hive
9. Processing large datasets on Spark framework.
10. Integrating Hadoop with other data analytic frameworks like R

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. TanmayDeshpande, “HadoopReal-World Solutions Cookbook”, Second Edition, Packt Publishing 2016.

Suggested Reading:

1. Edward Capriolo, Dean Wampler, and Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, October 2012.
2. VigneshPrajapati, "Big data Analytics with R and Hadoop", Packt Publishing, November 2013.
3. Nick Pentreath, “Machine Learning with Spark”, First Edition, Packt Publishing, 2015.

Web Resources:

1. https://parthgoelblog.wordpress.com/tag/hadoop-installation
2. http://www.iitr.ac.in/media/facspace/patelfec/16Bit/index.html
3. https://class.coursera.org/datasci-001/lecture
4. http://bigdatauniversity.com.

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Objectives:

1. To introduce R libraries for managing and interrogating raw and derived, observed, experimental datasets.
2. To build programs using Predictive Modeling.
3. To familiarize Regression and Classification Techniques with case studies.
4. To impart knowledge on the concepts of Neural Networks and various model Evaluation Techniques.
5. To explore time series models, Topic Modeling and Recommender Systems.

Course Outcomes:

After successful completion of the course, student will be able to:

1. Demonstrate the basic functions and implement R packages and commands
2. Apply regression analysis methods and infer the problems
3. Develop applications of neural networks and evaluate the techniques
4. Evaluation of ensemble methods
5. Build a system to perform topic modeling on real time datasets

List of Programs

1. Implementation of basic statistical functions of R programming
2. Demonstrate the file operations read and write, importing and exporting datasets
3. Demonstrate the regularization with the lasso in R
4. Implement the pocket perceptron algorithm for classification with neural networks
5. Solve a real-world regression problem by evaluating a neural network model to predict the energy
6. efficiency of the buildings
7. Build a neural network model that predicts a numerical digit (0-9) from *MNIST* database of handwritten digits
8. Explore the field of Banking and Finance and build a classification model which predicts credit scores
9. Design and evaluate a decision tree classifier which predicts whether a particular banknote is genuine or whether it has been forged
10. Build a model to predict heart disease based on their profile and a series of medical tests with bagging
11. Design a bagging model for predicting atmospheric gamma ray radiation
12. Predict promoters in gene sequences using Hidden Markov Model. The Data set contains a number of gene sequences from DNA belonging to the bacterium *E. Coli*
13. Implement Topic Modeling on online news stories

Text Books:

1. Rui Miguel Forte, "Mastering Predictive Analytics with R", Packt Publishing Ltd, 2015.
2. Roger D. Peng,"R Programming for Data Science", Lean Publishing, 2015.

Suggested Reading:

1. Lantz Brett, "Machine Learning with R", 2nd Edition, Packt Publishing Limited.
2. SunilaGollapudi, "Practical Machine Learning", Packt Publishing Ltd.
3. EthemAlpaydin, "Introduction to Machine Learning", 2nd Edition, PHI, 2013.

Datasets:

1. https://archive.ics.uci.edu/ml/index.php
2. https://www.kaggle.com/datasets
3. Energy Efficiency Data Set: http://archive.ics.uci.edu/ml/datasets/Energy+efficiency
4. MNIST dataset of handwritten digits http://yann.lecun.com/exdb/mnist/
5. German Credit Dataset: https://archive.ics.uci.edu/ml/datasets/Statlog+%28German+Credit+Data%29
6. Banknote Authentication Data Set: https://archive.ics.uci.edu/ml/datasets/banknote+authentication
7. MAGIC Gamma Telescope data set: https://archive.ics.uci.edu/ml/datasets/magic+gamma+telescope

20ITC107 **MINI PROJECT WITH SEMINAR**

Instruction	4 Hours per week
CIE	50 Marks
Credits	2

Course Outcomes:

Upon completing this course, students will be able to:

1. Formulate a specific problem and give solution.
2. Develop model/models either theoretical/practical/numerical form.
3. Solve, interpret/correlate the results and discussions.
4. Conclude the results obtained.
5. Write the documentation in standard format.

Guidelines:

- As part of the curriculum in the II- semester of the programme each students shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
- Each student will be allotted to a faculty supervisor for mentoring.
- Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
- Mini projects shall have inter disciplinary/ industry relevance.
- The students can select a mathematical modelling based/Experimental investigations or Numerical modelling.
- All the investigations are clearly stated and documented with the reasons/explanations.
- The mini-project shall contain a clear statement of the research objectives, background of the work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and references.

Department Review Committee: Supervisor and Two Faculty Coordinators

Guidelines for awarding marks (CIE):		**Max. Marks: 50**
Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Progress and Review
	05	Report
Department Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

20EG A101 **ENGLISH FOR RESEARCH PAPER WRITING**
(AUDIT COURSE)

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	50 Marks
Credits	0

Course Objectives:

1. To understand the nuances of language and vocabulary in writing a Research Paper.
2. To develop the content, structure and format of writing a research paper.
3. To enable the students to produce original research papers without plagiarism.

