Computer Science and Engineering (Artificial Intelligence and Machine Learning)

Preamble: The curriculum of B. Tech. Computer Science and Engineering (Artificial Intelligence and Machine Learning) program offered by the Department of Computer Science and Engineering under Academic Regulation 2020 is prepared in accordance with the curriculum framework of AICTE, UGC and Andhra Pradesh State Council of Higher Education (APSCHE). Further this Outcome Based Curriculum (OBC) is designed with Choice Based Credit and Semester System (CBCSS) enabling the learners to gain professional competency with multi-disciplinary approach catering the minimum requirement (Program Specific Criteria) of Lead Societies like ACM and other Professional Bodies as per the Engineering Accreditation Commission (EAC) of ABET and NBA. In addition, the curriculum and syllabi are designed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Professional Bodies, Research Organizations and Parents to capture their voice of the respective stakeholders.

The Curriculum design, delivery, and assessment, the three major pillars of academic system are completely aligned in line with Outcome Based Education (OBE) to assess and evaluate the learning outcomes to facilitate the learners to achieve their Professional and Career Accomplishments. As the institute is registered in ABC, the students have academic flexibility as per ABC in earning the total credits for the award of B. Tech Degree in Regular, Honors and Minors with specialization.

The Vision

To become the Centre of Excellence for technically competent and innovative computer engineers

The Mission

- To provide quality education and spread professional & technical knowledge, leading to a career as computer professionals in different domains of industry, governance, and academia
- To provide state-of-the art environment for learning and practices
- To impart hands on training in latest methodologies and technologies

Program Educational Objectives (PEOs)

The PEOs are the educational goals that reflect Professional and Career Accomplishments that a graduate should attain after 4 – 5 years of his/her graduation.

The graduates of Computer Science and Engineering (Artificial Intelligence and Machine Learning) of NSRIT will

1. Be Engineering professionals/innovators/entrepreneurs by adapting and engaging themselves in technology deployment and implementation in the industry
2. Have a sustained satisfactory professional career in their chosen profession as an individual and/or as a team member/team lead in an IT or allied industry
3. Engage themselves in life-long learning in advanced studies based on the demand driven need of the industries for their professional and career accomplishments

Program Outcomes (POs)

The POs are the transactional statements of graduate attributes (GAs) that each graduating engineer should possess in terms of knowledge, skill and behavior with a minimum target performance level at the time of graduation as fixed by the program of study seeking continuous improvement year on year.

The graduates of Computer Science and Engineering of NSRIT will be able to demonstrate the following outcomes in terms knowledge, skill and behavioral competencies at the time of graduation with the expected target performance level.

1. Apply the knowledge of basic sciences and fundamental engineering concepts in solving engineering problems (Engineering Knowledge)
2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences (Problem Analysis)
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations (Design/Development of Solutions)
4. Perform investigations, design and conduct experiments, analyse and interpret the results to provide valid conclusions (Investigation of Complex Problems)
5. Select/develop and apply appropriate techniques and IT tools for the design & analysis of the systems (Modern Tool Usage)
6. Give reasoning and assess societal, health, legal and cultural issues with competency in professional engineering practices (The Engineer and Society)
7. Demonstrate professional skills and contextual reasoning to assess environmental/societal issues for sustainable development (The Environment and Sustainability)
8. Demonstrate Knowledge of professional and ethical practices (Ethics)
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary situations (Individual and Team Work)
10. Communicate effectively among engineering community, being able to comprehend and write effectively reports, presentation and give / receive clears instructions (Communication)
11. Demonstrate and apply engineering & management principles in their own / team projects in multidisciplinary environment (Project Finance and Management)
12. Recognize the need for, and have the ability to engage in independent and lifelong learning (Life Long Learning)

Program Specific Outcomes (PSOs)

1. Apply the conceptual knowledge of computer science, machine learning and deep learning to solve real world problems
2. Develop skills to design and develop systems/applications to provide AI based solutions

Category-wise Credit Distribution of Courses

Category		AICTE	APSCHE	NSRIT (A)
HS	Humanities and Social Science	12.0	10.5	10.5
BS	Basic Science	25.0	18.0	21.0
ES	Engineering Science	24.0	22.5	19.5
PC	Professional Core	48.0	55.5	55.5
PE	Professional Elective	18.0	15.0	15.0
OE	Open Elective	18.0	12.0	12.0
IN	Internship (s), Project & Seminars	15.0	16.5	16.5
SC	Skill Oriented Courses	-	10.0	10.0
MC	Mandatory Courses	-	-	-
AC	Audit Course	-	-	-
Total no. of credits		160	160	160

Computer Science and Engineering (Artificial Intelligence and Machine Learning)

Credit requirement for the award of the degree under academic Regulation 2020 – 2021 for the candidates admitted from the academic year 2021 onwards		
	Four Years	Three Years
B. Tech. (Regular Degree)	160	121
B. Tech. (Honors Degree)	180	141
B. Tech. (With minor specialization other than Chosen Branch of Engg. & Tech.)	180	141

No.	Course Code	Course	POs	Contact Hours				
				L	T*	P	C	
Semester I								
01	20HSX01	Communicative English	10	3	0	0	3.0	HS
02	20BSX11	Linear Algebra and Differential Equations	1, 12[1]	3	1	0	3.0	BS
03	20BSX33	Applied Physics	1	3	1	0	3.0	BS
04	20ESX02	Programming for Problem Solving using 'C'	1	1	0	4	3.0	ES
05	20CS101	Fundamentals of Computer Science	1	3	0	0	3.0	ES
06	20HSX02	Communicative English Laboratory	1, 10	-	-	3	1.5	BS
07	20BSX34	Applied Physics Laboratory	1, 4	-	-	3	1.5	HS
08	20ESX07	Programming for Problem Solving using 'C' Lab	1, 4	-	-	3	1.5	ES
			Sub-total	13	02	13	**19.5**	
Semester II								
01	20BSX12	Partial Differential Equations and Vector Calculus	1	3	1	0	3.0	BS
02	20BSX23	Applied Chemistry	1	3	1	0	3.0	BS
03	20ESX05	Basic Electrical and Electronics Engineering	1	3	1	0	3.0	ES
04	20CS201	Data Structures using 'C'	1	3	1	0	3.0	ES
05	20EC203	Digital Logic Design	1	3	1	0	3.0	ES
06	20BSX24	Applied Chemistry Laboratory	1, 4	0	0	3	1.5	BS
07	20CS202	Data Structures using 'C' Laboratory	1, 4	0	0	3	1.5	ES
08	20ESX08	Basic Electrical & Electronics Engineering Lab	1, 4	0	0	3	1.5	ES
09	20MCX01	Environmental Science	1, 6	2	0	0	-	MC
			Sub-total	17	05	09	**19.5**	
Semester III								
01	20BSX16	Mathematical Foundations for Computer Science	1	3	1	0	3.0	BS
02	20CS302	Design and Analysis of Algorithms	1, 2, 3	3	1	0	3.0	PC
03	20CS303	Database Management Systems	1, PSO1	3	1	0	3.0	PC
04	20DS304	Programming with Python	1, 2, 5	3	1	0	3.0	PC
05	20CS305	Computer Organization	1	3	0	0	3.0	PC
06	20CS306	Design and Analysis of Algorithms Lab	4	-	-	3	1.5	PC
07	20CS307	Database Management Systems Laboratory	1, 4, PSO1	-	-	3	1.5	PC
08	20DS307	Programming with Python Lab	1, 4, 5	-	-	3	1.5	PC
09	20AIS01	Short-term Skill Oriented Elective[2]	4, 5	0	0	4	2.0	SC
10	20MCX02	Constitution of India[3]		0	0	0	-	MC
			Sub-total	15	4	13	**21.5**	

* Suggested hours for tutorial

[1] By default, all courses are mapped to PO 12 as they are weakly contributing

[2] The students shall opt any of the short-term skill-oriented course electives

[3] It is mandate for all students to pursue an online certification course for minimum duration of 30 hours

No.	Course Code	Course	POs	Contact Hours				
				L	T	P	C	
Semester IV								
01	20HSX03	Managerial Economics & Financial Analysis	11	3	0	0	3.0	HS
02	20BSX15	Probability and Statistics	2, 5	3	1	0	3.0	BS
03	20CS502	Computer Networks	1, 2	3	0	0	3.0	PC
04	20CS404	Operating Systems	1	3	1	0	3.0	PC
05	20AI405	Artificial Intelligence	1, 2	3	1	0	3.0	PC
06	20AI406	Python Programming for Statistics Laboratory	4, 5	0	0	3	1.5	PC
07	20AI407	Artificial Intelligence Laboratory	4, 5	0	0	3	1.5	PC
08	20CS408	Operating Systems Lab	4	0	0	3	1.5	PC
09	20AIS02	Short-term Skill Oriented Elective	4, 5	0	0	4	2.0	SC
			Sub-total	15	3	13	**21.5**	
Semester V								
01	20CS405	Theory of Computation	1, 2	3	1	0	3.0	PC
02	20AI502	Machine Learning	1, 2	3	1	0	3.0	PC
03	20AI503	High Performance Computing	2, 3, 5	3	1	0	3.0	PC
04	-	Professional Elective I		3	0	0	3.0	OE
05	-	Open Elective I		3	0	0	3.0	PE
06	20AI506	Web Development Laboratory	4, 5	0	0	3	1.5	PC
07	20AI507	Machine Learning Laboratory	4, 5, PSO1, PSO2	0	0	3	1.5	PC
08	20AIS03	Technical Paper Writing[4]	1, 10	0	0	4	2.0	SC
09	20MCX03	Intellectual Property Rights and Patents		0	0	0	-	MC
10	-	Summer Internship #1[5] / CSP		0	0	0	1.5	TG
			Sub-total	17	3	10	**21.5**	
Semester VI								
01	20CS603	Modern Software Engineering	1, 2, 3	3	0	0	3.0	PC
02	20AI602	Deep Learning Principles and Practices	2, 3, 5	3	1	0	3.0	PC
03	20AI603	Artificial Neural Networks	1, 2	3	1	0	3.0	PC
04	-	Professional Elective II		3	1	0	3.0	PE
05	-	Open Elective II		3	0	0	3.0	OE
06	20CS608	Modern Software Engineering Laboratory	4, 5	0	0	3	1.5	PC
07	20AI607	Deep Learning Laboratory	4, 5	0	0	3	1.5	PC
08	20AI608	Artificial Neural Networks Laboratory	4, 5	0	0	3	1.5	PC
09	20AIS04	Short-term Skill Oriented Elective		0	0	4	2.0	SC
10	20MCX04	Indian Traditional Knowledge	-	0	0	0	-	MC
			Sub-total	15	3	13	**21.5**	
Semester VII								
01	-	Professional Elective III		3	0	0	3.0	PE
02	-	Professional Elective IV		3	0	0	3.0	PE
03	-	Professional Elective V		3	0	0	3.0	PE
04	-	Open Elective III		2	0	2	3.0	OE
05	-	Open Elective IV		2	0	2	3.0	OE
06	20HSX04	Professional Ethics	8	3	0	0	3.0	HS
07	20AIS05	Datasets & Packages for ML Engineer	4, 5	0	0	4	2.0	SC

[4] The students are expected to identify one research area in the recent trends, collect recent research articles, prepare a technical research review paper and publish in renowned annual conferences/ journals, preferably indexed in Scopus or UGC care

[5] It is mandate for all the students to undergo 4-6 weeks of industrial training and appear for assessment during Semester V with report. With regard to Community Service Project (CSP), based on the availability the students can opt CSP as an alternate option for summer internship #1 for a duration of 08 weeks

08	-	Summer Internship #2[6]	All POs, PSOs	0	0	0	3.0	TG
			Sub-total	16	0	8	**23**	
Semester VIII								
01		Full Semester Internship[7]	5 – 10, PSOs				06	
02		Capstone Project[3]	5 – 10, PSOs				06	
			Sub-total				**12.0**	
			Total Credits				**160**	

List of Electives

Professional Elective #1								
1	20AI001	Fundamentals of Image Processing		3	0	0	3.0	PE
2	20AI002	Cryptography		3	0	0	3.0	PE
3	20AI003	Cloud Computing Essentials		3	0	0	3.0	PE
Professional Elective #2								
5	20AI004	Computer Vision and Applications		3	1	0	3.0	PE
6	20AI005	Cyber Security		3	0	0	3.0	PE
7	20AI006	Social Network Analysis		3	1	0	3.0	PE
Professional Elective #3								
9	20AI007	Bio-informatics		3	0	0	3.0	PE
10	20AI008	Fundamentals of Blockchain		3	0	0	3.0	PE
11	20AI009	Big Data Analytics		3	1	0	3.0	PE
Professional Elective #4								
13	20AI010	Soft Computing		3	0	0	3.0	PE
14	20AI011	Cyber Threat Analysis		3	0	0	3.0	PE
15	20AI012	Distributed Computing		3	0	0	3.0	PE
Professional Elective #5								
The curriculum provides academic flexibility to choose any of the domain specific courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration (4-credits) and the assessment shall be as per the academic regulation 2020.								PE
Open Elective #1								
25	20CEO01	Urban Environmental Service		3	0	0	3.0	OE
26	20CSO01	Data Structures and Algorithms		3	0	0	3.0	OE
27	20AIO01	Machine Learning for Engineers		3	0	0	3.0	OE
28	20DSO01	Introduction to Database Management Systems		3	0	0	3.0	OE
29	20ECO01	Architecture and Algorithms of IoT		3	0	0	3.0	OE
30	20EEO01	Introduction to Renewable Energy Sources		3	0	0	3.0	OE
31	20MEO01	Nano Technology		3	0	0	3.0	OE
32	20SHO01	Women and Society		3	0	0	3.0	OE
Open Elective #2								
33	20CEO02	Ecology, Environment and Resources		3	0	0	3.0	OE
34	20CSO02	Designing the Internet of Things		3	0	0	3.0	OE
35	20AIO02	Fundamentals of Deep Learning		3	0	0	3.0	OE
36	20DSO02	Introduction to Data Science		3	0	0	3.0	OE
37	20ECO02	IoT for Smart Grids		3	0	0	3.0	OE
38	20EEO02	Electrical Safety and Management		3	0	0	3.0	OE
39	20MEO02	Fundamentals of Automobile Engineering		3	0	0	3.0	OE
Open Elective #3								
40	20CEO03	Disaster, Risk mitigation and Management		3	0	0	3.0	OE
41	20CS302	Operating Systems		3	0	0	3.0	OE
42	20AIO03	Fundamentals of AI		3	0	0	3.0	OE
43	20DSO03	Introduction to Big Data		3	0	0	3.0	OE

[6] It is mandate for all the students to undergo 6-8 weeks of industrial training and appear for assessment during Semester VII with report and those opted FSI during Semester VII shall appear through online for reviews

[7] Students opting for FSI in VII semester have to take up courses of VII semester in VIII semester

44	20ECO03	Privacy and Security in IoT		3	0	0	3.0	OE
45	20EEO03	Low-cost Automation		3	0	0	3.0	OE
46	20MEO03	Industrial Automation		3	0	0	3.0	OE
47	20SHO02	Design Innovations		3	0	0	3.0	OE
Open Elective #4								
The curriculum provides academic flexibility to choose any of the inter-disciplinary courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration and the assessment shall be as per the academic regulation 2020.								OE
B. Tech. (Honors)								
Category I								
1	20DSH01	Text Analytics		4	0	0	4.0	HO
2	20AIH02	**Advanced Data Structures and Algorithms**		4	0	0	4.0	HO
3	20AIH03	**Game Theory**		4	0	0	4.0	HO
Category II								
4	20DSH04	Recommender Systems		4	0	0	4.0	HO
5	20AIH05	**Video Analytics**		4	0	0	4.0	HO
6	20AIH06	**Game Programming**		4	0	0	4.0	HO
Category III								
7	20DSH07	Data Analysis with MATLAB		4	0	0	4.0	HO
8	20AIH08	**Natural Language Processing**		4	0	0	4.0	HO
9	20AIH09	**3D Graphics and Animations**		4	0	0	4.0	HO
Category IV								
10	20DSH10	Data Preparation and Cleaning		4	0	0	4.0	HO
11	20AIH11	**Digital Forensics**		4	0	0	4.0	HO
12	20AIH12	**Augmented Reality and Virtual Reality**		4	0	0	4.0	HO
B. Tech. (Minor with Specialization)								
Category I								
1	20CEM01	Air Pollution		3	0	0	3.0	MI
2	20CSM01	E Commerce		3	0	0	3.0	MI
3	20MEM01	Biomaterials		3	0	0	3.0	MI
4	20EEM01	Basic Control systems		3	0	0	3.0	MI
5	20ECM01	Fundamentals of Electronics		3	0	0	3.0	MI
6	20AIM01	Fundamentals of Neural Networks		3	0	0	3.0	MI
7	20DSM01	Introduction to R Programming		3	0	0	3.0	MI
8	20SHM01	Psychology		3	0	0	3.0	MI
9	20SHM02	Statistical Methods		3	0	0	3.0	MI
10	20MBM01	General Management		3	0	0	3.0	MI
11	20MBM02	Human Resource Planning		3	0	0	3.0	MI
Category II								
12	20CEM02	Climate Change Mitigation and Adaptation		3	0	0	3.0	MI
13	20CSM02	Knowledge Discovery and Databases		3	0	0	3.0	MI
14	20MEM02	Micro Electromechanical Systems		3	0	0	3.0	MI
15	20EEM02	Basics of Electrical Machines and Drives		3	0	0	3.0	MI
16	20ECM02	Digital Electronics		3	0	0	3.0	MI
17	20AIM02	Machine Learning with Python		3	0	0	3.0	MI
18	20DSM02	Data Management and Analysis		3	0	0	3.0	MI
19	20SHM03	English for Media		3	0	0	3.0	MI
20	20SHM04	Statistical Inference		3	0	0	3.0	MI
21	20MBM03	Organization Behaviour		3	0	0	3.0	MI
22	20MBM04	Compensation Management & Employee Welfare Laws		3	0	0	3.0	MI
Category IIII								
23	20CEM03	Sustainability and Pollution Prevention Practices		3	0	0	3.0	MI
24	20CSM03	Database Security		3	0	0	3.0	MI
25	20MEM03	Surface Engineering		3	0	0	3.0	MI
26	20EEM03	Electrical Engineering Material Science		3	0	0	3.0	MI
27	20ECM03	Analog Electronic Circuits		3	0	0	3.0	MI
28	20AIM03	Interpretable Machine Learning		3	0	0	3.0	MI

29	20DSM03	Data Governance		3	0	0	3.0	MI
30	20SHM06	Journalism		3	0	0	3.0	MI
31	20SHM07	Statistical Quality Control		3	0	0	3.0	MI
32	20MBM05	Entrepreneurship & Business Venture Planning		3	0	0	3.0	MI
33	20MBM06	Performance Management & Talent Management		3	0	0	3.0	MI

Short Term Skill Oriented Electives								
34	20AIS01	JAVA Programming		0	0	4	2.0	SC
35	20AIS02	R Programming		0	0	4	2.0	SC
36	20AIS04	Deep Learning Frameworks		0	0	4	2.0	SC
Long Term Skill Oriented Courses (Industry Oriented)[8]								
37	20ICC01	Competitive Programming	-	2	0	8	6.0	ICC
38	20ICC02	Web Technologies – Theory to Practice	-	2	0	8	6.0	ICC
39	20ICC03	Java and Spring boot	-	2	0	8	6.0	ICC
40	20ICC04	Robotics Process Automation (RPA)	-	2	0	8	6.0	ICC
41	20ICC05	Information Security and Forensics	-	2	0	8	6.0	ICC
42	20ICC06	Battery Technologies for EV	-	2	0	8	6.0	ICC
43	20ICC07	Blockchain Technology	-	2	0	8	6.0	ICC
44	20ICC08	Network Administration	-	2	0	8	6.0	ICC
45	20ICC09	Product Engineering	-	2	0	14	9.0	ICC
46	20ICC10	Machine Learning Engineer	-	2	0	8	6.0	ICC
47	20ICC11	Data Scientist	-	2	0	8	6.0	ICC
48	20ICC12	Industrial IoT	-	2	0	8	6.0	ICC

List of Honors offered by Computer Science and Engineering (AI & ML) Program

1. **Data Analytics**
2. **Surveillance Systems**
3. **Game Programming**

List of Minor Specializations offered by Computer Science and Engineering (AI & ML) Program

1. Machine Learning and Deep Learning

List of Minor's offered by the Freshman engineering and Management studies such as

1. Liberal Arts
2. Statistics
3. General Management
4. Human Resource Management

These will be implemented for the 2021 admitted students

[8] The credits earned through Long Term Skill Oriented Course can be trade-off with any other 3-Credit course other than Professional Core

BS 20BSX16 Mathematical Foundations of Computer Science 3 1 0 3

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX16.1	Construct and Verify the Correctness of Statements using Propositional and Predicate Logic	3	1	L1, L2, L3
20BSX16.2	Illustrate the Operations on Discrete Structures such as Relations and Functions	3	1	L1, L2
20BSX16.3	Interpret the concepts of divisibility, prime number, congruence and number theorems	3	1	L1, L2, L3
20BSX16.4	Solve Recurrence Relations and Generating Functions	3	1	L1, L2, L3
20BSX16.5	Demonstrate Graphs and Trees as Tools to Visualize and Simplify Situations	3	1	L1, L2, L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge				

Unit I: Mathematical Logic 11 + 1 Hour

Propositional Calculus: Statements and Notations -Connectives - Well-formed Formulas - Truth Tables - Tautology – Equivalence Implication- principal disjunctive and conjunctive normal forms, Rules of Inference for Statement Logic - Proof Techniques - Proof by Contradiction.
Predicate Calculus: Predicative logic, free & bound variables, quantifiers, rules of inference.

Disjunctive and Conjunctive normal forms

Unit II: Binary Relations, Functions and Algebraic Structures 11 + 1 Hour

Binary Relations - Properties and Operations - Relational Graphs - Relation Matrices – Equivalence Relations - Partial Ordering Relations - Hasse Diagram.
Functions – Types of functions - Composition of Functions-Permutation and Recursive Functions.
Algebraic Structures (Definitions and simple illustrations) - Semi Groups – Monoids – Groups - Abelian Groups – Subgroups.

Algebraic Structures (Definitions and simple illustrations), Inverse functions

Unit III: Number Theory 11 + 1 Hour

Properties of integers, divisibility, Division theorem, Greatest Common Divisor (GCD), Euclidean algorithm, Least Common Multiple (LCM), testing for prime numbers, The Fundamental theorem of arithmetic, modular arithmetic: Congruence, congruence equations, Fermat's Theorem, Euler's Totient function, Euler's theorem, Chinese Remainder theorem.

Chinese Remainder theorem

Unit IV: Recurrence Relations 11 + 1 Hour

Generating Functions - Function of Sequences -Calculating Coefficient of Generating Functions.
Recurrence Relations - Solving Recurrence Relation by Substitution- solving homogeneous linear recurrence relations by characteristic roots method- non homogeneous linear recurrence relations

Applications: Algorithm Analysis - Time and Space Complexity

Unit V: Graph Theory (All theorems without proof) 11 + 1 Hour

Basic Concepts - Graph Theory- Sub graphs- Graph Representations- Adjacency and Incidence Matrices - Isomorphic Graphs- Paths and Circuits, Eulerian and Hamiltonian Graphs, planar graphs, spanning trees minimal spanning tree.

Operations on Graphs

Text Books

1. Kenneth H. Rosen, "Discrete Mathematics and Applications", 7th Edition, Tata McGraw Hill, 2015

2. Mott J. L, Kandel A and Baker T. P., Discrete Mathematics for Computer Scientists & Mathematicians, 2nd Edition, Prentice Hall , India, 2010
3. Santha S., Prasad E. V., "Mathematical Foundation for computer Science" 1st Edition, Cengage, 2017

Reference Books

1. Liu C. L. and Mohapatra D. P., "Elements of Discrete Mathematics, A Computer Oriented Approach", 4th Edition, Tata McGraw Hill, 2018
2. Tremblay J. P. and Manohar P., "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill, 2nd Edition, 1997
3. Swapan Kumar Sarkar, "A text book of Discrete Mathematics", S. Chand Publications, 7th Edition, 2018

Web References

1. https://nptel.ac.in/courses/106106094/
2. https://nptel.ac.in/courses/111/101/111101137/
3. http://www.saylor.org/course/cs202/
4. http://www.cse.iitd.ernet.in/~bagchi/courses/discrete-book

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	40	40
L3	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define converse, contra positive and inverse of an implication
2. Write a note on operator in modular arithmetic
3. Define Binary Relation
4. Define prime and co-prime numbers
5. A complete binary tree has 125 edges. How many vertices does it have?

L2: Understand

1. Show that the (~P P Q)) (~Q) statement is a tautology
2. Given R = {(1, 1), (1, 4), (4, 1), (2, 2), (2, 3), (3, 4), (3, 3), (3, 2), (4, 3),(4, 4)}. Verify the relation R on X = {1, 2, 3, 4} is an equivalence relation or not
3. Explain different tests for primality.
4. Solve $a_n-6a_{n-1}+9a_{n-2}=0$ for n>=2 given $a_0=5,a_1=12$
5. Explain minimal spanning tree of the graph with suitable example

L3: Apply

1. Find GCD of 330,616 using Euclidian algorithm
2. Solve the recurrence relation an - 7 a_{n-1} + 10 a_{n-2} =0 for n 2 using generating functions
3. Let G be the set of all non-zero real numbers with a binary operation *, defined as $a*b = a^2b^2$. Show that <G,*> is an abelian group
4. Show that the complete graphs K_2, K_3, K_4 are planar
5. Find the last two digits of 3333^{4444}

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Chairman
Board of Studies (Mathematics)

PC 20CS302 Design and Analysis of Algorithms 3 1 0 3.0

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PO12	
20CS302.1	Describe the process of analysing the performance of any algorithm	3	1	1	1	L1, L2
20CS302.2	Classify the time complexity of any algorithm to appropriate asymptotic class after computing its complexity	3	1	1	1	L1, L2
20CS302.3	Explain the general principle of different algorithm design strategies	3	1	1	1	L1, L2, L3
20CS302.4	Design algorithms for given computing problem by choosing appropriate design strategy	3	1	1	1	L1, L2, L3
20CS302.5	Calculate the performance of any algorithm designed to solve given computing problem	3	1	1	1	L1, L2, L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos						
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge						

Unit I: Introduction to algorithms **9 + 3 hours**

Fundamentals of algorithmic problem solving – Fundamentals of the analysis of algorithm efficiency: Analysis framework – Asymptotic notations and basic efficiency classes – Mathematical analysis of non-recursive algorithms – Mathematical analysis of recursive algorithms – Empirical analysis of algorithms – Brute Force Strategy: Bubble sort, Sequential search, String matching problem – Exhaustive Search Strategy: Knapsack problem

Depth First Search, Breadth First Search

Unit II: Algorithm Design Techniques I **12 + 3 hours**

Decrease and Conquer: General method, Insertion sort, Topological Sorting, Algorithm to generate combinatorial objects – Decrease by constant factor and variable size decrease – Divide and Conquer: General method, Merge sort, Quick sort, Multiplication of large integers, Strassen's matrix multiplication – Transform and Conquer: General method, Pre-sorting, Heaps and Heapsort

Balanced search trees

Unit III: Algorithm Design Techniques II **12 + 3 hours**

Greedy Technique: General method, Knapsack problem, Job sequencing with deadlines, Minimal cost spanning tree algorithms (Prim's and Kruskal's), Optimal merge pattern, Single source shortest path algorithm, Huffman trees and codes – Dynamic Programming: General method, 0/1 knapsack problem, All pair shortest path algorithm

Optimal Binary Search trees

Unit IV: Limitations of Algorithmic power **6 + 2 hours**

P, NP, NP – hard and NP-complete problems – Basic concepts, NP – hard graph problems, Cook's theorem

Simplified NP – hard problems

Unit V: Coping up with limitations of algorithmic power **8 + 2 hours**

Backtracking: General method, N-queen's problem, Subset sum problem, Hamiltonian circuit problem, Graph coloring problem - Branch and Bound: General method, Least Cost (LC) search, Control abstractions for LC search, Bounding, FIFO based branch and bound, LC based branch and bound, Traveling Salesman problem, Assignment problem

0/1 knapsack problem

Text Books

1. Anany Levitin, "Introduction to The Design and Analysis of Algorithms", Third Edition, Pearson Education, 2017
2. Ellis Horowitz, SatrajSahni and Rajasekaran, "Fundamentals of Computer Algorithms", Second Edition, University Press, 2007
3. T.H. Cormen., C.E. Leiserson,R.L.Rivest., C.Stein, "Introductionton Algorithms", Third Edition, MIT Press, 2009

Reference Books

1. Aho, Ullman and Hopcroft, "Design and Analysis of Computer Algorithms", First Edition, Pearson Education, 2002
2. Richard Johnson Baugh., Marcus Schaefer, "Algorithms", First Edition, Pearson Education, 2013

Web Resources

1. www.geeksforgeeks.com
2. www.sanfoundary.com
3. www.topcoder.com

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

L1: Remembering

1. Define algorithm
2. List the four properties of a good algorithm
3. Define time complexity and space complexity
4. What are asymptotic classes?
5. Define the principle of optimality
6. State Cook's theorem
7. Define minimal spanning tree
8. Define NP hard and NP complete problems

L2: Understanding

1. What do you mean by order of growth of an algorithm?
2. Write all the basic asymptotic classes in increasing order of their efficiency
3. Explain the general method of greedy technique
4. Describe the general method of dynamic programming strategy
5. Describe the working of backtracking algorithm
6. Exemplify decrease and conquer algorithm with appropriate example

L3: Applying

1. Design a recursive algorithm to find the sum of first n integers and compute its time and space complexity
2. Write the quick sort algorithm by applying divide and conquer strategy and compute it complexity
3. Assume a list of integers which are in increasing order. Compare the time complexity of quick sort and merge sort algorithms in terms of number of swaps performed
4. Design an algorithm based on dynamic programming to find the product of a chain of matrices
5. Solve 0/1 knapsack problem using branch bound technique

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Chairman
Board of Studies (CSE)

PC 20CS303 Database Management Systems 3 1 0 3.0

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

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO12	PSO1	
20CS303.1	Describe the basic concepts of databases and data models	3	1	2	L1, L2
20CS303.2	Illustrate the principles of relational data model	3	1	2	L1, L2, L3
20CS303.3	Apply SQL commands to work with databases	3	1	1	L1, L2, L3
20CS303.4	Apply the principles of database normalization	3	1	2	L1, L2, L3
20CS303.5	Describe the transaction management strategies and recovery systems	3	1	1	L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos					
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge					

Unit I: Introduction to Databases **9 + 3 Hours**

Overview of Data Base Systems, Database System Applications, File System VS Database System, Data Abstraction, Levels of Abstraction, Data Independence Instances and Schemas, Different Data Models, Database Languages, Data Base Users and Administrator, Database System Structure, N-tier Architecture, Database design and ER diagrams, Design Entities, Attributes and Entity sets, Relationships and Relationship Sets, Advanced Features of ER Model, Conceptual Design for Large enterprises

History of DBMS

Unit II: Relational Model, Relational Algebra and Relational calculus **9 + 3 Hours**

Relational Model: Introduction to the Relational Model, Integrity Constraint and key constraints over relations, Logical data base Design, Views, Destroying / Altering Tables and Views - Relational Algebra: Selection and Projection, Set Operations, Aggregate Operations, Renaming, Joins, Division, Additional Relational Algebraic operations - Relational calculus: Tuple Relational Calculus, Domain Relational Calculus

Expressive Power of Algebra and Calculus

Unit III: Structured Query Language **9 + 3 Hours**

SQL: Concept of different Database Languages over SQL - DDL, DML, DCL., Set operations, SQL Commands, Nested queries, Aggregate Functions, Null Value, Referential Integrity Constraints, views, Embedded SQL, Triggers, Cursors, Stored procedures, ODBC and JDBC.

Compare all Database Languages, Importance of Null values

Unit IV: Schema Refinement and Normalization **9 + 3 Hours**

Undesirable Properties in Relational Database Design, Functional Dependencies, Trivial and Nontrivial Dependencies, Closure Set of Functional Dependencies, Closure Set of Attributes. - Normalization: 1NF, 2NF, 3NF, BCNF, Lossless Join and Dependency Preserving decomposition, 4NF and 5NF- Indexing: Basic Concepts, Primary Index, Dense and Sparse Indices, Secondary Indices, Trees, Structured Indexing, Indexed Sequential Access Method (ISAM)

Compare all Normal Forms

Unit V: Transaction Management and Recovery System **9 + 3 Hours**

Transaction Management and Concurrency Control: Transaction Concept, ACID Properties, States of Transaction, Implementation of Atomicity & Durability, Schedules, Testing of Serializability, 2PL, Serializability and Recoverability, Introduction to Lock Management, Lock Conversions, Specialized Locking Techniques - Recovery System: Failure Classification, Storage Structure, Recovery and Atomicity, Log-Based Recovery, Recovery with Concurrent Transactions, Buffer Management, Failure with Loss of Non-volatile Storage, ARIES Recovery Method, Remote Backup Systems.

Concurrency Control without Locking

Text Books

1. Raghurama Krishnan, Johannes Gehrke, "Data base Management Systems", Third Edition, TATA McGraw Hill, 2008
2. Abraham Silber Schatz, Henry F Korth, S Sudarshan, "Database System Concepts", Sixth Edition, McGraw-Hill International Edition, 2013
3. Date CJ, Kannan A, Swamynathan S, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006

Reference Books

1. Elmasri Navrate, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2016
2. Peter Rob & Carlos Coronel, "Data base Systems design, Implementation, and Management", Tenth Edition, Pearson Education, 2013

Web References

1. http://www.nptelvideos.in/2012/11/database-managementsystem.html
2. https://www.javatpoint.com/dbms-tutorial

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	30	40
L3	40	30
Total (%)	100	100

L1: Remember

1. List all the types of database users
2. List out all the different types of data models present
3. Give syntaxes to Create and Alter a table
4. What is Redundancy?
5. List out the properties of transactions

L2: Understand

1. Compare the database system with conventional file system
2. Demonstrate the use of DISTINCT keyword in SQL select statement
3. Explain the following SQL constructs with examples:
   (1) Order by (2) group by and having (3) as select (4) schema
4. Explain the difference among Entity, Entity Type & Entity Set
5. Illustrate different types of joins in SQL

L3: Apply

1. Choose a relation R with 5 attributes ABCDE and the following FDs: A ->B, BC->E, and ED ->A. Is R in 3NF? Justify?
2. Apply Normalization technique for the following relation up to 3NF:
   Bank (acno, cust_name, ac_type, bal, int_rate, cust_city, branchId, branch_nm, br_city)
3. Construct a transaction state diagram and describe each state that a transaction goes through during its execution?
4. Utilize the following database schema to write queries in SQL
   Sailor (sid, sname, age, rating)
   Boats (bid, bname, bcolor)
   Reserves (Sid, bid, day)
   i) Find the sailors who have reserved a red boat
   ii) Find the names of the sailors who have reserved at least two boats
   iii) Find the colors of the boats reserved by 'Mohan'?
5. By considering relevant example, show insertion and deletion operations on a B-Tree.