Course Outcomes:

Upon completing this course, students will be able to:

1. Interpret the nuances of research paper writing.
2. Differentiate the research paper format and citation of sources.
3. To review the research papers and articles in a scientific manner.
4. Avoid plagiarism and be able to develop their writing skills in presenting the research work.
5. Create a research paper and acquire the knowledge of how and where to publish their original research papers.

UNIT -I

Academic Writing: Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT- II

Research Paper Format: Title – Abstract – Introduction – Discussion – Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

UNIT –III

Research Methodology: Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.

UNIT- IV

Process of Writing a research paper: Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft –Revising/Editing - The final draft and proof reading.

UNIT- V

Research Paper Publication: Reputed Journals – National/International – ISSN No, No. of volumes, Scopus Index/UGC Journals – Free publications - Paid Journal publications – /Advantages/Benefits

Text Book:

1. C. R Kothari, Gaurav, Garg, **Research Methodology Methods and Techniques,** New Age International Publishers. 4th Edition.

Suggested Reading:

1. Day R (2006) "How to Write and Publish a Scientific Paper**",** Cambridge University Press
2. MLA **"**Hand book for writers of Research Papers**"**, East West Press Pvt. Ltd, New Delhi, 7th Edition.
3. Lauri Rozakis, Schaum's, "Quick Guide to Writing Great Research Papers**"**, Tata McGraw Hills Pvt. Ltd, New Delhi.

Online Resource:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_mg13/preview

20CSO101 **BUSINESS ANALYTICS**
(OPEN ELECTIVE)

Instruction	3 hrs per week
Duration of End examination	3 hrs
Semester end examinations	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

1. Understanding the basic concepts of business analytics and applications
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics
3. Prepare the students to model business data using various data mining, decision making methods

Course Outcomes:

Upon completing this course, students will be able to:

1. To understand the basic concepts of business analytics
2. Identify the application of business analytics and use tools to analyze business data
3. Become familiar with various metrics, measures used in business analytics
4. Illustrate various descriptive, predictive and prescriptive methods and techniques
5. Model the business data using various business analytical methods and techniques

UNIT-I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

UNIT-II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization

UNIT-III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

UNIT-IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. **Clustering**: Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, **Prescriptive Analytics**- Linear Programming(LP) and LP model building,

UNIT-V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process, cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox

Text Books:

1. U Dinesh Kumar, "Data Analytics", Wiley Publications, 1st Edition, 2017
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business analytics Principles, Concepts, and Applications with SAS", Associate Publishers, 2015

Suggested Reading:

1. S. Christian Albright, Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", 5th Edition, Cengage, 2015

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18-mg11/preview
2. https://nptel.ac.in/courses/110105089/

20ITC108 **DISSERTATION PHASE- I**

Instruction	20 Hours per week
CIE	100 Marks
Credits	10

Course Outcomes:

At the end of the course:

1. Students will be exposed to self-learning various topics.
2. Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
3. Students will learn to write technical reports.
4. Students will develop oral and written communication skills to present.
5. Student will defend their work in front of technically qualified audience.

Guidelines:

- The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
- Seminar should be based on the area in which the candidate has undertaken the dissertation work.
- The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
- The preliminary results (if available) of the problem may also be discussed in the report.
- The work has to be presented in front of the committee consists of Head, Chairperson-BoS, Supervisor and Project coordinator.
- The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

Guidelines for the award of Marks:		Max. Marks: 50
Evaluation by	**Max .Marks**	**Evaluation Criteria / Parameter**
Supervisor	30	Project Status / Review(s)
	20	Report
Department Committee	10	Relevance of the Topic
	10	PPT Preparation(s)
	10	Presentation(s)
	10	Question and Answers
	10	Report Preparation

Note : Department committee has to assess the progress of the student for every two weeks.

20ITC109 **DISSERTATION PHASE- II**

Instruction	32 Hours per week
Duration of SEE	Viva
SEE	100 Marks
CIE	100 Marks
Credits	16

Course Outcomes:

At the end of the course:

1. Students will be able to use different experimental techniques and will be able to use different software/ computational/analytical tools.
2. Students will be able to design and develop an experimental set up/ equipment/test rig.
3. Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
4. Students will be able to either work in a research environment or in an industrial environment.
5. Students will be conversant with technical report writing and will be able to present and convince their topic of study to the engineering community.

Guidelines:

- It is a continuation of Project work started in III semester.
- The student has to submit the report in prescribed format and also present a seminar.
- The dissertation should be submitted in standard format as provided by the department.
- The candidate has to prepare a detailed project report consisting of introduction of the problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of the solution and results with analysis.
- The report must bring out the conclusions of the work and future scope for the study.
- The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner (HoD and BoS Chair Person), supervisor/co-supervisor.
- The candidate has to be in regular contact with his/her supervisor/co-supervisor.