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Chairman
Board of Studies (CSE)

PC 20DS304 Programming with Python 3 1 0 3

Pre- Requisite Concepts of Basic Mathmetics

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO2	
20DS304.1	Explain the basic language features of Python programming	3	2	L1, L2, L3
20DS304.2	Articulate and use various control structures and data structures in Python	3	2	L1, L2, L3
20DS304.3	Able to use the concepts of functions and modules to solve simple computing problems	3	2	L1, L2, L3
20DS304.4	Explain the object oriented programming principles	3	2	L1, L2, L3
20DS304.5	Illustrate the use of file functions in Python	3	2	L1, L2, L3
All the COs are by default mapped to PO12 as few topics are inbuilt in syllabus promoting autonomous learning				

Unit I:	**Introduction**	**9+3 hours**
Basic Concepts: Introduction to Python, Programming Paradigms: Functional Programming model, Procedural Programming Model, Object-Oriented Programming Model, Event-driven programming model – Python Basics - Comments, Identifiers, Keywords, Types, operators, precedence, associativity, conversions, Console input, output - Strings: properties, built-in functions, methods, conversion, comparisons *Integer and float ranges*		**COs: CO1**
Unit II:	**Control Statements and Data Structures**	**9+3 hours**
Decision control instructions – conditional expressions, logical operators, decision statements, repetition control instruction: while, for, break and continue, **Data Structures:** List, Tuples, Sets, Dictionaries, Comprehensions *Stack operations*		**COs: CO2**
Unit III:	**Functions, Modules & Packages**	**9+3 hours**
Functions: types of arguments, unpacking arguments, Recursion **Modules**:The Main Module, Creating Modules, Importing Module, Built in Modules - Random, Math, Date, Regex **Packages**: Introduction to PIP, Installing Packages using PIP. *Functional programming*		**COs: CO3**
Unit IV:	**Object Oriented Programming**	**9+3 hours**
Object Oriented Programming: OOP principles, Classes & Object, Class variables & Instance variables, Inheritance, Runtime Polymorphism , Abstract Classes,Overloading Operators, Exceptions: try,catch,finally,User defined exceptions *Iterators and generators*		**COs: CO4**
Unit V:	**File Operations**	**9+3 hours**

Files: File I/O, Read / Write Operations, File Opening Modes, Random Access File Functions, Problems Using Files **GUI Library**:tkinter **Mathematical Libraries**: NumPy, Pandas, Matplotlib *Case study: Text Analysis*	**COs: CO5**

Board of Studies		CSE (Data Science)	
Approved in : BoS No. II		25-03-2023	
Approved in ACM: ACM No. VI			
Expert talk (To be delivered by SMEs from industries)		**COs**	**POs**
1	Importance of learning Python	CO1 – CO6	PO1, PO2
2	Why Python is popular programming language	CO1 – CO6	PO1, PO2

Text Books

1. Yashavant Kanetkar.,Aditya Kanetkar., "Let Us Python", 3rd Edition, bpb., 2021
2. Kenneth A. Lambert., "Fundamentals of Python First Programs", 1st Edition, Cengage Learning, Inc., 2017
3. Vamsi Kurama., "Python Programming: A Modern Approach", 1st Edition, Pearson Education, 2018
4. Mark Lutz., "Learning Python", 1st Edition, Orielly, 2019

Reference Books

1. Gowrishankar S., Veena A., "Introduction to Python Programming", CRC Press, 2019
2. Daniel Liang Y., "Introduction to Programming Using Python", 1st Edition, Pearson, 2012
3. Allen Downey., "Think Python", 2nd Edition, Green Tea Press, 2017
4. Chun W., "Core Python Programming", 2nd Edition, Pearson, 2006

Web References

1. https://www.tutorialspoint.com/python3/python_tutorial.pdf
2. https://www.w3schools.com/python
3. https://www.programiz.com/python-programming
4. https://www.javatpoint.com/python-tutorial

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	40
L2	30	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List out Python Features and Applications
2. Define Variable? Write rules for naming variables?
3. What are the difference between list and tuples in Python?
4. List out any 5 functions in Datetime module
5. Define Class & Object

L2: Understand

1. Explain the type conversion functions with example?
2. Explain the following datastructures?
   i. list ii. tuple iii. strings
3. How to create a constructor in Python? Give an example
4. Demonstrate implementation of single inheritance in Python, with a program?
5. Explain the operator overloading with example

L3: Apply

1. Write a program that should print out the user's name the specified number of times
2. Write a program that generates a list of 20 random numbers between 1 and 100. Print the total and average of the elements in the list.
3. Write a function called sum_digits that is given an integer num and returns the sum of the digits of numbers.
4. Write a program that asks the user for an integer and creates a list that consists of the factors of that integer.
5. Write programs to demonstrate the usage of class & object.

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PC 20CS305 Computer Organization 3 0 0 3

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

Code	Course Outcomes	Mapping with Pos		DoK
		PO1	PO12	
20CS305.1	Describe the fundamental organization of computer system	3	1	L1, L2
20CS305.2	Explain the concepts of design of basic components of the system	3	1	L1, L2
20CS305.3	Explain the functional units of a processor and addressing modes, instruction format, program control statement	3	1	L1, L2
20CS305.4	Illustrate various algorithms to perform arithmetic operations	3	1	L1, L2
20CS305.5	Distinguish the organization of various parts of system memory hierarchy	3	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Digital Logic Circuits and Data Representation **12 Hours**

Digital components:Integrated Circuits,Decoders,Multiplexers,Registers,Shift Registers,Binary Counters,Memory Unit.

Data Representation: Data types, Complements, Fixed Point Representation, Floating – Point Representation, Other Binary Codes, Error Detection codes.

Computer Types, Generation of Computers.

Unit II :Register Transfer Language and Micro operations **12 Hours**

Register Transfer Language And Micro operations: Register Transfer language, Register Transfer Bus and memory transfers, Arithmetic Micro operations, logic micro operations, shift micro operations, Arithmetic logic shift unit.

Basic Computer Organization And Design: Instruction codes, Computer Register Computer instructions, Timing and control, Instruction cycle, Memory – Reference Instructions, Input – Output and Interrupt.

Assembly Language,Design of basic computer.

Unit III:Central Processing Unit and Micro Programmed Control **12 Hours**

Central Processing Unit: Stack organization, Instruction formats, Addressing modes, DataTransfer and manipulation, Program control, Reduced Instruction set computer.

Micro Programmed Control: Control memory, Address sequencing, Micro program example, Design of control unit.

General Register Organization,RISC Vs CISC Architecture.

Unit IV :Computer Arithmetic **12 Hours**

Computer Arithmetic: Addition and subtraction with Signed Magnitude Data - Hardware Implementation – Multiplication – Hardware Implementation for Signed Magnitude Data – Division - Hardware Implementation for Signed Magnitude Data – Divide Overflow - Floating Point Arithmetic operations.

BCD Adder-BCD Subtraction

Unit V:The Memory System and Input-Output Organization **12 Hours**

The Memory System:Main memory, Auxiliary memory, Associative Memory, Cache Memory, Virtual Memory.

Input-Output Organization : Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupts, Direct memory Access.

Synchronous data transfer, Memory Hierarchy

Text Books

1. M. Morris Mano,"Computer System Architecture", RevisedThird Edition, Pearson, 2017.

Reference Books

1. Carl Hamacher, ZvonkoVranesic, Safwat Zaky,"Computer Organization", Fifth Edition, McGraw Hill.
2. William Stallings, " Computer Organization and Architecture", SixthEdition, Pearson.
.

Web Resources

1. https://nptel.ac.in/courses/106/105/106105163/
2. https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/
3. https://www.javatpoint.com/computer-organization-and-architecture-tutorial

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	40
L2	50	60
Total (%)	100	100

L1: Remember

1. What is instruction cycle?
2. Define Cache memory. Mention any two advantages.
3. Listany fiveaddressing modes.
4. What is asynchronous serial transfer?
5. What is an interrupt?
6. Write about auxiliary memory.
7. What is LIFO?
8. What is a mapping function?
9. List any three types of computers.
10. Define Hit ratio and Miss ratio.
11. What is circular shift micro operation?
12. What are peripherals?

L2: Understand

1. Compare RISC over CISC.
2. Explain the structure of a basic computer system.
3. Explain the concept ofvirtual memory. Why it is significant?
4. Explain the steps involved in the complete execution of an instruction.
5. Differentiate between hardwired control and micro programmed control.
6. Explain the functions of typical input-output interface.
7. Explain the functional architecture of the computer system.
8. Discuss about set-associative mapping.
9. Explain the method of DMA transfer.
10. Explain about the error detection codes.
11. Explain the design of basic computer

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PC 20CS306 Design and Analysis of Algorithms Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with PO
20CS306.1	Calculate the time and space complexities of simple algorithms	3
20CS306.2	Implement divide and conquer strategy for computing problems and analyze their performance complexity	3
20CS306.3	Implement greedy strategy for computing problems and analyze their performance complexity	3
20CS306.4	Implement dynamic programming strategy for computing problems and analyse their performance complexity	3
20CS306.5	Implement backtracking and branch & bound strategies for computing problems and analyse their performance complexity	3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos		
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge		

List of Experiments

1. Write simple non-recursive algorithms and compute their time complexities
2. Write recursive algorithms and compute their time complexities
3. Implement various sorting algorithms and compare their performance for varying inputs
4. Design and implement algorithms based on divide and conquer strategy to solve computing problems
   i) Quick sort
   ii) Merge sort
   iii) Multiplication of large integers
5. Design and implement algorithms based on greedy strategy to solve following problems
   i) Construction of minimal cost spanning tree
   ii) Single source shortest path problem
   iii) Job sequencing with deadlines
6. Design and implement algorithms based on dynamic programming principle to solve following problems
   i) All pair shortest path algorithms
   ii) 0/1 Knapsack problem
7. Design and implement algorithms based on backtracking principle to solve following problems
   i) Hamiltonian circuit problem
   ii) N-queen's problem
8. Design and implement algorithms based on branch and bound principle to solve following problems
   i) Travelling Salesman problem
   ii) Assignment problem

Reference

1. Lab Manual for Design and Analysis of Algorithms Lab Department of Computer Science and Engineering, NSRIT

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PC 20CS307 Database Management Systems Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs		
		PO1	PO4	PSO1
20CS307.1	Implement database design concepts with ER diagrams	2	3	1
20CS307.2	Construct SQL queries for database manipulation	2	3	1
20CS307.3	Demonstrate PL/SQL programming	2	3	1
20CS307.4	Demonstrate Normalization techniques	2	3	1
20CS307.5	Execute various queries related to transaction processing and locking	2	3	1
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create				

List of Experiments

1. Design ER models for the given application
2. Construct SQL Queries to perform the following
   a. Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, viewing all databases, creating a database Viewing all Tables in a Database
3. Construct SQL Queries to perform the following:
   a. Altering a Table, Dropping /Truncating/Renaming Tables, backing up/Restoring a database
4. Write SQL program to perform different JOIN operations
5. Write PL/SQL program to create a Stored Procedure
6. Write PL/SQL program to create a Function.
7. Write PL/SQL program to create a Package
8. Write PL/SQL program for Trigger
9. Write SQL Queries to demonstrate Transaction Control Language
10. Design a complete Database for a chosen application

References

1. Lab Manual for "Database Management Systems Lab", Department of Computer Science and Engineering, NSRIT

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PC 20DS307 Programming with Python Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs	
		PO4	PO5
20DS307.1	Demonstrate the use of basic language features	3	3
20DS307.2	Develop simple programs to solve computing problems using control structures and data structures	3	3
20DS307.3	Develop simple programs to solve computing problems using user defined functions and modules	3	3
20DS307.4	Demonstrate the usage of object-oriented principles	3	3
20DS307.5	Demonstrate the usage of files and packages	3	3
All the COs are by default mapped to PO12 as few topics are inbuilt in syllabus promoting autonomous learning			

List of Experiments

1. Write programs to demonstrate the usage of I/O functions
2. Write programs to demonstrate the usage of operators and expressions
3. Write programs to demonstrate the use of control statements
4. Write programs to demonstrate the use of the data structures
5. Write programs to demonstrate the use of strings
6. Write programs to demonstrate the usage of user defined functions
7. Write programs to demonstrate the usage of modules
8. Write programs to demonstrate the usage of object-oriented principles
9. Write programs to demonstrate packages
10. Write programs to demonstrate the usage of files

Indicative list of questions

1. Write a program to display your details using output function
2. Write a program to find the sum of the even numbers & odd numbers up to a given number
3. Write a program to find the given year is leap year or not
4. Write a program to find the sum of the individual digits of a given number
5. Write a program that asks the user for an integer and creates a list that consists of the factors of that integer
6. Write a program that generates a list of 20 random numbers between 1 and 100. Print the list.
   a. Print the average of the elements in the list.
   b. Print the largest and smallest values in the list.
   c. Print the second largest and second smallest entries in the list
   d. Print how many even numbers are in the list
7. Write a program that uses a for loop to print the numbers 8, 11, 14, 17, 20, . . . , 83, 86, 89
8. Write a program that generates a list of 20 random numbers between 1 and 100. Print the total and average of the elements in the list
9. Write a function called number_of_factors that takes an integer and returns how many factors the number has
10. Write a function called merge that takes two already sorted lists of possibly different lengths, and merges them into a single sorted list without using the sort method

References

1. Lab Manual for Foundations of Programming with Python Lab, Department of CSE (Data Science), NSRIT

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Board of Studies (CSE-DS)

SC **20AIS01 JAVA Programming** 0 0 4 2.0

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

Code	Course Outcomes	Mapping with POs		DoK
		PO4	PO5	
20AIS01.1	Write programs in JAVA to solve simple computing problems	2	3	L1, L2, L3
20AIS02.2	Apply the object-oriented programming principles	2	3	L1, L2, L3,
20AIS03.3	Design simple applications with database connectivity	2	3	L1, L2, L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge				

JAVA fundamentals – Classes and Objects – Inheritance – Polymorphism – I/O streams – Exception handling – Packages – Database connectivity

Resources

1. www.javatpoint.com
2. www.tutorialpoint.com
3. www.w3schools.com

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Board of Studies CSE (AIML)

MC 20MCX02 Constitution of India 2 0 0 0.0

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

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO12	
20MCX02.1	Summerizing the basic features and modalities aboutIndian Constitution	3	3	1	L1
20MCX02.2	Identify the Indian Federalism and Panchayath Raj systems in Indian Constitution	3	3	1	L1
20MCX02.3	Identify theLegislature and Judiciary systems in Indian Constitution	3	3	1	L2
20MCX02.4	Interpreting the political system that exists in India	3	3	1	L1,L2
20MCX02.5	Categorising the contemporary issues in global politics and Election commission in India	3	3	1	L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos					
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge					

Unit I: Indian Constitution 10 Hours

Meaning of the Indian Constitution, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947,Indian Constitution and its Salient Features, The role of B.R. Ambedkar in the making of the Indian Constitution,The Preamble of theConstitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional,The Historical Perspectives of the Constitutional Amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency and Local Self Government – Constitutional Scheme in India.

Unit II: Indian Federalism 10 Hours

Meaning and Definition of Federalism, Structure and Features of Indian Federalism, Difference between Indian and Federation of other States, Difference between Federal and Unitary Features, Critical Evaluation of the Indian Federal System, Decentralisation of Powers, Centre-State Relations, 73rdAmendment, Panchayath Raj Institutions.

Unit III: Union Government 10 Hours

Powers of Indian Parliament, Functions of RajyaSabha and LokSabha, Powers and Functions of the President, Powers and Functions of the Prime Minister. Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Lok Pal and LokAyukta, The Lokpal and Lokayuktas Act 2013.

Unit IV: Challenges to Indian Political System 10 Hours

Caste: A General Overview of the Indian Scenario,TheCaste Issues in the Pre Independence Period, Gandhi Ambedkar Debate and the Poona Pact.The Politics of Caste in the Post IndependencePeriod, Mandal Commission Reservation Policy in Government Jobs.The History of Communalism in India, The Concept of Terrorism and its Emergence in the Global Phenomenon since the End of Cold War.

Unit V: India's External Relations andElection Commission 10 Hours

Cold War and Post Cold War Era, Foreign Policy, Indian and its Neighbours, India's Extended Neighbourhood in West Asia and South East Asia. India's Relations with the United States and Russia, India and the World Organisations, India in the 21stCentury.Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission, Functions of Commissions for the welfare of SC/ST/OBC and women.

Text Books

1. Austin G., "Working of a Democratic Constitution of India", Oxford University Press, New Delhi,2004
2. Basu D.D.,"An Introduction to the Constitution of India", Prentice Hall, New Delhi,2005
3. Chandhoke N. and Priyadarshini, "Contemporary India: Economy, Society, Politics", Oxford University Press,New Delhi, 2009
4. Jayal N. G. and Maheta P. B., Oxford Companion to Indian Politics",Oxford University Press, New Delhi, 2010
5. VanaikA. and BharghavaR."Understanding Contemporary India: Critical Perspectives", Orient Blackswan, New Delhi, 2010

Reference Books

1. Noorani A. G.,"Constitution Questions in India: The President, Parliament and the States", Oxford University Press, New Delhi, 2000
2. Chakravarthy B.and Pandey K. P., "Indian Government and Politics", Sage Publications, New Delhi, 2006
3. Bajpai. Kanti and Pant V. Harsh,"India's Foreign Policy: A Reader", Oxford University Press, New Delhi, 2013
4. Laxmikanth M., "Indian Polity for Civil Services Examinations", Tata McGraw Hill, New Delhi, 2016
5. Singh M.P. andSaxena R.,"Indian Politics: Contemporary Issues and Concerns", PHI Learning,New Delhi, 2008

Web References

1. https://en.wikipedia.org/wiki/Federalism.in.India
2. https://legislative.gov.in/constitution-of-india
3. https://en.wikipedia.org/wiki/Foreign_relations_of_India
4. https://en.wikipedia.org/wiki/Government_of_India

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Chairman
Board of Studies (EEE)

HS 20HSX03 Managerial Economics and Financial Analysis 3 0 0 3

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

Code	Course Outcomes	Mapping with POs		DoK
		PO11	PO12	
20HSX03.1	Understand the theoretical concepts of managerial economics to make decisions for business problems	3	1	L1, L2
20HSX03.2	Gain adequate theoretical knowledge on microeconomics concepts to perform successful business operations	3	1	L1, L2
20HSX03.3	Understand the basic accounting principles and capital formation and planning	3	1	L1, L2
20HSX03.4	Apply accounting concepts to analyze financial strength of business	3	1	L3, L4
20HSX03.5	Gain theoretical knowledge on the entrepreneurship management and types of firms	3	1	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

UnitI: Introduction to Managerial Economics and Demand Analysis **9 Hours**

Definition of Managerial Economics –Scope of Managerial Economics and its Relationship with other Subjects – Concept of Demand, Types of Demand, Determinants of Demand- Demand Schedule, Demand Curve, Law of Demand and its Limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand Forecasting and Methods of Forecasting.

Role of Managerial Economist, Law of Supply

Unit II: Production and Cost Analysis **9 Hours**

Theory of Production: Meaning and Factors of Production, Production Function with One Variable Input (Law of Variable Proportion), With Two Variable Inputs (Law of Returns to Scale) Theory of Cost: Different Cost Concepts and Different Relations between Cost and Output in Short Run and Long Run. Managerial uses of Revenue and Cost Concepts Break-Even Point). Pricing Strategies.