Guidelines for awarding marks in CIE:		**Max. Marks: 100**
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Department Review Committee	05	Review 1
	10	Review 2
	10	Review 3
	15	Final presentation with the draft copy of the report in standard format
	20	Submission of the report in a standard format
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Analytical / Programming / Experimental Skills Preparation
	10	Report preparation in a standard format

Guidelines for awarding marks in SEE: (Max. Marks: 100)

Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
External and Internal Examiner(s)	20	Power Point Presentation
	40	Quality of thesis and evaluation
	20	Quality of the project • Innovations • Applications • Live Research Projects • Scope for future study • Application to society
	20	Viva-Voce

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum (with effect from 2023-24)

M.Tech. (Artificial Intelligence and Data Science)

SEMESTER– I

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	23MTC101	Mathematical Foundations for Data Science	3	-	3	40	60	3
2	23ADC101	Artificial Intelligence	3	-	3	40	60	3
3		Program Elective-1	3	-	3	40	60	3
4		Program Elective-2	3	-	3	40	60	3
5	23MEM103	Research Methodology and IPR	2	-	3	40	60	2
6		Audit Course-1	2	-	2	-	50	Non-Credit
PRACTICALS								
7	23MTC102	Mathematical Foundations of Data Science Lab	-	2	-	50	-	1
8	23ADC105	Artificial Intelligence Lab	-	2	-	50	-	1
9		Laboratory-3 **(Based on Elective-2)**	-	2	-	50	-	1
TOTAL			**14**	**06**	**17**	**350**	**350**	**17**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE-Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum (with effect from 2023-24)

M.Tech. (Artificial Intelligence and Data Science)

SEMESTER-II

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	23ADC102	Introduction to Data Science	3	-	3	40	60	3
2	23ADC103	Machine Learning	3	-	3	40	60	3
3	23ADC104	Deep Learning	3	-	3	40	60	3
4		Program Elective-3	3	-	3	40	60	3
5		Program Elective-4	3	-	3	40	60	3
PRACTICALS								
6	23ADC106	Introduction to Data Science Lab	-	2	-	50	-	1
7	23ADC107	Machine Learning Lab	-	2	-	50	-	1
8		Laboratory-6 **(Based on Elective-4)**	-	2	-	50	-	1
9	23ADC109	Mini Project with Seminar	-	4	-	50	-	2
TOTAL			**15**	**10**	**15**	**400**	**300**	**19**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE-Continuous Internal Evaluation SEE-Semester End Examination

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

AICTE Model Curriculum (with effect from 2023-24)

M.Tech. (Artificial Intelligence and Data Science)

SEMESTER–III

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1		Program Elective-5	3	-	3	40	60	3
2		Open Elective	3	-	3	40	60	3
3		Audit Course-2	2	-	2	-	50	Non-Credit
PRACTICALS								
3	23ADC110	Dissertation/Phase-I	-	20	-	100	-	10
TOTAL			8	20	8	180	170	16

SEMESTER–IV

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per Week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
PRACTICALS								
1	23ADC111	Dissertation/Phase-II	-	32	Viva-Voce	100	100	16
TOTAL			-	32	-	100	100	16

L: Lecture T: Tutorial D: Drawing P: Practical

CIE-Continuous Internal Evaluation SEE-Semester End Examination

Total No. of Credits: 68

LIST OF COURSES

S.No.	Code	Course	Credits
Mandatory Courses			
1.	23MEM103	Research Methodology and IPR	2
Program Elective-1, Elective-3 and Elective-5 Courses (without Lab)			
2.	23ADE101	Soft Computing	3
3.	23ADE102	Cloud Computing	3
4.	23ADE103	Information Retrieval Systems	3
5.	23ADE104	Time Series Analysis & Forecasting	3
6.	23ADE105	Social Network Analytics	3
7.	23ADE106	Block Chain Technology	3
8.	23ADE107	Intelligent Bio Informatics	3
9.	23ADE108	Recommender Systems	3
10.	23ADE109	Reinforcement Learning	3
11.	23ADE110	GPU Computing	3
12.	23ADE111	Scalable Algorithms and Systems for Data Analysis	3
13.	23ADE112	Cyber Physical Systems	3
14.	23ADE113	Explainable AI	3
15.	23ADE114	Advanced Data Structures	3
16.	23ADE115	High Performance Computing	3
17.	23ADE116	Ethics in AI	3
Program Elective-2 and Elective-4 Courses (with Lab)			
18.	23ADE117	Digital Image Processing and Analysis	3
19.	23ADE118	Cyber Security	3
20.	23ADE119	Big Data Analytics	3
21.	23ADE120	Augmented and Virtual Reality	3
22.	23ADE121	Predictive Analytics with R	3
23.	23ADE122	Natural Language Processing	3
24.	23ADE123	Robotic Process Automation	3

25.	23ADE124	Federated Machine Learning	3
26.	23ADE125	Internet of Things	3
27.	23ADE126	Advanced Algorithms	3
Audit Course – 1 and 2			
28.	23EGA101	English for Research Paper Writing	0
29.	23CEA101	Disaster Mitigation and Management	0
30.	23EEA101	Sanskrit for Technical Knowledge	0
31.	23ECA101	Value Education	0
32.	23EGA102	Constitution of India	0
33.	23ADA101	Pedagogy Studies	0
34.	23EGA103	Stress Management by Yoga	0
35.	23EGA104	Personality Development Through Life's Enlightenment Skills	0
Open Elective Courses			
36.	23CS0101	Business Analytics	3
37.	23MEO102	Introduction to Optimization Techniques	3
38.	23CEO101	Cost Management of Engineering Projects	3
39.	23MEO101	Industrial Safety	3
40.	23MEO103	Composite Materials	3
41.	23EEO101	Waste to Energy	3
Labs, Seminars & Projects			
Laboratory-2 and Laboratory-4 (Based on Elective-2 and Elective-4 Courses) *			
42.	23ADE127	Digital Image Processing and Analysis Lab	1
43.	23ADE128	Cyber Security Lab	1
44.	23ADE129	Big Data Analytics Lab	1
45.	23ADE130	Augmented and Virtual Reality Lab	1
46.	23ADE131	Predictive Analytics in R Lab	1
47.	23ADE132	Natural Language Processing Lab	1
48.	23ADE133	Robotic Process Automation Lab	1