Economies of Scale and Diseconomies of Scale

Unit III: Introduction to Accounting andFinancial Planning **9 Hours**

Financial Accounting- Concepts and Conventions – Double Entry System – Preparation of Journal, Ledger and Trial Balance – Preparation of Final Accounts: Trading, Profit and Loss Account and Balance Sheet.

Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time Value of Money- Methods of Appraising Project Profitability -Traditional Methods and Modern Methods.

Branches of Accounting, Concept of Working Capital

Unit IV: Financial Analysis through ratios **9 Hours**

Computation, Analysis and Interpretation of Liquidity Ratios (CurrentRatio and Quick Ratio), Activity Ratios (Inventory Turnover Ratio and Debtor Turnover Ratio), Capital StructureRatios (Debt- Equity Ratio, Interest Coverage Ratio) and Profitability Ratios (Gross Profit Ratio, Net ProfitRatio,Operating Ratio, P/E Ratio and EPS).

Cash Flow Statement and Funds Flow Statement (Theory Only)

Unit V: Introduction of Entreprenuershipand New Economic Environment **9 Hours**

Definition of Entrepreneur and Entreprenuership, Internal and External Factors; Types of Entrepreneurs; Classification of Entrepreneurship.

Characteristic Features of Business, Features and Evaluation of SoleProprietorship, Partnership, Joint Stock Company, Public Enterprises, Changing Business Environment in Post-Liberalizations Scenario.

Industrial Policy 1991

Text Books

1. AppaRao N., Vijay Kumar P., "Managerial Economics and Financial Analysis", Cengage Publications, New Delhi, 2011
2. Siddiqui S. A. and Siddiqui A. S., "Managerial Economics and Financial Analysis", New Age International Publishers, 2012
3. Kuberudu B. and Ramana T. V., "Managerial Economics and Financial Analysis", Himalaya Publishing House, 2014
4. Aryasri A. R., "Managerial Economics and Financial Analysis", Tata Mcgraw Hill, 2011

Reference Books

1. Maheswari V., "Managerial Economics", Sultan Chand,2014
2. Suma Damodaran, " Managerial Economics", Oxford, 2011
3. Vanitha Agarwal, " Managerial Economics", Pearson Publications, 2011
4. Sanjay Dhameja, "Financial Accounting for Managers", Pearson Publications, 2011
5. Maheswari V., "Financial Accounting", Vikas Publications, 2012
6. Dominick Salvatore,"Managerial Economics: Principles and World Wide Application", 7th Edition, Oxford University Press, 2012

Web References

1. https://btechgeeks.com/mefa-notes/#google_vignette
2. https://www.smartzworld.com/notes/managerial-economics-and-financial-analysis-pdf-notes-mefa
3. https://www.scribd.com/document/259129127/Mefa-course-plan
4. https://www.coursera.org/browse/business/entrepreneurship

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	20	20
L3	20	20
L4	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Managerial Economics?
2. What is meant by Elasticity of demand? How do you measure it?
3. Define different product curves
4. Define Accounting
5. Define Partnership

L2: Understand

1. Explain the role of a Managerial Economist in a Business firm
2. Explain the concept cross elasticity of demand. Illustrate your answer with suitable examples
3. Explain the formation of a Joint Stock Company
4. Distinguish between a partnership and a joint stock company
5. Explain accounting principles

L3: Apply

1. Journalise the following transactions
   2013 Jan 1st ABC Firm commenced business with Rs.40000
   Jan 2nd Deposited into bank Rs.30000
   Jan 3rd Bought goods worth Rs.48000 from Kamala
   Jan 4th Sold goods worth Rs.60000
2. Calculate Net Profit Ration from the following data
   Sales returns Rs.100000 Administration expences Rs.10000

Gross Profit Rs.40000 Selling expences Rs.10000
Income from investment Rs.5000 Loss on account of fire Rs.3000

3. From the following particulars findout
   Selling price Rs.200 per unit
   Variable cost Rs.100 per unit
   Total fixed cost Rs.96000
   i) Break even units and values
   ii) Sales to earn a profit Rs.20000
4. The following are the Ratios related to XYZ Limited company.
   Inventory holding period 2 months
   Gross profit ration 25 %
   Gross profit for the current year announced Rs.200000
   Closing stock is excess of Rs 40000 over opening stock. Findout
   A) Sales
   B) Cost of goods sold
   C) Closing stock
   D) Opening stock

L4: Analyze

1. A Project cost is Rs.144000. The average annual cash inflows are likely to be Rs.45000 for a period of 5 Years calucalte IRR for the project
2. The cost of project is Rs.50000 The annual cash iunflows for the next 4 years are Rs.25000 what is the PBP for the project
3. A firm is considering two different investment options A & B detailes of both the options are given below (Rs,in Lakhs)

	Investment cost	**Inflow 1**	**Inflow 2**	**Inflow 3**
Option A	(25)	10	10	12
Option B	(40)	15	20	24

4. ARR method (ARR on original investment)
   Inintial investment Rs.1200000

Year	Cashinflows (Rs)	
	Project A	Project B
1	600000	500000
2	500000	300000
3	200000	200000
4	-	300000

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Board of Studies (MBA)

BS 20BSX15 Probability and Statistics 3 1 0 3

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

	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX15.1	Classify the concepts of Statistics and its importance and Interpret Measures of Central Tendency and Dispersion of Data	3	1	L1, L2, L3
20BSX15.2	Identify the suitable discrete and continuous probability distributions to solve various engineering problems	3	1	L1, L2, L3
20BSX15.3	Identify the estimation errors in sampling distributions	3	1	L1, L2, L3
20BSX15.4	Apply the proper test statistics to test the hypothetical data by Tests of Hypothesis	3	1	L1, L2, L3
20BSX15.5	Apply the method of least squares, correlation and regression analysis to fit the curves	3	1	L1, L2, L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge				

Unit I: Descriptive statistics methods 11 + 1 Hour

Introduction to Statistics- Population vs Sample -Collection of data primary and secondary data- Data visualization, Measures of Central tendency, Measures of Variability (spread or variance)- Skewness-Kurtosis.

Measures of Dispersion – Range – Quartile Deviation

Unit II: Probability and Probability Distributions 11 + 1 Hour

Review of probability- Conditional probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution function – Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

Moment generating function

Unit III: Sampling Theory 11 + 1 Hour

Introduction – Population and samples – Sampling distribution of Means and variances(Definitions only) – Central limit theorem (without proof) -Introduction to Student's t- Distribution, Chi-square Distribution and F- Distribution Point and Interval Estimations Maximum error of estimate.

Introduction to Sampling, parameters, statistics.

Unit IV: Tests of Hypothesis 11 + 1 Hour

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Large samples: Tests concerning one mean and two means - Small samples:
Student t-distribution (test for single mean, two means and paired t-test) - Chi-square test for Single variance- Chi-square - Test for goodness of fit

Test for single proportion, Difference of proportions (Large Samples)

Unit V: Curve Fitting, Correlation and Regression 11 + 1 Hour

Curve fitting: Method of least squares – Straight line – Parabola – Exponential – Power curves.
Correlation: Correlation – correlation coefficient – rank correlation – regression coefficients and properties – regression lines.

Power curves by the method of least squares

Text Books

1. Miller and Freund J. E., "Probability & Statistics for Engineers", 9th Edition, Prentice Hall of India, 2011
2. Iyenger T. K. V., Prasad M. V. S. S. N., Ranganatham S., KrishnaGandhi.B., "Probability & Statistics", 2nd Edition, S. Chand Publications, 2019

Reference Books

1. Arnold O. Allen, "Probability & Statistics", Academic Press, 2nd Edition, 2005
2. Shahnaz Bathul, "A Text Book of Probability & Statistics", 2nd Edition, V. G. S. Book Links, 2nd Edition, 2007
3. Murugesan and Gurusamy, "A Text Book of Probability & Statistics", 2nd Edition Anuradha Publications, 2011

Web References

1. https://nptel.ac.in/courses/111106112/
2. https://nptel.ac.in/courses/111105090/
3. https://nptel.ac.in/courses/111101004/
4. https://nptel.ac.in/courses/111102111/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	10
L2	50	50
L3	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define conditional probability
2. Define Population and Sample
3. Write about Skewness and Kurtosis
4. State Correlation and Regression
5. State Mean and Variance in Sampling Distribution

L2: Understand

1. State and prove Bayes theorem
2. Write the differences of collection of primary and secondary data type of variable
3. Find out the Kurtosis of the data

Class Interval	0 -10	10 - 20	20 – 30	30 - 40
Frequency	1	3	4	2

4. The mean height of students in a college is 155cms and S.D. is 15. What is the probability that mean height of 36 students is less than 157 cms
5. The number of auto mobile accidents per week in a certain community are as follows: 12, 8, 20, 2, 14, 10, 15, 6, 9, 4. Are these frequencies in agreement with the belief that accident conditions were the same during this 10 weeks period

L3: Apply

1. Calculate the regression equation Yon X from the data given below taking deviations from the actual means of X and Y

Price(Rs)	10	12	13	12	16	15
Amount Demanded	40	38	43	45	37	43

2. The coefficient of Rank Correlation between marks in Statistics and Mathematics obtained by a certain group of students is 0.8. If the sum of the squares of the difference in ranks to be 33. Find the number of students in the group
3. A normal population has a mean of 0.1 and S.D. of 2.1 then find the probability that mean of a sample of size 900 will be negative

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Board of Studies (Mathematics)

PC 20CS502 Computer Networks 3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO2	PO12	
20CS502.1	Describe the functions of each layer in OSI model	3	1	1	L1, L2
20CS502.2	Describe the functions of data link layer and the protocols	3	1	1	L1, L2
20CS502.3	Explain the functions of network layer and its protocols	3	1	1	L1, L2
20CS502.4	Illustrate the session layer issues and transport layer services	3	1	1	L1, L2
20CS502.5	Exemplify the functions of application layer and presentation layer and their protocols	3	1	1	L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos					
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge					

Unit I: Introductionto Networks **12 Hours**

Network Topologies, Network Hardware, Network Software. Reference models- The OSI Reference Model- the TCP/IP Reference Model - Physical Layer: Guided Transmission Media, Digital Modulation & Multiplexing, Public Switched Telephone Network

Network Devices; The Mobile Telephone System

Unit II:Data Link Layer **12 Hours**

Data Link Layer Design issues, Error Detection &Correction, Elementary Data Link protocols, Sliding window protocols The Medium Access control sublayer: Multiple access protocols, Wireless LANS

Bluetooth, Data Link layer switching

Unit III: Network Layer **12 Hours**

Design Issues-The Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, Quality of Service, The Network Layer in the Internet.

Routing for mobile hosts, Routing in Ad Hoc Networks.

Unit IV: Transport Layer **12 Hours**

The Transport Service, Elements of Transport Protocols, The Internet Transport Protocols: UDP, The Internet Transport Protocols: TCP, Performance issues.

Delay-Tolerant Networking: DTN Architecture, The Bundle protocols

Unit V: Application Layer **12 Hours**

The Domain Name System: The DNS Name Space, Resource Records, Name Servers, Electronic Mail: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery

World Wide Web; Streaming Audio &Video

Text Books

1. Tanenbaum and David J Wetherall, “Computer Networks”, 5th Edition, Pearson Education, 2010
2. Behrouz A.Forouzan,FirouzMosharraf,“Computer Networks: A Top Down Approach”,McGraw Hill,1st Edition,2012.

Reference Books

1. LL Peterson, BS Davie, Morgan-Kauffman,“Computer Networks: A Systems Approach”, 5th Edition, 2011.
2. JF Kurose, KW Ross, Addison-Wesley, “Computer Networking: A Top-Down Approach”,5th Edition, 2009.
3. William Stallings, Pearson,“Data and Computer Communications” , 8th Edition, 2007

Web Resources

1. https://nptel.ac.in/courses/106/105/106105183/
2. https://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_networ

k_pdf_version.htm

3. https://www.javatpoint.com/computer-network-tutorial

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	30
L2	50	70
Total (%)	100	100

L1: Remember

1. List any 2 advantages and disadvantages of mesh topology
2. Define Maximum Data rate of a channel
3. Define Ethernet and Fast Ethernet
4. Define Congestion.
5. Write the general principles of congestion
6. Define TCP & UDP
7. Write the Application layer paradigms.
8. What are the problems with Congestion?
9. What are the design issues of data link layer?
10. What is the significance of DNS?

L2: Understand

1. Explain the structure of UDP Header format.?
2. Illustrate Routing of Packets within Virtual Circuit Subnet.?
3. Explain Traffic Aware Routing?
4. Compare the throughput of pure aloha and slotted aloha.?
5. Explain Channel Allocation strategies?
6. Explain about the sliding window protocol using Go-Back-NA.?
7. Explain Simplex Stop & Wait Protocol?
8. Compare and contrast synchronous time division multiplexing and statistical time division multiplexing.?
9. Explain Signal to Noise Ratio?
10. Explain different Network Topologies.?

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PC 20CS404 Operating Systems 3 1 0 3

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20CS404.1	Describe the structure, components and functionalities of operating system	3	1	L1, L2
20CS404.2	Describe the process management activities of operating system	3	1	L1, L2
20CS404.3	Illustrate the use of process synchronization tools	3	1	L1, L2
20CS404.4	Describe the various memory management and allocation techniques	3	1	L1, L2
20CS404.5	Demonstrate different secondary storage management strategies and file system	3	1	L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge				

Unit I: Introduction to Operating System Concepts **9 + 3 Hours**

What operating system do, operating system operations, Process management, Memory management, Storage management, Protection and security, Computing environments, operating systems services, System call, Types of system call, Operating system generation, System boot

The Shell, Mobile Operating System, Choice of Interface

Unit II: Process Management **9 + 3 Hours**

Process concept:The process, Process state, Process control block, Threads, Process scheduling: Scheduling queues, Schedulers, Context switch, Operations on processes, Inter process communication.
Multithread programming: Overview, Benefits, Multithreading models.
Process scheduling:Basic concepts, Scheduling criteria, Scheduling algorithms.

Process Termination, Multiprocess Architecture

Unit III: Synchronization **9 + 3 Hours**

Background, The Critical-section problem, Peterson's solution, Synchronization hardware, Semaphores, Classic problems of synchronization, Monitors.
Deadlocks:System model, Deadlock characterization, Methods for handling deadlock, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

Transactional Memory, Two Phase Locking

Unit IV: Memory Management **9 + 3 Hours**

Background, Swapping, Contiguous memory allocation, Segmentation, Paging, Structure of the page table.
Virtual memory management:Background, Demand paging, Page replacement, Thrashing.
Mass-Storage Structure: Overview of Mass-Storage Structure, Hard disk drives, Volatile memory, HDD Scheduling-FCFS Scheduling, SCAN Scheduling, Selection of a Disk-Scheduling Algorithm.

Buddy System, Prepaging

Unit V: File system Interface **9 + 3 Hours**

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.

Consistency Checking, Malware, Denial of service

Text Books

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne,"Operating System Concepts", TenthEdition,John Wiley and Sons Inc., 2018
2. William Stallings,"Operating Systems - Internals and Design Principles", Ninth Edition, Pearson, 2018

Reference Books

1. Andrew S. Tanenbaum, "Modern Operating Systems", Fourth Edition, Pearson, 2015
2. Charles Crowley,"Operating Systems: A Design-Oriented Approach",First Edition, Tata McGrawHill Education, 2001
3. Dhananjay M. Dhamdhere,"Operating Systems: A Concept-Based Approach", Third Edition, McGrawHill Higher Education, 2017

Web Resources

1. http://nptel.ac.in/downloads/106108101/
2. https://www.coursera.org/learn/iot/lecture/MrgxS/lecture-3-1-operating-systems
3. https://www.geeksforgeeks.org/operating-system-introduction-operating-system-set-1/
4. https://www.unf.edu/public/cop4610/ree/Notes/PPT/PPT8E/CH12-OS8e.pdf
5. https://in.udacity.com/auth?next=/course/introduction-to-operating-systems--ud923

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	40
L2	50	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Operating System
2. What are operating system services?
3. List any four types of system calls
4. What is a process? List any four fields of process control block
5. What are the necessary conditions for a deadlock?
6. Differentiate between binary and counting semaphore.
7. What are the various attributes that are associated with an opened file?