49.	23ADE134	Federated Machine Learning Lab	1
50.	23ADE135	Internet of Things Lab	1
51.	23ADE136	Advanced Algorithms Lab	1
Seminar and Projects			
52.	23ADC109	Mini Project with Seminar	2
53.	23ADC110	Dissertation Phase-I	10
54.	23ADC111	Dissertation Phase-II	16

*** Lab courses for Laboratory-2 and Laboratory-4 must be in one-to-one correspondence with the Elective courses opted in Program Elective-2 and Program Elective-4, respectively.**

23MTC101

MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Discuss vector space and subspace.
2. Understand the linear transformation.
3. Explore the stochastic processes.
4. Explain different estimates.
5. Fit the curve to the data using the least squares approximation.

COURSE OUTCOMES: After the completion of this course, the student will be able to

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

1. Identify the Basis and Dimension of vector space.
2. Calculate the Rank and Nullity of linear transformation.
3. Determine the stochastic measures for the process.
4. Infer the estimation of the statistical Parameters.
5. Apply the appropriate model for Regression diagnostic of the raw data.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	-	1	2	1
CO2	2	-	1	2	1
CO3	3	-	1	3	2
CO4	3	-	2	3	2
CO5	3	-	1	3	2

UNIT I

General Vector Spaces: Introduction to General Vector Spaces, Subspace of a Vector Space, Linear Independence and Basis, Dimension, Properties of a Matrix, solutions to a non-homogeneous system of linear equations.

UNIT II

Linear Transformations: Introduction to Linear Transformations, Kernel and Range of a Linear Transformation, Rank and Nullity, Inverse Linear Transformations, The Matrix of a Linear Transformation, Composition and Inverse Linear Transformations.

UNIT III

Expectation: Introduction, Moments, Expectation Based on Multiple Random Variables, Transform Methods, Moments and Transforms of Some Distributions (Weibul and Exponential), Computation of Mean Time to Failure. Stochastic Process: Classification of Stochastic Processes, the Bernoulli Process, the Poisson Process and the normal process.

UNIT – IV

Concepts of Inference: Point Estimation, Maximum Likelihood Estimation, Confidence Interval Estimation, Hypothesis Testing, Likelihood Ratio Tests; Inferences for Single Samples: Inferences on Mean (Large Samples), Inferences on Mean (Small Samples), Inferences on Variance.

.

UNIT – V

The least squares Approximation: The least squares method, The model for simple linear regression, Fitting a line, goodness of fit, Statistical inference with the simple linear regression model, perdition and confidence intervals, Regression diagnostics. Multiple linear regression, the model for multiple linear regression, Goodness of fit, multiple correlation coefficient, Statistical inference for multiple regression, ANOVA tables.

TEXT BOOKS:

1. Kishor S. Trivedi, "Probability and Statistics with Reliability", "Queuing, and Computer Science Applications", John Wiley & Sons, 2016.
2. Randall Pruim, "Foundations and Applications of Statistics" (An Introduction Using R), American Mathematical Society, 2010.
3. Kuldeep Singh, Linear Algebra Step by Step, Oxford University Press, 2014.

Reference Books:

1. William M. Mendenhall Terry L. Sincich, STATISTICS for Engineering and the Sciences, SIXTH EDITION, CRC Press Taylor & Francis Group, 2016.
2. David.Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/ Cole, 2005.

23ADC101

ARTIFICIAL INTELLIGENCE

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. 1.Understand the basics of AI and concept of Intelligent Agent.
2. Familiarize the various Searching techniques
3. Introduce first-order and second-order predicate Logic to infer knowledge
4. Explore classical and real-world planning approaches
5. Understand uncertainty and probabilistic reasoning models

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand the basics of AI and concept of Intelligent Agent.
2. Compare the advanced Searching techniques.
3. Understand and apply the first-order and second-order predicate Logic to infer the knowledge
4. Analyse classical and real-world planning approaches
5. Understand the uncertainty and apply the probabilistic reasoning models

CO-PO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	3	3	3
CO2	3	1	3	3	3
CO3	3	1	2	2	2
CO4	2	1	3	2	3
CO5	2	1	3	2	2

UNIT-I

Introduction: AI Definition, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art ; Intelligent Agents : Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents; Solving Problems by Searching: Problem Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

UNIT-II

Beyond Classical Search: Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Online Search Agents and Unknown Environments, Adversarial Search: Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions, Stochastic Games, Partially Observable Games, State-of-the-Art Game Programs; Alternative Approaches; Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs , Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.