L2: Understand

1. Discuss the essential properties of operating systems -Batch, Interactive, Timesharing Real time and Distributive
2. Explain how multiprogramming increases the utilization of CPU
3. Why system calls are needed in operating system?
4. Distinguish between logical address and physical address
5. What is the difference between a process and thread?
6. How does the system detect thrashing? What can the system do to eliminate this problem?
7. Consider the following four processes represented as (Process, Arrival Time,Burst Time) with the length of CPU burst in milliseconds.
   { (P1, 0, 10), (P2, 1, 7), (P3, 2, 13), (P4, 3, 11) }. Using preemptive SJFscheduling: (i) Draw Gantt chart
   (ii) Calculate average waiting time.
8. Why semaphores are important? Suggest the solution for bounded bufferproblem with semaphores
9. Explain the steps involved in handling a page fault with aneat sketch

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Board of Studies (CSE)

PC 20AI405 Artificial Intelligence 3 1 0 3

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

Code	Course Outcomes	Mapping with POs		PO12	DoK
		PO1	PO2		
20AI405.1	Describe the foundational principles of artificial intelligence	3	2	1	L1, L2
20AI405.2	Formalise the given problem using different AI methods	3	2	1	L1, L2
20AI405.3	Explain different concepts of logic	3	2	1	L1, L2
20AI405.4	Describe the different methods of knowledge representation	3	2	1	L1, L2
20AI405.5	Explain the priciples and applications of expert systems	3	2	1	L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos					
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge					

Unit 1: Introduction to Artificial Intelligence **9+3 Hours**

Introduction – History - Intelligent systems - Foundations of AI – Applications – Tic-Tac-Tie game playing - Development of AI languages - Current trends in AI

Online agents

Unit II: Problem Solving **9+3 Hours**

Problem solving: State-Space search and Control strategies: Introduction - General problem solving - Characteristics of problem - Exhaustive searches - Heuristic search techniques - Iterativedeepening A* - Constraint satisfaction - Problem reduction and game playing: Introduction - Problem reduction - Game playing - Alphabeta pruning - Two-player perfect information games

Unknown environment

Unit III: Logic concepts **9+3 Hours**

Introduction - Propositional calculus - Proportional logic - Natural deduction system - Axiomatic system - Semantic tableau system in proportional logic - Resolution refutation in proportional logic

Predicate Logic

Unit IV: Knowledge Representation **9+3 Hours**

Introduction - Approaches to knowledge representation - Knowledge representation using semantic network - Extended semantic networks for KR - Knowledge representation using frames - Advanced knowledge representation techniques: Introduction - Conceptual dependency theory - Script structure - Cyc theory - Case grammars

Semantic web

Unit V: Expert Systems **9+3 Hours**

Expert system and applications: Introduction - Phases in building expert systems - Expert system versus traditional systems - Rule-based expert systems - Blackboard systems - Truth maintenance systems - Application of expert systems

List of shells and tools

Text Books

1. Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Fourth Edition, Pearson Education, 2020
2. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007

Reference Books

1. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
2. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
3. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013

Web Resources

1. https://nptel.ac.in

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. State the tasks which are associated with A.I.
2. Give an example of script-arithmetic problem.
3. Define Script
4. Recall Intelligence

L2: Understand

1. Explain Turing Test.
2. Explain the characteristics of production system.
3. Write A* algorithm in detail and explain its functionality to solve 8-puzzle problem.
4. Explain the semantic analysis phase done through case grammars in Natural Language understanding

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PC 20AI406 Python Programming for Statistics Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs		
		PO4	PO5	
20AI406.1	Demonstrate basic programming constructs of Python	3	1	
20AI406.2	Interpret data visualization with Python libraries and packages	3	1	
20AI406.3	Apply statistical modelling techniques to data	3	1	
20AI406.4	Apply and interpret inferential procedures when analysing real time data	3	1	
20AI406.5	Apply descriptive and predictive analysis using Python	3	1	

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

1	Create a list and perform the following methods 1) insert () 2) remove () 3) append () 4) len () 5) pop () 6) clear ()
2	Create a dictionary and apply the following methods 1) Print the dictionary items 2) access items 3) use get () 4)change values 5) use len ()
3	Create a tuple and perform the following methods 1) Add items 2) len () 3) check for item in tuple 4)Access items
4	Write a python program to add two numbers
5	Write a python program to print a number is positive/negative using if-else
6	Write a python program to find largest number among three numbers.
7	Write a python Program to read a number and display corresponding day using if_elif_else
8	Data visualization using (IRIS data set) implement with python libraries like a) matplotlib b) seaborn
9	Data visualization using (IRIS data set) implement with python libraries like a) ggplot b) plotly
10	Apply a simple Linear regression model in python
11	Apply statistical exploration using seaborn
12	Apply multiple Regression including multiple factors in python(take IRIS data set)
13	Apply Hypothesis statistical test in python
14	Apply statistical inference on real dataset with Poisson Process
15	Apply Exponential distribution on real dataset with Poisson Process
16	Apply Descriptive & predictive analysis on IRIS data set using python

Reference

1. Lab Manual for Python Programming for Statistics Lab, Department of Computer Science and Engineering, NSRIT

PC 20AI407 Artificial Intelligence Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs	
		PO4	PO5
20AI407.1	Implement simple PEAS for the given AI tasks	3	3
20AI407.2	Implement the simulated annealing techniques for simple problems	3	3
20AI407.3	Implement the Genetic algorithm for simple problems	3	3
20AI407.4	Demonstrate the use of backtracking algorithms to solve problems	3	3
20AI407.5	Implement simple reasoning system using inference mechanism	3	3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			

List of Experiments

1. Study of PROLOG
2. Write simple facts using statements in PROLOG
3. Write program to solve monkey banana problem
4. Write a program in turbo PROLOG for medical diagnosis and show the advantage and disadvantage of green and red cuts
5. Write a program to implement factorial, Fibonacci of a given number
6. Write a program to solve 4-Queen and 8-puzzle problem.
7. Write a program to solve traveling salesman problem
8. Implementation of A* Algorithm using LISP /PROLOG
9. Implementation of Hill Climbing Algorithm using LISP /PROLOG
10. Implementation of Towers of Hanoi Problem using LISP /PROLOG

Reference

1. Lab Manual for Artificial Intelligence Lab Department of Computer Science and Engineering, NSRIT

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PC 20CS408 Operating Systems Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs	
		PO1	PO4
20CS408.1	Demonstrate the basic UNIX commands and system calls	3	1
20CS408.2	Implement various CPU scheduling algorithms	3	1
20CS408.3	Implement different algorithms for process communication and synchronization	3	1
20CS408.4	Implement algorithms to handle deadlock situations	3	1
20CS408.5	Implement different memory management techniques and page replacement algorithms	3	1
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create..			

List of Experiments

1. Study of various Unix/Linux general purpose utility command list: man, who, cat, cd, cp, ps, ls, mv, rm, mkdir, rmdir, echo, more, date, time, kill, history, chmod, chown, finger, pwd, cal, logout, shutdown
2. Implementation of fork ( ), wait ( ), exec ( ), and exit ( ), System calls
3. Implementation of cp command with the use of open ( ), read ( ), write ( ) system calls
4. Implement the following CPU scheduling algorithms
   (a) FCFS (b) SJF (c) Priority (d) Round Robin
5. Implement two process communication using shared memory
6. Implement two process communication using Pipes
7. Implement Dinning Philosopher's problem using semaphores
8. Implement Producer Consumer problem using semaphores
9. Implement Bankers algorithm for Deadlock Prevention
10. Implement Bankers algorithm for Deadlock Avoidance
11. Implement the memory management techniques of Multiprogramming with fixed number of tasks (MFT)
12. Implement the memory management techniques of Multiprogramming with variable number of tasks (MVT)
13. Implement the following page replacement algorithms
    (a) FIFO (b) LRU (c) LFU

References

1. Lab Manual for Operating Systems Lab, Department of Computer Science and Engineering, NSRIT

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SC **20AIS02 R Programming** 0 0 4 2.0

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

Code	Course Outcomes	Mapping with POs		DoK
		PO4	PO5	
20AIS02.1	Solve simple problems using features of R	2	3	L1, L2, L3
20AIS02.2	Analyze and visualize data using R	2	3	L1, L2, L3,
20AIS02.3	Write statistical analysis of data using R	2	3	L1, L2, L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge				

Introduction to R – Data types and variables – Control statements and functions - Data manipulation and analysis – Data visualization – Statistical analysis – Data import and export

Resources

1. https://www.datacamp.com/courses/tech:r
2. https://r4ds.had.co.nz/
3. www.rstudio.com

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PC 20CS405 Theory of Computation 3 1 0 3.0

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO2	
20CS405.1	Construct Automata, Regular Expression for any pattern	3	1	L1, L2
20CS405.2	Write Context free grammar for any Construct.	3	1	L1, L2
20CS405.3	Design Turing machine for any Language	3	1	L1, L2
20CS405.4	Describe the different phases of a compiler	3	1	L1, L2, L3
20CS405.5	Apply different parsing algorithm to develop the parser for a given grammar	3	1	L1, L2, L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge				

Unit I: Introduction to Finite Automata and Regular Expression **9 + 3 Hours**

Why study of Automata theory, Concepts of Automata, Acceptance of String, Definitions of alphabet, strings, language, grammar, types of grammar, Deterministic finite automata, non-Deterministic Finite Automata, Design of NFA, equivalence of NFA and DFA Conversion of NFA to DFA, Finite Automata with epsilon transitions, Minimization of Finite automata, Mealy and Moore machines, Applications and limitations, Regular expressions, regular sets, Identity rules, Equivalence of two regular expressions, Finite automata and regular expressions, Inter conversion, closure properties, Regular Expressions and Regular grammars, Applications of regular Expressions.

Comparison between Mealy and Moore, Conversion of NFA with ϵ moves to DFA

Unit II: Context free Grammar &Push Down Automata **9 + 3 Hours**

Classification of Grammars, Left Most and Right Most Derivations, Ambiguous Grammar, Elimination of Useless, Epsilon, Unit Symbols, Normal Forms, Pumping Lemma, Applications, Pushdown Automata, Definition, Graphical Notation, Design of Push Down Automata, Equivalence of Push Down Automata and Context free grammar, Applications of Push Down Automata

Applications of Push Down Automata, Classification of types of grammars

Unit III: Turing Machines and Computability **9 + 3 Hours**

Turing Machines Definition, Turing Machine Model, Representation of Turing machine, Instantaneous description, Transition diagram, ways of representing Turing machine's- tabular form, diagram, church's thesis, universal Turing machine, Decidable and Un decidable problems, Halting Problems, Classes of P and NP Problems.

Applications of Turing Machine

Unit IV: Introduction to compilers and Syntax Analysis **9 + 3 Hours**

Introduction to Language processing, Structure of a compiler, Lexical Analysis role, specification of tokens, Syntax Analysis role, Context free grammars writing a grammar, Top down, bottom up parsing and LR parsing, LR1,LALR parsers, Syntax Directed Transactions

Comparison between different types of parsers, CLR parser

Unit V: Intermediate Code and Code Optimization **9 + 3 Hours**

Generation variants of Syntax tree 3 Address code, Types and Declaration Type Checking, Back patching, Machine independent optimization, A simple code generation, basic blocks and flow graphs, The principles sources of Optimization peep hole, Introduction to Data flow Analysis. Code Optimization: Principal sources of Code Optimization, Loop Optimization, Basic Blocks & Flow Graphs, DAG Representation of Basic Blocks, Applications of DAG, Local Optimization.

Performing three address code, Construction of directed acyclic graph

Text Books

1. John. E. HoPCroft, Rajeev Motwani and Ullman J. D., "Introduction to Automata Theory, Languages and Computation", Third edition, Pearson Education
2. Alfred V Aho,Jeffrey D.Ullman, Monica Lam and RaviSethi "Principles of Compiler Design", Second edition, Pearson Education

Reference Books

1. K.L.P.Mishra and N.Chandrasekhar "Theory of computation", PHI
2. Kenneth.C.Louden,"Compiler Construction", Vikas Publication House, 2015
3. Dhananjay Steven Muchnic, "Advanced Compiler Design and Implementation", Elsevier Publications

Web Resources

1. http://nptel.ac.in/courses/106/106/106106049/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

L1: Remember

1. Define DFA and NFA
2. Write the Identity rules
3. Write Normal Forms.
4. Write any five Applications of Pumping lemma
5. What is Lexical Analysis

L2: Understand

1. Explain Chomsky hierarchy
2. Construct Parse tree for a given grammar S->AB/a A->b,B->a
3. Explain all phases of Compiler
4. Check whether the Given grammar is Ambiguous or not
5. Explain three address code

L3: Apply

1. Apply Different Parsing Algorithms
2. Construct Turing Machine for a given grammar
3. Construct DFA and NFA with suitable example
4. Minimize the Given Finite Automata for the sting accepting even a's and even b's
5. Construct SLR parsing table for the grammar S->AB/a A->b,B->a
6. Convert NFA to DFA for the string accepting 0101

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PC 20AI502 Machine Learning 3 1 0 3

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

Code	Course Outcomes	Mapping with POs		PO3	PO 12	DoK
		PO1	PO2			
20AI502.1	Describe the essential elements of machine learning	3	2	1	1	L1, L2
20AI502.2	Explain the learning algorithms for tree-based models and rule-based models	3	2	1	1	L1, L2
20AI502.3	Describe the algorithms for linear models and distance-based models	3	2	1	1	L1, L2
20AI502.4	Describe various probabilistic models	3	2	1	1	L1, L2
20AI502.5	Explain ensemble learning and feature engineering methods	3	2	1	1	L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos						
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge						

Unit 1: Introduction **9 Hours**

The ingredients of machine learning: Tasks - the problems that can be solved with machine learning – Models - the output of machine learning – Features - the workhorses of machine learning. Binary classification and related tasks: Classification, Scoring and ranking – Beyond binary classification – handling more than two classes – Unsupervised learning – Regression – Descriptive learning – Concept learning – Hypothesis space

Class probability estimation

Unit II: Tree models and Rule models **9 Hours**

Decision trees – Random and Probability estimation trees – Tree learning as variance reduction – Rule based models: Learning ordered lists – learning unordered rule set – Descriptive rule learning

First-order rule learning

Unit III: Linear models and distance-based models **9 Hours**

The Least Squares method – The Perceptron – Support Vector Machine – Kernel methods – Neighbours and exemplars – Nearest-neighbour classification – Distance-based clustering – Hierarchical clustering

Kernels to distances

Unit IV: Probabilistic models **9 Hours**

Normal distribution and its geometrical interpretation – Probabilistic model for categorical data – Discriminative learning – Probabilistic model for hidden variables – Compression based models

Comparison of all models

Unit V: Features, Ensemble and Reinforcement learning **9 Hours**

Kinds of features – Feature transformations – Feature construction and selection – Model ensembles – Bagging – Random forests – Boosting – Mapping Ensemble landscapes – bias, variance, other ensemble models – Reinforcement learning – Introduction – Q learning - Example

Meta learning

Text Books

1. Peter Flach, “Machine Learning – The art and science of algorithms that make sense of data”, Cambridge Press, 2012
2. Tom Michell, “Machine Learning”, McGraw Hill, 2014

Reference Books

1. Peter Harington, “Machine Learning in Action”, Cengage Publications, 2012
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learningll, MIT Press, 2012

Web Resources

1. https://nptel.ac.in

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Machine Learning.
2. List the types of Machine Learning.
3. State Bayes Theorem.
4. What is Regularization?

L2: Understand

1. Demonstrate Linear Regression.
2. Explain Back Propagation Algorithm.
3. Illustrate Decision Tree Induction process
4. Explain Genetic Operations with examples

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PC 20AI503 High Performance Computing 3 1 0 3.0

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

Code	Course Outcomes	Mapping with POs				DoK
		PO2	PO3	PO5	PO12	
20AI503.1	Describe GPU architecture	3	1	1	1	L1, L2
20AI503.2	Write programs using CUDA, identify issues and debug them	3	1	1	1	L1, L2, L3
20AI503.3	Implement efficient algorithms in GPU for common application kernels	3	1	1	1	L1, L2, L3
20AI503.4	Write simple programs using OpenCL	3	1	1	1	L1, L2, L3
20AI503.5	Identify efficient parallel programming patterns to solve problems	3	1	1	1	L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs						
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge						

Unit I: GPU Architecture **9+3 hours**

Evolution of GPU architectures – Understanding Parallelism with GPU –Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

RISC pipeline

Unit II: Multi Processor Architecture **9+3 hours**

Using CUDA – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions

Divergence

Unit III: Issues in Programming **9+3 hours**

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

Error handling

Unit IV: OPENCL Basics **9+3 hours**

OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.

More OpenCL examples

Unit V: Efficient MPI programming **9+3 hours**

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.

Issues in clusters

Text Books

1. Shane Cook, "CUDA Programming: ―A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing)", First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, "Heterogeneous computing with OpenCL", Third Edition, Morgan Kauffman, 2015.

Reference Books

1. Nicholas Wilt, "CUDA Handbook: A Comprehensive Guide to GPU Programming", First edition, Addison – Wesley, 2013
2. Jason Sanders, Edward Kandrot, "CUDA by Example: An Introduction to General Purpose GPU Programming", Addison – Wesley, 2010
3. David B. Kirk, Wen-mei W. Hwu, "Programming Massively Parallel Processors – A Hands-on Approach", Third Edition, Morgan Kaufmann, 2016

4. http://www.nvidia.com/object/cuda_home_new.html
5. http://www.openCL.org

Web Resources

1. http://www.nptelvideos.in/2012/11/high-performance-computing.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List any four advantages of GPUs
2. List the differences between CPU and GPU
3. What are the core features of GPUs?
4. Define pipelining
5. What is meant by instruction cycle?

L2: Understand

1. Explain multiprocessor architecture with diagram
2. Describe the working of multiprocessor environment
3. Explain parallel processing in terms of instruction execution in multiprocessor environment
4. Explain clustering in multiprogramming environment

L3: Apply

1. Write any four instructions in OPENCL
2. Write a simple program in CUDA
3. Illustrate matrix multiplication in parallel programming

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PE 20AI001 Fundamentals of Image Processing 3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20AI001.1	Understand principles of image acquisition	-	L1, L2
20AI001.2	Explain spatial enhancement techniques		L1, L2
20AI001.3	Explain filtering in the frequency domain		L1, L2
20AI001.4	Illustrate morphological based processing		L1, L2
20AI001.5	Understand different edge detection techniques		L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction and Digital Image Processing Fundamentals **9 hours**

Digital Image Processing- Origin, Fundamental steps, Components, Applications, Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels

Mathematical tools used in image processing

Unit II: Intensity Transformations and Spatial Filtering **9 hours**

Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods, Using Fuzzy Techniques for Intensity Transformations

Spatial Filtering

Unit III: Filtering in Frequency Domain **9 hours**

Preliminary Concepts, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform (DFT) of One Variable, Extension to Functions of Two Variables, Some Properties of the 2-D Discrete Fourier Transform, The Basics of Filtering in the Frequency Domain, Image Smoothing Using Frequency Domain Filters, Image Sharpening Using Frequency Domain Filters

Selective Filtering and its implementation

Unit IV: Morphological Image Processing **9 hours**

Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms, Gray-Scale Morphology

Applications of morphology

Unit V: Image Segmentation **9 hours**

Fundamentals, Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation.

Implementation of image segmentation

Text Books

1. Rafel C. Gonzalez, Richard E Woods, "Digital Image Processing" Pearson Education, 4th Edition, 2018.
2. Anil K. Jain, "Fundamentals of Digital Images Processing", Pearson Education India, 1st edition, 2015.

Reference Books

1. Alan C. Bovik, "Handbook of Image and Video Processing", Academic Press; 2nd edition, 2005.
2. Willliam K Pratt, "Digital Image Processing", John Willey, 2002.
3. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011

Web Resources

1. https://www.tutorialspoint.com/dip/index.htm
2. https://www.geeksforgeeks.org/digital-image-processing-basics/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remembering

1. Define Image Sampling
2. What is image transform?
3. Define the term Luminance?
4. Write The Expression Of One-dimensional Discrete Fourier Transforms?
5. What Is Cosine Transform?