UNIT-III

Logical Agents : Knowledge-Based Agents, the Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic; **First-Order Logic:** Representation Revisited, Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic; Inference in First-Order Logic: Propositional Vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution

UNIT-IV

Classical Planning: Definition of Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs, Other Classical Planning Approaches, Analysis of Planning Approaches; Planning and Acting in the Real World: Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multiagent Planning; Knowledge Representations: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information, The Internet Shopping World

UNIT-V

Quantifying Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use, The Wumpus World Revisited; Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Networks, Probabilistic Reasoning over Time: Time and Uncertainty, Inference in Temporal Models, Hidden Markov Models

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Edition, 4th Edition

SUGGESTED READING:

1. Rich, Knight, Nair: ―Artificial intelligence‖, Tata McGraw Hill, Third Edition, 2009.
2. Nilsson, N., ―Artificial Intelligence: A New Synthesis‖, San Francisco, Morgan Kaufmann, 1998.
3. Kulkarni, Parag, Joshi, Prachi , ―Artificial Intelligence : Building Intelligent Systems‖, PHI, 2015
4. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs19/
2. https://www.coursera.org/learn/ai-for-everyone

23ME M103

RESEARCH METHODOLOGY AND IPR

Instruction	2 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

COURSE OBJECTIVES: This course aims to

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

COURSE OUTCOMES: After completion of this course, students will be able to

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights\

CO-PO Articulation Matrix

PO/CO	PO1	PO2	PO3
CO1	3	2	1
CO2	3	3	3
CO3	3	2	2
CO4	3	1	2
CO5	3	3	3

UNIT-I

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT-II

Literature Survey Report Writing: Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT-III

Research Design: Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT-IV

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, Ftest, z-test

UNIT-V

Patents and Copy Right: Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

TEXT BOOKS:

1. C. R. Kothari, "Research Methodology, Methods & Technique", New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011.

SUGGESTED READING:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications", Macmillan India ltd, 2006
2. B. L.Wadehra, "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications", Universal law Publishing Pvt. Ltd., India 2000.
3. P. Narayanan, "Law of Copyright and Industrial Designs", Eastern law House, Delhi 2010.

23ADE102

CLOUD COMPUTING

(Program Elective-1, Elective-3 and Elective-5 Courses)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Familiarize basic concepts of cloud computing and enabling technologies.
2. Introduce Auto-Scaling, capacity planning and load balancing in cloud.
3. Impart knowledge on issues related to security, privacy and compliance.
4. Introduce cloud management standards and programming models.
5. Deal with the concepts of Service-oriented architecture and cloud database technology.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand different types of cloud computing concepts and the techniques.
2. Determine the issues related to scaling, capacity planning and load balancing.
3. Assess the cloud infrastructure, information security and compliance issues.
4. Analyse the Portability and Interoperability issues of cloud virtualization.
5. Evaluate the importance of SOA and cloud database technology.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	2	2	2
CO2	2	2	2	2	2
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3

UNIT-I

Introduction-Limitations of the Traditional Computing Approaches, Three Layers of Computing, Three Layers in Traditional Computing, The End of Traditional Computing, Influences behind Cloud Service Adoption. Benefits and challenges: Origin of the Term 'Cloud Computing', Early Initiatives, Utility Computing, Metering and Billing in Cloud, Separation of Data Center Operation, Benefits of Cloud Computing, Challenges of Cloud Computing, How Cloud Computing Addresses Business Challenges, Ethical Issues in Cloud Computing, Cloud Computing: Network as Computer, Role of Web Service, Role of API, Ubiquitous Cloud, Confusion Between Cloud and Internet. Cloud computing services, Resource Virtualization, Resource pooling, sharing and provisioning.

UNIT-II

Scaling in cloud- Introduction to Scaling, Scaling in Traditional Computing, Scaling in Cloud Computing, Foundation of Cloud Scaling, Scalable Application, Scaling Strategies in Cloud, Auto-Scaling in Cloud, Types of Scaling, Performance and Scalability , the Resource Contention Problem , Cloud Bursting: A Scenario of Flexible Scaling, Scalability is a Business Concern

Capacity Planning- Capacity Planning, Capacity Planning in Computing, Capacity Planning in Cloud Computing, Approaches for Maintaining Sufficient Capacity, Steps for Capacity Planning

Load Balancing- Load Balancing , Importance of Load Balancing in Cloud Computing, Load Balancing in Cloud, Goals of Load Balancing, Categories of Load Balancing, Load Balancing Algorithms, Case study on Google cloud and Amazon Elastic Compute Cloud (EC2), File System and Storage.

UNIT-III

Content Delivery Network: CDN Service Operations, Evolution of CDN, Advantages of CDN, Disadvantages of CDN, CDN Service Provider, Security Reference Model

Security Issues- Cloud security, threats to Cloud Security, Infrastructure Security, Information Security, Identity Management and Access Control, Cloud Security Design Principles, Cloud Security Management Frameworks, Security-as-a-Service, Privacy and Compliance Issues.

UNIT-IV

Portability and Interoperability Issues- Challenges in the Cloud, The Issues in Traditional Computing, Addressing Portability and Interoperability in Cloud, Portability and Interoperability Scenarios, Machine Imaging or Virtual Machine Image, Virtual Appliance, Difference between Virtual Machine Image and Virtual Appliance, Open Virtualization Format (OVF), Cloud Management and a Programming Model Case Study, Popular Cloud Services.