L2: Understanding

1. Explain Mask of Kernels
2. Explain Spatial Filtering
3. What Is Maximum Filter And Minimum Filter?
4. Explain Erosion and Dilation with a suitable example
5. Explain Region Based Image Segmentation

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PE 20AI002 Cryptography 3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20AI002.1	Understand the essential concepts in number theory	-	L1, L2
20AI002.2	Describe classical cryptographic techniques		L1, L2
20AI002.3	Explain various symmetric ciphers		L1, L2
20AI002.4	Explain different asymmetric ciphers		L1, L2
20AI002.5	Describe the use of hash functions		L1, L2
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction to Number Theory **9 hours**

Basic Concepts of Number Theory and Finite Fields: Divisibility and the divisibility algorithm - Euclidean algorithm - Modular arithmetic - Groups - Rings and Fields - Finite fields of the form GF(p) - Finite fields of the form GF(2n)

Polynomial arithmetic

Unit II: Classical Encryption Techniques **9 hours**

Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques, Steganography - SYMMETRIC CIPHERS: Traditional Block Cipher structure, Data Encryption Standard (DES)

Design issues of DES

Unit III: Symmetric Ciphers **9 hours**

AES CIPHER - Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs

Character cipher

Unit IV: Public Key Cryptography **9 hours**

The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography - Prime Numbers, Fermat's and Euler's theorem - Chinese Remainder theorem

Primality Testing

Unit V: One-way Hash functions **9 hours**

N-Hash, MD4, MD5, Secure Hash Algorithm [SHA] - One way hash functions using symmetric block algorithms - Using public key algorithms - Choosing a one-way hash function - Message Authentication Codes - Digital Signature Algorithm - Discrete Logarithm Signature Scheme

Features of hash function

Text Books

1. William Stallings, "Cryptography and Network Security – Principles and Practices", 8th edition, Pearson Education, 2019
2. Behrouz A Forouzan, "Cryptography and Network Security", 3rd edition, Tat Mc Graw Hill, 2018

Reference Books

1. Bernard Meneges, "Network Security and Cryptography", Cengage Learning, 2013
2. Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Prentice Hall, ISBN 0-13-046019-2

Web Resources

1. www.geeksforgeeks.com
2. www.sanfoundary.com
3. www.topcoder.com

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

L1: Remembering

1. Define cryptography
2. Define steganography
3. Define plain text and cipher text
4. Define encryption and decryption
5. Draw the structure of block cipher

L2: Understanding

1. Explain about one-way hash functions
2. Write the Chinese Reminder theorem
3. Describe public key cryptography with necessary diagrams
4. Describe RSA algorithm with example
5. Explain Data Encryption standard (DES)
6. Explain the Key Expansion process in AES.

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PE 20AI003 Cloud Computing Essentials 3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20AI003.1	Articulate the basic concepts of cloud computing	-	L1, L2
20AI003.2	Understand the technologies that help in enabling cloud computing		L1, L2
20AI003.3	Explain the architecture of cloud for different services		L1, L2
20AI003.4	Describe the security issues in cloud		L1, L2
20AI003.5	Explain resource management for cloud services		L1, L2
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction **9 hours**

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning

On-demand provisioning

Unit II: Cloud Enabling Technologies **9 hours**

Service Oriented Architecture – REST and Systems of Systems – Web Services – PublishSubscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support

Disaster Recovery

Unit III: Cloud Architecture, Services and Storage **9 hours**

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage –

Cloud Storage Providers

Unit IV: Resource Management and Security in Cloud **9 hours**

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security

Security Standards

Unit V: Cloud Technologies and Advancements **9 hours**

Hadoop – MapReduce – Virtual Box -- Google App Engine – Programming Environment for Google App Engine –– Open Stack – Federation in the Cloud – Four Levels of Federation

Federated Services and Applications

Text Books

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Securityll, CRC Press, 2017
3. Rajkumar Buyya, James Broberg, Andrzej Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, New York, USA, 2011
4. Kris Jamsa, Jones,"Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More", Bartlett Publishers, Paperback edition,2013

Reference Books

1. Raghuram Yeluri," Building the Infrastructure for Cloud Security", Published March 2014.
2. George Reese, "Cloud Application Architectures", First Edition, O"Reilly Media 2009
3. Thomas Erl," Cloud Computing: Concepts, Technology & Architecture", May 2013.

4. Srinath Perera and Thilina Gunarathne, "Hadoop Map Reduce cookbook", Packt publishing

Web Resources

1. https://onlinecourses.nptel.ac.in/noc18_cs16/preview
2. https://www.w3schools.in/cloud-computing/cloud-computing/
3. http://freevideolectures.com/blog/2015/04/guide-to-learn-cloud-computing/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

L1: Remembering

1. What are virtual machines?
2. What is Hybrid cloud.
3. What is the use of big data?
4. What is service-oriented architecture?
5. List any 4 uses of cloud computing.

L2: Understanding

1. Explain the characteristics of Cloud Computing
2. What are the benefits of virtualization in cloud computing?
3. What are the advantages of "PAAS"? Explain with example.
4. What are pros and cons in comparison of Public Vs Hybrid cloud?
5. Describe the IBM smart cloud architecture and core Services.
6. Write a short note on importance of Quality and Security in Cloud.

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OE **20CEO01 Urban Environment and Health** **3 0 0 3**

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

Code	Course Outcomes	Mapping with POs	DoK
20CEO01.1	Identify urban – health relationships	-	L1, L2
20CEO01.2	Demonstrates the connection between urban built form and healthoutcomes		L1, L2
20CEO01.3	Discuss the distribution of health risks of urban transportation grid		L1, L2
20CEO01.4	Assess and plan for community needs in health-care infrastructure		L1, L2
20CEO01.5	Identify preliminary opportunities for advancing urban health outcomes		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Health and Planning **9 Hours**

Introduction: The Historical Link, Dividing Health and Planning, Urban Health – Basic Conceptions in the Literature, Urban Form,Physical Activity.

Health Promotion

Unit II: Built Urban Form and Health **9 Hours**

Renewing the Health-Urban Link, the Urban Form, the Metropolitan Sprawl Index, Using Measured Urban Forms to Assess Health Effects, Environmental Factors and Physical Activity

Alternatives to Metropolitan Sprawl Index

Unit III: Transportation Systems **9 Hours**

Transport Planning, Private Motor Vehicles as Health Risks, Private Motor Vehicles and Obesity, Public Transport, Mixed-use Medium-density and Pedestrians Travel, Proximity and Individual Factors.

Residential and Travel Preferences

Unit IV: Spatial Access to Health Services **9 Hours**

Introduction, The Concept of Access, Dimensions of Spatial Access, Primary Care Supply and Access, Spatial Access and Travel Behavior, Access andMortality.

Access to health care Aligned with Transport

Unit V: Challenges and Opportunities **9 Hours**

Introduction, Challenges, Conceptual Frameworks, Investigative Methods and Data Collection, Limited Policy Capacity, Fragmented Initiatives, Opportunities, Interdisciplinary Engagement, Major Conceptual Programs, Priorities for future Research.

Promotion of physical activity in daily routines

Text Books

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. George Luber and Jay Lemery, "Global Climate Change and Human Health", 1st Edition Jossey-Bass, 2015

Reference Books

1. Pataki, Diane E., et al. "Coupling biogeochemical cycles in urban environments: ecosystem services, green solutions, andmisconceptions" Frontiers in Ecology and the Environment, 2011
2. Frank, L., Engelke, P., and Schmid, T., "Health and Community Design: The Impact of The Built Environment on Physical Activity", Island Press, Washington, D.C., 2003
3. Eiichi Taniguchi, Tien Fang Fwa and Russell G Thompson, "Urban Transportation and Logistics", CRC Press, 2014

Web References

1. https://www.oecd.org/health/health-systems/32006565.pdf
2. https://www.pdfdrive.com/urban-environment-proceedings-of-the-10th-urban-environment-symposium-e157051203.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive LevelsL1: Remember

1. How is natural environment different from urban environment?
2. How does the urban environment affect health and well-being?
3. How can urban areas improve health?

L2: Understand

1. Explain the most important problem related to health in urban area
2. Describe the differences between physical activity for transportation and physical activity for recreation
3. Consider a study that evaluates the health of people in two communities, one with sidewalks and one without. The studyauthors find that the rate of lung cancer is higher in the community without sidewalks, and conclude that sidewalks protect against lung cancer. What concerns would you have about accepting this conclusion?

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OE 20CSO01 Data Structures and Algorithms 3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20CSO01.1	Understand the advanced data structures and algorithms	-	L1, L2, L3
20CSO01.2	Demonstrate through abstract properties of various data structures such as stacks, queues and lists to implement efficient programs using data structures.	-	L1, L2, L3
20CSO01.3	Demonstrate through various searching & sorting techniques	-	L1, L2, L3
20CSO01.4	Apply data structures and algorithms to solve real world problems.	-	L1, L2, L3
20CSO01.5	Apply algorithm analysis techniques to evaluate the performance of an algorithm.	-	L1, L2, L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction to Data Structures & Algorithms **9 hours**

Introduction to Data Structure, Data Organization, Abstract Data Types, Elementary data types; Basic concepts of data Structures; performance measures for data structures, Time and Space Complexity. Introduction to Algorithms, Asymptotic notations and common functions. Algorithm Specifications: Performance Analysis and Measurement

Efficiency of an Algorithm

Unit II: Arrays and Linked Lists **9 hours**

Arrays- Definition, Different types of Arrays, Application of arrays, Sparse Matrices and their representations. Linked lists- Definition, Implementation of Singly Linked Lists, Doubly Linked List, Operations on a Linked List. Insertion, Deletion and Traversal. Stack-Basic Concept of Stack, Stack as an ADT and operations in stack. Queue-Basic Concept of Queue, Queue as an ADT and Operations in Queue

Generalized Linked List, Applications of Stack and Queue

9 hours

Unit III: Trees and Graphs

Trees- Basic concept of Binary tree, Operations in Binary Tree, Tree Height, Level and Depth, Binary Search Tree, Insertion, Deletion, Traversals, Search in BST, 2-4 trees. Graph-Matrix Representation Of Graphs, Elementary Graph operations(Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree)

Applications of Tress and Graph

Unit IV: Algorithm Design Techniques I **9 hours**

Divide and Conquer-General method, Merge sort, Quick sort. Brute force- approach, bubble sort, Linear Search techniques.

Preferences of Merge and quick sort techniques.

Unit V: Algorithm Design Techniques II **9 hours**

Greedy Technique, General method, Knapsack problem, Job sequencing with deadlines, Minimal cost spanning tree algorithms (Prim's and Kruskal's), Dynamic Programming: General method, 0/1 knapsack problem, All pair shortest path algorithm

Usages of Greedy algorithms.

Text Books

1. Reema Thareja, "Data Structures Using C", Second Edition, Oxford, 2014
2. Horowitz, Sahni and Anderson Freed, "Fundamentals of Data Structures in C", Second Edition, 2008
3. Mark Allen Weis , "Data Structures and Algorithm Analysis in C", Second edition, Pearson, 1997

Reference Books

1. Salaria R.S., "Data Structures and Algorithms using C", Fifth Edition, Khanna Publishing, 2018
2. Richard F Gilberg, "Data Structures: A PseudoCode Approach With C++" Fifth edition, Thomson Press(India), 2004
3. Amitava Nag and Jyothi Prakash Singh, "Data Structures and Algorithms Using C", Second Edition, Vikas Publishing, 2009

Web References

1. https://www.springboard.com/library/software-engineering/data-structures-and-algorithms/
2. https://www.geeksforgeeks.org/data-structures/
3. https://www.programiz.com/dsa

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Describe Data Structure and Algorithm
2. Illustrate some applications of stack
3. Describe about a Queue
4. List two applications of Data Structures

L2: Understand

1. Classify data structures
2. Explain about asymptotic notations
3. Differentiate Linked List, Stack and Queue
4. Explain about different sorting algorithms

L3: Apply

1. Implement the append method, which should add a new element onto the tail of the linked list
2. Implement stack using arrays and linked lists
3. Implement Queue using arrays and Linked Lists
4. Illustrate the importance of recursion

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OE 20AIO01 Machine Learning for Engineers 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20AIO01.1	Describe different types of learning's	-	L1, L2
20AIO01.2	Explain different supervised learning algorithms		L1, L2
20AIO01.3	Explain different unsupervised learning algorithms		L1, L2
20AIO01.4	Describe various types of machine learning models		L1, L2
20AIO01.5	Choose appropriate machine learning model and algorithm for given task		L1, L2
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction to learning **9 hours**

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – LinearSeparability – Linear Regression

Examples of regression

Unit II: Linear Models **9 hours**

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice –Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

Applications of perceptron

Unit III: Trees and Probabilistic Models **9 hours**

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbour Methods – Unsupervised Learning – K means Algorithms – Vector Quantization

Self-Organizing Feature Map

Unit IV: Dimensionality Reduction and Evolutionary Models **9 hours**

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Geneticalgorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms

Markov decision process

Unit V: Graphical Models **9 hours**

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models

Tracking Methods

Text Books

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2013

Reference Books

1. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", 1st Edition, Cambridge University Press, 2012.
2. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", 1st Edition, Wiley, 2014

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

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels L1: Remember

1. Define Machine Learning.
2. List the types of Machine Learning.
3. State Bayes Theorem.
4. What is Regularization?

L2: Understand

1. Demonstrate Linear Regression.
2. Explain Back Propagation Algorithm.
3. Illustrate Decision Tree Induction process
4. Explain Genetic Operations with examples

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OE 20DSO01 Introduction to Database Management Systems 3 0 0 3

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

Code	Course Outcomes	Mapping withPos	DoK
20DSO01.1	Describe the basic concepts of DBMS And different data models	-	L1, L2
20DSO01.2	Apply Constrains on relations		L2,L3
20DSO01.3	Apply SQL commands on relations		L1,L3
20DSO01.4	Understand PL/SQL operations		L1,L2,L3
20DSO01.5	Understand the principles of database normalization andTransaction management system.		L1,L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge			

Unit I: Introduction to Databases **9 Hours**

Overview of Data Base Systems, Database System Applications, File System VS Database System, Data Abstraction, Levels of Abstraction, Data Independence Instances and Schemas, Different Data Models, Database Languages, Data Base Users and Administrator, Database System Structure, N-tier Architecture, Database design and ER diagrams, Design Entities, Attributes and Entity sets, Relationships and Relationship Sets, Advanced Features of ER Model

History of DBMS

Unit II: Relational Model, Relational Algebra and Relational calculus **9 Hours**

Relational Model: Introduction to the Relational Model, Integrity Constraint and key constraints over relations, Logical data base Design, Views, Destroying / Altering Tables and Views - Relational Algebra: Selection and Projection, Set Operations, Aggregate Operations, Renaming, Joins, Division, Additional Relational Algebraic operations - Relational calculus: Tuple Relational Calculus, Domain Relational Calculus

Expressive Power of Algebra and Calculus

Unit III: Structured Query Language **9 Hours**

SQL: Concept of different Database Languages over SQL - DDL, DML, DCL., Set operations, SQL Commands, Nested queries, Aggregate Functions, Null Value, Referential Integrity Constraints, views.

Compare all Database Languages

Unit IV: Schema Refinement and Normalization **9 Hours**

Understand PL/SQL block, components of PL/SQL block, Control statements and conditional statements in PL/SQL Embedded SQL, Triggers, Cursors,Stored procedures packages

Compare all Normal Forms

Unit V: Normalization **9 Hours**

Understand the principles for Relational Database Design, Functional Dependencies, Trivial and Nontrivial Dependencies, Closure Set of Functional Dependencies, Closure Set of Attributes. - Normalization: 1NF, 2NF, 3NF, BCNF, Lossless Join and Dependency Preserving decomposition, 4NF and 5N.

Transaction Concept, ACID Properties, States of Transaction, Implementation of Atomicity & Durability, Schedules,

Concurrency Control without Locking

Text Books

1. Abraham Silber Schatz, Henry F Korth, S Sudarshan, "Database System Concepts", 6th Edition, McGraw-Hill International Edition, 2013
2. Date CJ, Kannan A, Swamynathan S, "An Introduction to Database Systems", 8th Edition, PearsonEducation, 2006
3. Raghurama Krishnan, Johannes Gehrke, "Data base Management Systems", 3rd Edition, TATA McGraw Hill, 2008

Reference Books

1. Elmasri Navrate, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016
2. Peter Rob & Carlos Coronel, "Data base Systems design, Implementation, and Management", 10th Edition,Pearson Education, 2013

Web References

1. https://www.javatpoint.com/dbms-tutorial
2. https://www.geeksforgeeks.org/introduction-of-dbms-database-management-system-set-1/?ref=lbp

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	30	40
L3	40	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List types of database users
2. List out all types of data models present
3. Give syntaxes to Create and Alter a table
4. What is Redundancy?
5. List out the properties of transactions

L2: Understand

1. Compare the database system with conventional file system
2. Demonstrate the use of DISTINCT keyword in SQL select statement
3. Explain the following SQL constructs with examples:
   (1) Order by (2) group by and having (3) as select (4) schema
4. Explain the difference among Entity, Entity Type & Entity Set
5. Illustrate ACID properities

L3: Apply

1. Choose a relation R with 5 attributes ABCDE and the following FDs: A ->B, BC->E, and ED ->A. Is R in 3NF? Justify?
2. Apply Normalization technique for the following relation up to 3NF:
   Bank (acno, cust_name, ac_type, bal, int_rate, cust_city, branchId, branch_nm, br_city)
3. Construct a transaction state diagram and describe each state that a transaction goes through during its execution?
4. Demonstrate serializabulity concept

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OE 20ECO01 Architectures and Algorithms of IoT **3 0 0 3**

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

Code	Course Outcomes	Mapping with POs	DoK
20ECO01.1	Demonstrate the Architecture and applications of IoT	-	L1, L2
20ECO01.2	Explain the protocol concept and data bases of IoT		L1, L2, L3
20ECO01.3	Construct the IoT device design space and Platform design		L1, L2, L3
20ECO01.4	Explain the IoT network model and Eventanalysis		L1, L2, L3
20ECO01.5	Demonstrate the Industrial Internet of Thingsand its Architecture		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: The IoT Landscape **09 Hours**

What Is IoT?, Applications , Architectures , Wireless Networks, Devices, Security and Privacy , Event-Driven Systems.

Ethernet

Unit II: IoT System Architectures **09 Hours**

Introduction, Protocols Concepts, IoT-Oriented Protocols, Databases, Time Bases, Security.