UNIT-V

Service-Oriented Architecture: The Pre-SOA Era, Role of SOA in Cloud Computing, Service-Oriented Architecture, Goal of System Designing, Service Represents Business Functionality, Open Standard Implementation, Benefits of SOA, SOA and Cloud Computing.

Database Technology: Database in Cloud, Data Models, Database-as-a-Service, Relational DBMS in Cloud, Non-relational DBMS in Cloud.

TEXT BOOK:

1. Sandeep Bhowmik, “Cloud Computing”, Cambridge University Press, 2017.

SUGGESTED READING:

1. Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, “Distributed and Cloud Computing from Parallel Processing to the Internet of Things”, Elsevier, 2012.
2. Barrie Sosinsky” Cloud Computing Bible”, Wiley-India, 2010
3. Ronald L. Krutz, Russell Dean Vines “Cloud Security: A Comprehensive Guide to Secure Cloud Computing”, Wiley- India,2010
4. John W. Rittenhouse, James F. Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2009.
5. Enterprise Cloud Computing - Technology, Architecture, Applications by Gautam Shroff, Cambridge University Press, 2016. 3 Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra,

WEB RESOURCES:

1. https://nptel.ac.in/courses/106105167/1
2. https://www.manning.com/books/exploring-cloud-computing (e-book)
3. https://www.coursera.org/specializations/cloud-computing

23ADE119

BIG DATA ANALYTICS

(Program Elective-2 and Elective-4 Courses)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aims to

1. Introduce to some of the most common frameworks such as Apache Spark, Hadoop, MapReduce, Pig and Hive
2. Provide Large scale data storage technologies such as NoSQL distributed databases with MongoDB
3. Facilitate learning of Spark and GraphX with machine learning applications

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Design of Hadoop Distributed Files system and build applications using MapReduce
2. Perform analysis on large datasets using Pig and Hive
3. Model the data using NoSQL and MongoDB
4. Develop applications of Parallel programming with Spark and Spark SQL
5. Develop machine learning solutions using Spark and Spark GraphX.

CO-PO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	2	2	3	3
CO2	3	2	2	3	2
CO3	3	1	1	2	2
CO4	3	2	3	3	2
CO5	3	2	3	3	2

UNIT-I

Introduction to Big Data: Introduction, Big Data Enabling Technologies, Hadoop Stack for Big Data

The Hadoop Distributed Files system: Overview, The Design of HDFS, HDFS Concepts, The Command-Line Interface, Hadoop File systems.

MapReduce: Overview, Developing a MapReduce Application, How MapReduce works, MapReduce Types and Formats, MapReduce Features, MapReduce Examples.

UNIT-II

Pig: Generating Examples, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators, Pig in Practice.

Hive: Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User-Defined Functions, Writing a User Defined Functions, Writing a User Defined Aggregate Function.

UNIT-III

No SQL Databases: Review of traditional Databases, Need for NoSQL Databases, Columnar Databases, Failover and reliability principles, CAP Theorem, Differences between SQL and NoSQL databases.

Working Mechanisms of Mongo DB: Overview, Advantages, Environment, Data Modelling, Create Database, Drop Database, Create collection, Drop collection, Data types, Insert, Query, Update and Delete operations, Limiting and Sorting records, Indexing, Aggregation

UNIT-IV

Parallel programming with Spark: Overview of Spark, Fundamentals of Scala and functional programming, Spark concepts - Resilient Distributed Datasets (RDD), creating RDDs, Basic Transformations, Basic Actions, Word Count example; Spark operations, Job execution, Spark Applications – Cluster computing with working sets.

Spark SQL: What is SQL, Big Data and SQL – Spark SQL, How to Run Spark SQL Queries, Tables, Views, Databases, Select Statements.

UNIT-V

Machine Learning with Spark: Designing a Machine Learning System, Obtaining, Processing and Preparing Data with Spark, Building a Recommendation Engine with Spark, Building a Classification Model with Spark, Building a Regression Model with Spark and Building a Clustering Model with Spark.

Spark GraphX & Graph Analytics: *GraphX* – Introduction, Graphs in Machine Learning Landscape, Graph-structured data, PageRank, *Graph Analytics* – Property Graphs, Graph Operators, Distributed Graphs, GraphX – Unified Analytics; *Case Study*: Flight Data Analysis using Spark GraphX

TEXT BOOKS:

1. Tom White, "Hadoop: The Definitive Guide", Fourth Edition, O'Reilly Media Inc, 2015.
2. Bill Chambers & Matei Zaharia, “Spark: The Definitive Guide”, O'Reilly Media Inc, 2018.
3. Nick Pentreath, “Machine Learning with Spark”, First Edition, Packt Publishing, 2015.

SUGGESTED READING:

1. Thilinagunarathne, “Hadoop MapReduce v2 Cookbook”, Second Edition, Packet Publishing, 2015.
2. Chuck Lam, Mark Davis, Ajit Gaddam, “Hadoop in Action”, Manning Publications Company, 2016.
3. Alex Holmes, “Hadoop in Practice”, Manning Publications Company, 2012.
4. Alan Gates, "Programming Pig", O'Reilly Media Inc, 2011.
5. Edward Capriolo, Dean Wampler, Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, 2012.