Message Queuing Telemetritransport (MQTT)

Unit III: IoT Devices **09 Hours**

The IoT Device Design Space, Cost of Ownership and Power Consumption, Cost per Transistor and Chip Size, Duty Cycle andPower Consumption.

Platform Design

Unit IV: Event-Driven System Analysis **09 Hours**

IoT Network Model - Events, Networks, Devices and Hubs, Single-Hub Networks, Multi-hub Networks, Network Models andPhysical Networks, IoT Event Analysis - Event Populations, Stochastic Event Populations, Environmental Interaction Modeling.

Event Transport and Migration

Unit V: Industrial Internet of Things **09 Hours**

Introduction, Industrie 4.0, Industrial Internet of Things (IIoT), IioT Architecture, Basic Technologies, Applications and Challenges.

Integrated IIoT

Textbooks

1. Dimitrios Serpanos and Marilyn Wolf, "Internet-of-Things (IoT) Systems Architectures, Algorithms,Methodologies", Springer, Cham, 2018
2. Vijay Madisetti and Arshdeep Bahga, " Internet of Things (A Hands-on Approach)", Universities Press, 2015

Reference Books

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons Ltd, UK, 2014
2. Olivier Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", John Wiley and Sons Ltd., UK, 2012

Web Resources

1. https://books.google.co.in/books?isbn=1119969093
2. https://books.google.co.in/books?isbn=135123093X

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	35	35
L3	35	35
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is IoT?
2. List any three applications of IoT
3. Define protocol concept of IoT
4. Define data base
5. What is Duty cycle?

L2: Understand

1. Explain the Architecture of IoT
2. Explain the Security and privacy of IoT
3. Illustrate the Protocol Concept of IoT
4. Explain the Date bases of IoT
5. Demonstrate the IoT Device Design Space

L3: Apply

1. Identify the Wireless Networks for IoT
2. Model the Event-Driven Systems for IoT
3. Construct the IoT-Oriented Protocols
4. Construct the Platform Design for IoT

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OE 20EEO01 Introduction to Renewable Energy Sources 3 0 0 3

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

Code	Course Outcomes	Mapping with PO's	DoK
20EEO01.1	Understand the significance of solar energy		L1, L2
20EEO01.2	Provide the importance of Wind Energy		L1, L2
20EEO01.3	Understand the role of ocean energy in the Energy Generation		L1, L2
20EEO01.4	Explain the utilization of Biogas plants and geothermal energy		L1, L2
20EEO01.5	Explain the concept of energy Conservation		L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge			

Unit I: Solar Energy **09 Hours**

Solar Radiation, Measurements of Solar Radiation, Flat Plate And Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar , Photo Voltaic Conversion, PV Characteristics Solar Cells, Solar PV Power Generation, Solar PV Applications.

Thermal analysis of flat plate collectors

Unit II: Wind Energy **09 Hours**

Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Wind Turbine Generator

Betz Criteria

Unit III: Ocean Energy **09 Hours**

Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants, Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants

Open and closed OTEC Cycle

Unit IV: Bio Mass **09 Hours**

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gasdigesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.

I.C Engine Operation

Unit V: Geo Thermal Energy and Energy Conservation **09 Hours**

Resources, types of wells, methods of harnessing the energy, scope in India. Principles of energy conservation, the different energy conservation appliances, cooking stoves, Benefits of improved cooking stoves over the traditional cooking stoves

Hydro Thermal, Geo-pressured, Hot dry rocks

Text Books

1. R K Gupta and S C Bhatia "Renewable Energy" Woodhead publishing India Pvt. Ltd.,2019
2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Second Edition, IEEE Press, Wiley,2013
3. Ranjan Rakesh, Kothari D. P.& Singal K. C., "Renewable Energy Sources And Emerging Technologies", 2 nd Edition, PHI, 2013
4. Mukund R. Patel, "Wind and Solar Power Systems – Design, Analysis and Operation", 2nd Edition, Taylor &Francis, 2006

Reference Books

1. S Sukhatme, J Nayak, "Solar Energy: Principles of Thermal Collection and Storage", 3rd Edition, Tata Mcgraw Hill , 2003.
2. Tiwari and Ghosal, "Renewable energy resources", 2nd edition, Narosa Publishing house, 2001
3. B H Khan, "Non conventional energy resources", 2 nd Edition, Tata Mcgraw Hill, 2001

Web References

1. https://nptel.ac.in/courses/121/106/121106014/
2. https://www.edx.org/learn/renewable-energy
3. https://www.coursera.org/learn/renewable-energy-resources-and-technologies

Internal Assessment Pattern

CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	40	30
L2	60	70
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive LevelsL1: Remember

1. What is meant by Solar Thermal Energy?
2. Give the classification of small hydro power stations.
3. What are the various losses occurring in the fuel cell?
4. List various Biomass resources.
5. What is the basic principle of Tidal Power?

L2: Understand

1. Explain in detail about flat plate collectors and give its advantage and disadvantages.
2. Explain the principle of working of a H2 - O2 fuel cell.
3. Explain about Dry, Wet and Hot water Geo thermal systems.
4. Compare between Geo thermal power plant and Conventional thermal power plant.
5. Explain about the site requirements to construct a Tidal Power Plant.

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OE 20MEO01 Nano Technology 3 0 0 3

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

Code	Course Outcomes	Mapping with PO's	DoK
20MEO01.1	*Describe* the fundamental science of nano materials	-	L2
20MEO01.2	Demonstrate the preparation of nano materials		L1,L2
20MEO01.3	Explain of the challenges on safe nano technology		L1,L2
20MEO01.4	Develop knowledge in characteristic nano material		L1,L2,L3
20MEO01.5	Apply Nano science for industrial applications		L1,L2,L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction 09 Hours

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nano structured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.

Introduction to properties and motivation for study (qualitative only)

Unit II: General Methods Of Preparation 09 Hours

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly,Vapour phase deposition, MOCVD, Sputtering, Evaporation.

Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE

Unit III: Nano materials 09 Hours

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays- functionalization and applications-Quantum wires.

Quantum dots-preparation, properties and applications

Unit IV: Characterization Techniques 09 Hours

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy includinghigh-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA.

SIMS-Nano-indentation

Unit V: Applications 09 Hours

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems(MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition.

Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TEXT BOOKS:

1. Edelstein A.S and Cammearata R.C, Eds., "Nanomaterials: Synthesis, Properties And Applications", Institute OfPhysics Publishing, Bristol And Philadelphia, 1996.
2. John Dinardo N, "Nanoscale Characterization Of Surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley- VCH, 2000
3. Murthy B.S and Shankar P, " Nanoscience and NanoTechnology" , 1st Edition, Springer Publications,2013
4. Louis Hornyak and Tibbals H F, " Introduction to Nanoscience and NanoTechnology" , 1stEdition,Tailor Francis CRC Press,2008

REFERENCE BOOKS:

1. Timp G, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations".Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Web references:

1. http://www.nano.gov
2. http://mrsec.wisc.edu/edetc/IPSE/links.html
3. http://nptel.ac.in/courses/112105182/9
4. IOPSCIENCE—Nanotechnology

Internal Assessment Pattern

CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	40	20
L2	60	40
L3		40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive LevelsL1: Remember

1. What is Nano technology?
2. How does Nano Technology Works?
3. 3.What are Nano Materials?
4. Who is Developing Nano technology?

L 2: Understand

1. What Are Some Of The Most Interesting Nanoparticles Found In Nature (Not Manufactured In The Lab)?
2. Given The Nano-Size Of The Particles, Are There Any Effective Respirator Filters To Guard Against Inhalation?
3. What Do You Feel The Repercussions Are For Extended Life Through Utilization Of Nanotechnology?
4. What Is The Risk Of Not Developing Nanotech (In Health Care, Environmental Protection, And Economic Development)?

L 3: Applying

1. How are safety tests carried out in nano tech?
2. Seems that (nano)tech is moving fast. Is there a risk that results of safety testing will be out-of-date as soon as printed? How to keep up pace?
3. Discuss about targeted drug delivery using nanoparticles.

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PC 20AI506 Web Development Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs	
		PO4	PO5
20AI506.1	Design simple web pages with HTML	3	3
20AI506.2	Design web pages with CSS styling	3	3
20AI506.3	Design web sites with forms and tables	3	3
20AI506.4	Design responsive pages with JavaScript	3	3
20AI506.5	Design dynamic web pages	3	3

List of Experiments

1. Study of HTML tags
2. Design of web pages using HTML
3. Study of CSS styling
4. Design web pages with styling using CSS
5. Design simple web site with various features
6. Design web site for a chosen application with static pages
7. Design web site for a chosen application with dynamic pages
8. Design of responsive pages with javascript
9. Mini project

Reference

1. Lab Manual for Web Development Lab Department of Computer Science and Engineering AIML NSRIT

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PC 20AI507 Machine Learning Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs			
		PO4	PO5	PSO1	PSO2
20AI507.1	Demonstrate the use of python packages for developing machine learning models	3	3	2	2
20AI507.2	Implement different classification algorithms	3	3	2	2
20AI507.3	Implement different clustering algorithms	3	3	2	2
20AI507.4	Develop machine learning models for performing prediction task	3	3	2	2
20AI507.5	Demonstrate handling of different types of data sets	3	3	2	2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos					

List of Experiments

1. Study of packages in Python for handling dataset and to generate graphs
2. Design and development of models for text data classification
3. Design and development of models for image classification
4. Design and development of models for house price prediction task
5. Design and development of models for disease prediction task
6. Design and development of models for clustering tasks
7. Design and development of models for handling audio data
8. Design and development of models for language translation
9. Mini project

Reference

1. Lab Manual for Machine Learning Lab - 1 Department of Computer Science and Engineering, NSRIT

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AC Technical Paper Writing

0 0 2 0

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

No.	Course Outcomes
1	Develop searching latest relevant literature pertaining to the topic of interest
2	Develop self-learning ability to become a lifelong independent learner
3	Develop the habit of writing technical manuscript as per the requirement
4	Develop presentation skills and speak with appropriate technical phrases
5	Explore the research topics and develop research interests
6	Comprehend the latest technologies, techniques, tools, and methodologies
Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes	

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MC **20MCX03 Intellectual Property Rights and Patents** **2 0 0 0.0**

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

Code	Course Outcomes	Mapping with POs		DoK
		PO11	PO12	
20MCX03.1	Acquire knowledge on intellectual property rights	-	-	L1, L2
20MCX03.2	Know about the acquisition of trademarks	-	-	L1, L2
20MCX03.3	Identify the importance of copyrights, patents and transfer of ownership	-	-	L1, L2
20MCX03.4	Reciprocate to new developments of intellectual property rights	-	-	L1, L2
20MCX03.5	International overview of IPR	-	-	L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Intellectual property: **4 Hours**

Concepts, types of intellectual property,international organizations, agencies and importance of intellectual propertyrights.IndustrialProperty,technologicalResearch,InventionsandInnovations – Important examples of IPR.,IPR in India and Abroad

Unit II: Introduction toTrade Marks: **4 Hours**

Purpose and function of trademarks, acquisition of trade markrights,selecting and evaluating trademark ,trademark registration processes.Trade Secrets and Industrial Design registration in India and Abroad

Unit III: Registration of Copy Rights **4 Hours**

Fundamentals of copy right law,rights of reproduction, rights to perform the work publicly, copy right ownership issues, copyrightregistration, international copyright laws.
Law of patents: Foundation of patent law, patent searching process, ownership rights andtransfer.

Unit IV: Latest development of intellectual property Rights **4 Hours**

New developments in trademark law; copy right law, patent law, intellectual property audits, Infringement of IPRs,Enforcement Measures,Emerging issues

Unit V:Enforcement Of IPRs **4 Hours**

International overview on intellectual property, international – trade mark law, copy right law, international patent law international development in trade secrets law

Text Books

1. Deborah., E. Bouchoux, “Intellectual Property Right”, Cengage learning
2. Prabuddha Ganguli,TataMcGraw Hill, Intellectual property right - Unleashing the knowledge economy, Publishing Company Ltd.
3. Cornish, William Rodolph & Llewelyn, David, Intellectualproperty:patents, copyright, trademarks andallied rights. Sweet& Maxwell,8/e,2013.

Reference Books

1. Cornish, William Rodolph. Casesandmaterialsonintellectualproperty.Sweet&Maxwell, 5/e,2006.
2. Lo,JackandPressman,David.Howtomakepatentdrawings:apatentityourselfcompanion. Nolo, 5/e 2007.

Web References

1. https://www.investopedia.com/terms/i/intellectualproperty.asp
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3217699/
3. https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	60	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Industrial property?
2. What are the fundamentals of copy rights
3. Define patents and its approval process
4. Define copy right law.
5. Define transfor of trade marks.

L2: Understand

1. Explain the role trade scerets in company law.
2. Explain the concept owenership rights of patents with suitable examples
3. Explain the international patent law.
4. Distinguish between copy rights and patents.
5. Explain copt right registration.

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IN Summer Internship #1/CSP 0 0 0 1.5

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

No.	Course Outcomes
1	Demonstrate the theoretical learning outcomes
2	Integrate theory and practice during graduation
3	Comprehend the industry practices in the relevant and allied field of study
4	Develop communication skills in terms of oral, written, and graphical communications
5	Develop problem solving skills
6	Develop work habits and teamwork in a multidisciplinary setting for a successful career after graduation
Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes	

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PC 20CS603 Modern Software Engineering 3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PO12	
20CS603.1	Understand knowledge in practice of software engineering skills	3	2	2	1	L1, L2
20CS603.2	Implement software engineering models, methodologies, practices to fit the nature of software	3	2	2	1	L1, L2, L3
20CS603.3	Implement modern phases of software development with the agile process	3	2	2	1	L1, L2, L3
20CS603.4	Implement design and develop correct and robust software products	3	2	2	1	L1, L2, L3
20CS603.5	Implement right strategies in software testing, quality, risk mitigations	3	2	2	1	L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs						
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge						

Unit I: Introduction to Software Engineering **9 hours**

The evolving of software - Nature of software - Software myths - Knowledge and Core Principles Software Engineering - Process framework - The capability maturity model (CMMI) process patterns - Process assessment - Personal and team process models - The waterfall model - Incremental process models - The unified process: Agility - Agile Process - Extreme Programming (XP) - The Role of tools in Agile process

Evolutionary process model

Unit II: Software Requirements Engineering and Modelling **9 hours**

Functional and non-functional requirements - User requirements - System requirements - Interface specification - The software requirements document. Feasibility studies - Requirements elicitation and analysis - Requirements validation - Requirements management - Context models - Behavioral models - Data models

Identify non-functional requirements in the software's that you used frequently

Unit III: Design, The Unified Process Model, Coding **9 hours**

The process in design – Quality - Design concepts - Design model - Data design - Software Architecture - Architectural Genres - Architectural styles and patterns - Architectural design - Assessing Alternative Architectural Designs - Architectural Mapping Using Data Flow - Conceptual model of UML - UML Models that Supplement the Use Case - Class diagrams - Sequence diagrams - Collaboration diagrams - Use case diagrams - Component diagrams - Structured coding Techniques-Coding Styles-Standards and Guidelines

Documentation Guidelines-Modern Programming Language Features

Unit IV: Testing and Quality Assurance **9 hours**

Elements of Software Quality Assurance - SQA Tasks - Goals & Metrics - Statistical SQA - Software Reliability - A Strategic Approach to Software Testing - Strategic Issues - Test Strategies for Conventional Software - Test Strategies for Object-Oriented Software - Validation Testing - System Testing - Software Testing Fundamentals - Internal and External Views of Testing - White-Box Testing - Basis Path Testing

Test Strategies for WebApps, The Art of Debugging

Unit V: Risk Mitigation and Maintenance **9 hours**

Risk management - Reactive Vs Proactive risk strategies - Software risks - Risk identification - Risk projection – Risk mitigation plan - Software Maintenance - Software Supportability- Reengineering- Business Process Reengineering- Software Reengineering- Reverse Engineering- Restructuring- Forward Engineering

Economics of Reengineering

Text Books

1. Roger S. Pressman, "Software Engineering a practitioner's approach", McGraw Hill Higher Education, Eighth edition, 2015.
2. Rajib Mall, "Fundamentals of Software Engineering", 5th Edition, PHI, 2018
3. Ian Sommerville, "Software Engineering", Ninth edition, 2011
4. Rajiv Chopra, "Modern Software Engineering", Wiley, 2019

Reference Books

1. Pankaj Jalote , "Software Engineering - A Precise Approach", Wiley India, 2010.
2. Ugrasen Ivor Jacobson and Harold "Bud" Lawson, "The Essentials of Modern Software Engineering", ACM Books, 2019
3. Murali D. Ramisetty Rao and Narayana V. S., "Software Engineering New Approach", BS publications, First Edition, 2018

Web Resources

1. https://en.wikipedia.org/wiki/Software_engineering
2. https://www.compact.nl/en/articles/modern-software-development/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	20
L2	40	40
L3	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Describe two types of models available in SDLC
2. What is the need to learn Software Engineering Concepts?
3. What is agile process?
4. How tools play important role in Agile Process?

L2: Understand

1. Describe key taken a ways in the agile methodology
2. What is SQA role in software engineering?
3. Summarize the myths in software development
4. Demonstrate requirements eliciting

L3: Apply

1. Apply test Strategies for Object-Oriented Software
2. Illustrate Strategic approach in software testing
3. What are steps to be followed in requirement modeling of Web App?
4. Illustrate risk mitigation plan for a software development

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PC 20AI602 Deep Learning Principles and Practices 3 1 0 3.0

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

Code	Course Outcomes	Mapping with POs				DoK
		PO2	PO3	PO5	PO12	
20AI602.1	Understand the basic concepts of deep learning	3	2	2	1	L1
20AI602.2	Illustrate different deep learning models	3	2	2	1	L1, L2
20AI602.3	Explain dimension reduction techniques	3	2	2	1	L1, L2
20AI602.4	Describe the optimization in deep learning networks	3	2	2	1	L1, L2
20AI602.5	Analyse the deep learning applications	3	2	2	1	L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs						
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge						

Unit I: Deep Learning Concepts **9 +3 hours**

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

Terminologies of machine learning

9 + 3 hours

Unit II: Neural Networks fundamentals

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters

Design parameters of deep networks

9+3 hours

Unit III: Convolution Neural Networks - 1

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers.