Web Resources:

1. https://nptel.ac.in/courses/106104189
2. http://www.planetcassandra.org/what-is-nosql
3. https://stanford.edu/~rezab/sparkworkshop/slides/xiangrui.pdf
4. https://class.coursera.org/datasci-001/lecture

23EGA101

ENGLISH FOR RESEARCH PAPER WRITING
(Audit Course – 1 and 2)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	-
Credits	0

Prerequisite: Writing to express on science and technological concepts with good taste for research and development.

COURSE OBJECTIVES: This course aims to

1. Motivate learners for academic writing and thus encourage them for continuous professional updating and up-gradation.
2. Facilitate a practical understanding of the multiple purposes of Writing Research Papers and help them infer the benefits and limitations of research in science and technology.
3. Brainstorm and develop the content, formulating a structure and illustrating the format of writing a research paper.
4. Survey and select a theme/topic for a thorough reading and to writing a research paper.
5. Understand to implement the intricacies of writing and publishing a research paper.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Improve work performance and efficiency, illustrate the nuances of research paper writing and draw conclusions on professional usefulness.
2. Classify different types of research papers and organize the format and citation of sources.
3. Explore various formats of APA, MLA and IEEE and set up for writing a research paper.
4. Draft paragraphs and write theme based thesis statements in a scientific manner.
5. Develop an original research paper while acquiring the knowledge of how and where to publish their papers.

CO-PO-PSO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PSO1	PSO2
CO 1	1	2	1	1	1
CO 2	1	1	1	1	1
CO 3	1	2	2	1	1
CO 4	1	2	1	1	1
CO 5	2	3	1	1	1

UNIT - I

Academic Writing: Meaning & Definition of a research paper; Purpose of a research paper - Scope, Benefits, Limitations and outcomes for professional development, An introduction to methods and Approaches of Research.

UNIT - II

Research Paper Format: Title - Abstract - Introduction - Discussion - Findings - Conclusion - Style of Indentation - Font size/Font types - Indexing - Citation of sources.

UNIT - III

Process of Writing a research paper, Writing to Draft a Format, Develop content, Adapting, Reviewing, Paraphrasing& Plagiarism Checks.

UNIT - IV

Choosing a topic - Thesis Statement - Outline - Organizing notes - Language of Research - Word order, Paragraphs - Writing first draft-Revising/Editing - The final draft and proof reading. Understanding APA, MLA, IEEE formats.

UNIT - V

Research Paper Publication Reputed Journals –Paid, Free and peer reviewed journals, National/International - ISSN No, No. of volumes, Scopus Index/UGC Journals. Getting Papers Published.

TEXT BOOKS:

1. Kothari, C. R. and Gaurav, Garg, Research Methodology Methods and Techniques", 4thEdition, New Age International Publishers, New Delhi, 2019.
2. Ellison, Carroll. "Writing Research Papers", McGraw Hill's Concise Guide, 2010.
3. Lipson, Charles. "Cite Right: A Quick Guide to Citation Styles-- MLA, APA, Chicago, the Sciences, Professions, and More", 2nd Edition,. University of Chicago Press. Chicago, 2018.

SUGGESTED READING:

1. Day, Robert A. "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006
2. Girden, E. R. "MLA Hand book for writers of Research Papers", 7th Edition, East West Press Pvt. Ltd, New Delhi, 2009
3. Bailey, Stephen. "Academic Writing: A Handbook for International Students", Routledge, 2018

Online Resources:

1. https://onlin://onlinecourses.nptel.ac.in/noc 18_mg13/preview
2. https://nptel.ac.in/courses/121/106/121106007/
3. https://www.classcentral.com/course/swayam-introduction-to-research-5221

Writing Tools:

1. https://owl.purdue.edu/owl_exercises/index.html - The Owl writing lab
2. https://www.turnitin.com/login_page.asp?lang=en_us – Turn tin software

23MTC102

MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE LAB

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to

1. To learn techniques for finding Eigen values and Eigen vectors.
2. To learn about reliability for probability function.
3. To learn about Estimating the parameter using LR test.
4. To learn about Hypothesis Testing for generalized linear model.
5. To learn about Prediction and Analysis of Variance.

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Construct Eigen vectors for the nth order transformation.
2. Test the reliability for the probability function.
3. Estimate the parameter using the LR test.
4. Identify the significance level for the generalized linear model.
5. Predict the values of generalized linear models using Analysis of Variance.

CO-PO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3		2	2	1
CO2	3		2	2	1
CO3	3		2	2	1
CO4	3		2	2	1
CO5	3		2	2	1

LIST OF PROGRAMS:

1. Compute Eigen values and Eigen vectors for nth order transformation.
2. Solution of non- homogenous system of linear equations.
3. Estimate Inverse matrix of linear transformation.
4. Verification of MTTF for the continuous Distributions.
5. Likely Hood Ratio Test by Hypothesis Testing.
6. Hypothesis Testing by F-Test.
7. Compute the significance level (P value) for generalized linear model.
8. Linear Predicted Model.
9. Multiple Regression Model.
10. ANOVA for Multiple Regressions.

REFERENCE BOOKS:

1. R For Statistics by Cornillon Pierre Andre Et Al , T and F India,January 2015.
2. An Introduction to Statistical Learning: with Applications in R,Springer; 2017.R Statistics Cookbook, Francisco Jureting, Packt publishing ltd,2019.

23ADC105

ARTIFICIAL INTELLIGENCE LAB

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to

1. Familiarize with search and game playing strategies.
2. Introduce logic programming concepts through Prolog
3. Learn probabilistic reasoning on uncertain data.
4. Learn knowledge representation and inference
5. Learn building AI Systems

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Solve AI problems through Python Programming
2. Demonstrate an intelligent agent
3. Evaluate Search algorithms
4. Build knowledge representation system and infer knowledge from it
5. Apply probabilistic reasoning on data.

CO-PO Articulation Matrix

PO/PSO/CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	3	3	3
CO2	3	1	3	3	2
CO3	2	1	3	2	2
CO4	2	-	3	3	3
CO5	2	1	3	2	1

LIST OF PROGRAMS:

1. Implementation of uninformed search techniques.
2. Implementation of informed search techniques.
3. Implementation of game search.
4. Implementation of a program to represent knowledge
5. Implementation of a program to construct a Bayesian network from given data.
6. Implementation of a program to infer from the Bayesian network.
7. Installation of Prolog and demonstration of basic operations.
8. Mini Project work

TEXT BOOK:

1. Russell, Norvig, ―Artificial Intelligence: A Modern Approach‖, Pearson Education, Third Edition, 2015
2. Allen B. Downey, ―Think Python How to Think Like a Computer Scientist‖, Second Edition, O'Reilly, 2016.

SUGGESTED READING:

1. Saroj Kaushik, ―Artificial Intelligence‖, Cengage Learning India, 2011.
2. Rich, Knight, Nair: ―Artificial intelligence‖, Tata McGraw Hill, Third Edition, 2009.
3. Nicole Bauerle, Ulrich Rieder, ―Markov Decision Process with Applications to Finance‖, Springer, 2011.
4. Nilsson. N., ―Artificial Intelligence: A New Synthesis‖, First Edition, Morgan Kaufmann, 1998.
5. Trivedi, M.C., ―A Classical Approach to Artificial Intelligence‖, Khanna Publishing House, Delhi

WEB RESOURCE:

1. https://ai.berkeley.edu/project_overview.html
2. http://aima.cs.berkeley.edu/

23ADE129

BIG DATA ANALYTICS LAB
(Laboratory-2 & 4 (Based on Elective-2 & 4 Courses)*)

Instruction	2 P Hours per week
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aims to

1. To provide the knowledge to setup a Hadoop Cluster and to develop programs using MapReduce
2. To introduce Pig, PigLatin and HiveQL and NoSQL to process big data
3. To introduce the latest big data frameworks and writing applications using Spark and Scala

COURSE OUTCOMES: After the completion of this course, the student will be able to

1. Understand Hadoop working environment
2. Work with big data applications in multi node clusters using MapReduce
3. Write scripts using Pig to solve real world problems.
4. Write queries using Hive to analyse the datasets
5. Use Spark working environment to solve real world problems.

CO-PO Articulation Matrix

PO/PSO CO	PO1	PO2	PO3	PSO1	PSO2
CO1	3	1	2	3	2
CO2	3	2	2	3	2
CO3	3	1	2	3	2
CO4	3	1	2	3	2
CO5	3	1	2	3	3

LIST OF PROGRAMS:

1. Demonstrate the following using HDFS
   a. Basic HDFS commands
   b. Working with Hadoop file system: Reading, Writing and Copying
2. Develop the following applications using MapReduce
   . Word count application using Map Reduce on single node cluster
   a. Analysis of Weather Dataset on Multi node Cluster using Hadoop
   b. Real world case studies on Map Reduce applications
3. Writing User Defined Functions/Eval functions for filtering unwanted data in Pig
4. Working with Hive on the following
   . HiveQL
   a. Writing User Defined Functions in Hive
5. Demonstrate the working of NoSQL database MongoDB
6. Implement the following on Spark
   . Processing large datasets on Spark framework
   a. Word count application
7. Build a Clustering Model with Spark
8. Implement the case study “Flight Data Analysis” using Spark GraphX

TEXT BOOKS:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media Inc, 2015.
2. TanmayDeshpande, “HadoopReal-World Solutions Cookbook”, Second Edition, Packt Publishing 2016.

SUGGESTED READING:

1. Edward Capriolo, Dean Wampler, and Jason Rutherglen, "Programming Hive", O'Reilly Media Inc, October 2012.
2. VigneshPrajapati, "Big data Analytics with R and Hadoop", Packt Publishing, November 2013.
3. Nick Pentreath, “Machine Learning with Spark”, First Edition, Packt Publishing, 2015.

Web Resources:

1. https://parthgoelblog.wordpress.com/tag/hadoop-installation
2. http://www.iitr.ac.in/media/facspace/patelfec/16Bit/index.html
3. https://class.coursera.org/datasci-001/lecture
4. http://bigdatauniversity.com.