Need for dimension reduction

9+3 hours

Unit IV: Convolution Neural Networks - 2

LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. RCNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO

Computational Artificial Neuroscience

Unit V: Natural Language Processing with Recurrent neural networks **9+3 hours**

About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Cooccurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe.

LSTM

Text Books

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press, UK, 2017
2. Antonio Gulli and Sujit Pal, “Deep Learning with Keras “, Packt Publishing Ltd, Birmingham, UK, 2017
3. Deep Learning A Practitioner’s Approach Josh Patterson and Adam Gibson O’Reilly Media, Inc.2017

Reference Books

1. Cosma Rohilla Shalizi, “Advanced Data Analysis”, Elementary Point of View, 2015.

2. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.
3. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Web References

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

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List any four benefits of artificial neural networks
2. List any four features of ANN
3. What are deep neural networks?
4. Define supervised and unsupervised learning
5. Define generalization

L2: Understand

1. Explain the design parameters of deep neural networks
2. Describe the dimensionality reduction techniques
3. Explain backpropagation algorithm
4. Describe any two applications of deep networks for image processing
5. Write about any five applications of deep networks

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PC 20AI603 Artificial Neural Networks 3 1 0 3

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO3	
23AI302.1	Explain the building blocks and operations of artificial neural networks	3	2	L1, L2
23AI302.2	Explain architecture, taxonomy and functions of several neural networks	3	2	L1, L2
23AI302.3	Describe the structure, function, and applications of single layered feed forward networks	3	2	L1, L2
23AI302.4	Describe the structure, function, and applications of multi layered feed forward networks	3	2	L1, L2
23AI302.5	Describe the principles and implementations of associative memories	3	2	L1, L2
All the COs are by default mapped to PO12 as few topics are inbuilt in syllabus promoting autonomous learning				

Unit I:	**Introduction to Artificial Neural Networks**	**9+3 hours**

Introduction, Historical Development of Neural Networks, Biological Neural Networks, Comparison between Biological and Artificial Neural Network, Neural Network Architectures, Building Blocks of Artificial Neural Networks, Artificial Neural Networks Terminologies

Types of Learning

Unit II:	**Fundamental Models of Artificial Neural Networks**	**9+3 hours**

Introduction, McCulloch Pitts Neuron Model, Perceptron Networks, Perceptron Convergence Theorem, BackPropagation, Learning Rules, Adaline and Madaline Networks

Non-linear Separability

Unit III:	**Self-Organizing Maps**	**9+3 hours**

Introduction, Kohenen Self Organizing Networks, Counter Propagation Networks, CPN Building Blocks, Full Counter Propagation Network, Forward-only Counter Propagation Network

Outstar Learning

Unit IV:	**Adaptive Resonance Theory**	**9+3 hours**

Introduction, Adaptive Resonance Theory (ART) Architecture, Basic Operation, Basic Training Steps, ART 1 Architecture and Algorithm, ART 2 Architecture and Algorithm

Learning in ART

Unit V:	**Associative Memory Networks**	**9+3 hours**

Introduction, Algorithms for Pattern Association, Hetero Associative Memory Networks, Auto Associative Memory Networks, Bi-directional Associative Memory

Hopfield Memory

Text Books

1. S N Sivanandam., S Sumathi., S N Deepa., "Introduction to Neural Networks using MATLAB 6.0", 2nd Edition, Tata McGraw-Hill Publications, 2006

Reference Books

1. Simon Haykin., "Neural Networks", 2nd Edition, Pearson Education, 2001
2. James A. Freeman., David M. Skapura., "Neural Networks Algorithms, Applications and Programming Techniques", Addison-Wesley Publications, 2002

Web References

1. https://www.tutorialspoint.com/artificial_neural_network/index.htm
2. https://nptel.ac.in/courses/117/105/117105084/
3. http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture4.pdf
4. https://freebiesglobal.com/artificial-neural-networks-ann-with-keras-in-python-and-r-6
5. http://www.nptelvideos.in/2012/12/neural-networks-and-applications.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Neural Computing
2. Define ANN and Neural Computing
3. List any 4 design parameters in the design of Artificial Neural Network
4. What kinds of transfer functions can be used in each layer?
5. Define Pattern Association
6. What is Adaline Model?
7. What are the types of Learning?
8. What is simple artificial neuron?
9. List any 4 applications of Artificial Neural Network
10. Define Delta Learning rule

L2: Understand

1. Describe on the process of assigning and updating weights in a artificial neural network
2. What are the design steps to be followed for using ANN for your problem?
3. Describe least square algorithm with example
4. Why XOR Problem cannot be solved by a single layer perceptron? Write an alternative solution for it
5. Explain Back Propagation Network with necessary diagrams and equations
6. Write the differences between Hetero Associative Memories and Interpolative Associative Memories

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PE 20AI004 Computer Vision and Applications 3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20AI004.1	Describe the foundational concepts of image processing	-	L1, L2
20AI004.2	Explain shape analysis techniques		L1, L2
20AI004.3	Describe transform methods for different objects		L1, L2
20AI004.4	Explain 3D vision techniques		L1, L2
20AI004.5	Understand the applications of computer vision techniques		L1, L2
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Review of Image Processing Techniques **9 hours**

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology

Texture

Unit II: Shapes and Regions **9 hours**

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors

Region descriptors, moments

Unit III: Hough Transform **9 hours**

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection

Generalized Hough transform

Unit IV: 3D vision and motion **9 hours**

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion

Spline based motion

Unit V: Applications **9 hours**

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking and occlusion

Giat Analysis

Text Books

1. Baggio D. L., “Mastering OpenCV with Practical Computer Vision Projects”, Packt Publishing, 2012.
2. Davies E. R., “Computer & Machine Vision”, Fourth Edition, Academic Press, 2012.
3. Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for Analyzing Images”, O'Reilly Media, 2012.

Reference Books

1. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, Third Edition, Academic Press, 2012.

2. Szeliski R., "Computer Vision: Algorithms and Applications", Springer 2011.
3. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

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PE 20AI005 Cyber Security 3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO2	PO3	PO12	
20AI005.1	Understand the components of cyber security	3	1	1	1	L1, L2
20AI005.2	Describe the need of security for operating systems and networks	3	1	1	1	L1, L2
20AI005.3	Explain the countermeasures of security attacks	3	1	1	1	L1, L2
20AI005.4	Understand the importance of privacy in cyber space	3	1	1	1	L1, L2
20AI005.5	Explain the implementation of organizational security	3	1	1	1	L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos						
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge						

Unit I: Introduction to Cyber Security **9 hours**

Introduction -Computer Security -Threats -Types of threats – Types of attackers -Harm -Vulnerabilities – Controls -Web User Side – Browser Attack Types – Web Attacks Targeting Users – False or Misleading Content – Malicious Web Content- Protecting against Malicious Web Pages

Types of Malwares

Unit II: Security in Operating Systems and Networks **9 hours**

Security in Operating Systems – Operating System Structure – Security features of Operating Systems – Network Security Attacks – Threats to Network Communications – Port Scanning – Wireless Network Security – Wi-Fi Background – Vulnerabilities in Wireless Networks- Difference between WEP and WPA – Comparison between DoS and DDoS

Protocol Layers, Address and Routing

Unit III: Security Countermeasures **9 hours**

Firewalls – What is a Firewall? – Design of Firewalls – Types of Firewalls – Personal Firewalls – Comparison of Firewall Types – Intrusion Detection and Prevention Systems – Types of IDSs – Intrusion Prevention System -Intrusion Response – Goals for IDS – IDS Strengths and Limitations – Databases – Security Requirements of Databases

Network Management

Unit IV: Privacy in Cyberspace **9 hours**

Privacy Concepts – Privacy Principles and Policies – Privacy on the Web – Email Security – Privacy Impacts of Emerging Technology -Electronic Voting – VoIP and Skype – Privacy in the Cloud

Authentication and Privacy

Unit V: Organizational Security **9 hours**

Policies, Procedures, Standards, and Guidelines – Security Awareness and Training – Physical Security – Computer Location and Facility Construction – Facilities Access Controls – Contingency Planning – Environmental Issues – Electromagnetic Eavesdropping

Issues and Challenges in Organizational Security

Textbooks

1. Charles P. Pfleeger, Shari Lawrence, and Pfleeger Jonathan Margulies, “Security in Computing”, Fifth Edition, Pearson Edition, 2015
2. George K. Kostopoulous, “Cyber Space and Cyber Security”, CRC Press, 2013

Reference Books

1. Nina Godbole,Sunit Belapure, “Cyber Security, Understanding cybercrimes, computer forensics and legal perspectives”, Wiley Publications, Reprint 2016
2. Scott Barman, “Writing Information Security Policies”, New Riders Publications, 2002
3. William Stallings, “Cryptography and Network security”, Pearson Education, 7th Edition, 2016

Web Resources

1. https://online.stanford.edu/professional-education/cybersecurity
2. https://www.cybrary.it/course/introduction-to-it-and-cybersecurity/
3. https://www.springboard.com/resources/learning-paths/cybersecurity-foundations/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
Total (%)	100	100

L1: Remembering

1. What is Cyber Crime? List the types of cybercriminals
2. What are the weak areas of the ITA 2000?
3. What is a Rootkit?
4. Define Mobile viruses and Mishing
5. Define the different categories of cybercrimes?
6. How to prevent SQL Injection Attacks?
7. What is the need for Computer Forensics?

L2: Understanding

1. Explain the following terms related to cybercrimes: i) Spamming ii) Salami technique iii) Hacking iv) Password sniffing
2. Discuss the global perspective on cybercrimes.
3. Define Social Engineering? Describe the classification of Social Engineering with examples.
4. Explain the following terms according to IT Act 2000: i) Records as evidence ii) Proof of electronic agreements iii) Status of electronic
5. Discuss the legal perspectives of cybercrime.
6. What are the positive aspects of the ITA 2000? Explain
7. What are the physical security countermeasures for laptops?

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PE 20AI006 Social Network Analysis 3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20AI006.1	Understand the internal components of social network	-	L1, L2
20AI006.2	Describe the model of social networks		L1, L2
20AI006.3	Explain the mining methods possible in social networks		L1, L2
20AI006.4	Describe the prediction process in social network		L1, L2
20AI006.5	Describe the applications of social networks		L1, L2
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction **9 hours**

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: Evolution of Social Networks **9 hours**

Evolution in Social Networks– Framework, Tracing Smoothly Evolving Communities, Models and Algorithms for Social Influence Analysis, Influence Related Statistics, Social Similarity and Influence, Influence Maximization in Viral Marketing, Link Prediction in Social Networks,

Feature based link prediction

Unit III: Modelling and Visualization **9 hours**

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix- Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications

Use of Hadoop and MapReduce

Unit IV: Opinion Mining and Communities **9 hours**

Applications of Community Mining Algorithms, Node Classification in Social Networks Opinion Extraction–Sentiment Classification and Clustering, Temporal Sentiment Analysis-Irony Detection in Opinion Mining-Wish Analysis

Product Review mining

Unit V: Applications **9 hours**

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. Ajith Abraham, Aboul Ella Hassanien and Václav Snášel, “Computational Social Network Analysis: Trends, Tools and Research Advances”, Springer, 2012
2. Borko Furht, “Handbook of Social Network Technologies and Applications”, First edition, Springer, 2011
3. Charu C. Aggarwal, “Social Network Data Analytics”, Springer; 2014

Reference Books

1. Giles, Mark Smith, John Yen, “Advances in Social Network Mining and Analysis”, Springer, 2010
2. Guandong Xu , Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, First edition, Springer, 2012

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

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OE 20CEO02 Ecology, Environment and Resource Management 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20CEO02.1	Discuss the role that humans play in affecting the characteristics ofthe environment	-	L1, L2
20CEO02.2	Understand the interrelationships between land, sea, theatmosphere and the living things that occupy these environments		L1, L2
20CEO02.3	Distinguish between economic growth and economic developmentand outline the nature of a sustainable economy		L1, L2
20CEO02.4	Identify the environmental attributes to be considered for the EIAstudy		L1, L2
20CEO02.5	Develop a thorough understanding of Environmental Policies andlegislationspracticed in India		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction 9 Hours

Meaning, scope and evolution of ecology. Man, environment and ecosystem. Components of nature, Structure and Function, Flow of material, Ecological Succession, Tropic levels, Food chain, Food web, Ecological pyramids.

Adaptation, Environmental Zones

Unit II: Ecosystem and its relevance to Environment 9 Hours

Resources and human settlements impact of advanced agricultural methods, Impact of urbanization and industrialization on nature. Urban ecosystem approach evolution and significance .Settlement planning.

Energy Conservation

Unit III: Resource Management and Sustainable Development 9 Hours

Sustainable Development, Fundamentals concerning Environment and Sustainable Development, Economy, Poverty, Human Settlement Issues, Land Resources, Forests, Mountains, Agriculture, Biodiversity, Protection of Oceans, Industry and Business.

Planning for environmentally sensitive areas

Unit IV: Environmental Impact Assessment 9 Hours

Meaning, Significance and framework. Methodologies, Checklist, Matrices, Network and social cost-benefit analysis. Sources andacquisition of environmental information. Environment impact studies of development projects.

EIA Case Studies

Unit V: Environmental Policies and Legislations in India 9 Hours

Major environment policies and legislations in India - The Ministry of Environment & Forests, The Central Pollution Control Board. Policies to protect environment in India – Environment Protection Act, 1986, National Conservation Strategy and Policy Statementon Environment and Development, 1992, Policy Statement for the abatement of Pollution, 1992, National Environment Policy, 2006, Vision Statement on Environment and Health. Legislations and Rules for the protection of Environment in India.

Five year plans in relation to environmental aspects

Text Books

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. Walter E. Westman, "Ecology, Impact Assessment and Environmental Planning", John Wiley & Sons, 1985
3. Chadwick A., "Introduction to Environmental Impact Assessment", Taylor & Francis, 2007

Reference Books

1. Charles H. Southwick D., "Ecology and the Quality of Our Environment", Van No strand Co New York, 1976
2. Barthwal, R.R., "Environmental Impact Assessment", New Age International, New Delhi, 2002

Web References

1. http://iced.cag.gov.in/?page_id=256
2. http://econdse.org/wp-content/uploads/2016/07/chapter-1-gupta.pdf
3. https://www.researchgate.net/publication/341521590_Chapter_5_Environmental_Polic y_in_India
4. https://www.preventionweb.net/files/15417_nationalenvironmentpolicyandstrateg.pdf

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive LevelsL1: Remember

1. What is Ecology?
2. List any three ways in which humans directly influence environmental conditions
3. What is the goal of sustainable development?
4. List the three sequential phases of EIA
5. Enlist any four principles of National Environmental Policy of India

L2: Understand

1. Explain the key principles of the ecosystem approach to conserving natural resources
2. Explain the impact of urbanization on nature
3. How does sustainable development make economic sense for society?
4. Discuss the importance of EIA activities for developing countries
5. Discuss the objectives and founding principles of India's National Environmental Policy

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OE 20CSO02 Designing the Internet of Things 3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20CSO02.1	Illustrate the IoT in different contexts	-	L1, L2
20CSO02.2	Outline the Design Principles for Connected Devices		L1, L2
20CSO02.3	Explain the Internet Principles & Application Layer Protocols		L1, L2
20CSO02.4	Apply the Prototyping concepts in IoT		L1, L2
20CSO02.5	Analyse the Prototyping Embedded Devices		L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Overview of Internet of Things **9 hours**

The flavour of the Internet of Things, The "Internet" of "Things", Technology of IoT, Enhanced Objects, Who is making the Internet of things.

Applications of IoT

Unit II: : Design Principles for Connected Devices **9 hours**

Calm & Ambient Technology, Magic as Metaphor, Privacy: Keeping secrets, Web Thinking for Connected Devices

Examples of Connected Devices

Unit III: : Internet Principles **9 hours**

Internet Communications-IP,TCP, The IP protocol suite(TCP/IP), UDP, IP Addresses-DNS, static IP Address assignment, Dynamic IP Address assignment, IPV6, MAC Addresses, TCP & UDP Ports, Application Layer Protocols

HTTPS: Encrypted HTTP

Unit IV: Thinking About Prototyping **9 hours**

Sketching, Familiarity, Costs versus Ease of prototyping, Prototypes & Production, Open Source versus Closed Source

Embedded Platforms

Unit V: Prototyping Embedded Devices **9 hours**

Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, BeagleBone Black, Electric Imp

Aurdino Components

Textbooks

1. Adrian, McEwen & Hakim Casimally, "Designing The Internet of Things", John Wiley and Sons, 2014
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Wiley, 2019

Reference Books

1. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms", Morgan Kaufmann,2016
2. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, "Internet Of things With Raspberry Pi And Arduino", CRC Press/Taylor & Francis Group, 2019

Web Resources

1. https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/
2. https://tutorialspoint.dev/computer-science/computer-network-tutorials/the-new-internet-internet-of-everything
3. https://www.javatpoint.com/iot-internet-of-things

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
Total (%)	100	100

L1: Remembering

1. Define IoT
2. What are the Enhanced objects for IoT?
3. What is a Prototype?
4. Define Sketching
5. Define DNS

L2: Understanding

1. Explain the following terms related to Protocols: UDP, TCP
2. Discuss in detail about MAC Addresses
3. Define Prototyping? Describe the Embedded Computing Basics
4. Explain Application Layer Protocols
5. Discuss the Costs versus Ease of prototyping

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OE 20AIO02 Fundamentals of Deep Learning 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20AIO02.1	Describe the fundamental concept of artificial neural networks	-	L1, L2
20AIO02.2	Describe the function of different deep neural networks		L1, L2
20AIO02.3	Explain different deep learning algorithms		L1, L2
20AIO02.4	Describe the functioning of convolution and recurrent neural networks		L1, L2
20AIO02.5	Choose appropriate deep neural network for given application		L1, L2
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit 1: Introduction to Deep Learning **9 hours**

Basics: Biological Neuron, Idea of computational units, McCulloch– Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

Logic gates with perceptron

Unit 2: Feedforward Networks **9 hours**

Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization – Regularization, autoencoders

Applications of multilayer perceptron

Unit 3: Convolution Networks **9 hours**

Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs – Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet

Applications of CNN

Unit 4: Recurrent Neural Networks **9 hours**

Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks –The Long Short-Term Memory

Applications of RNN

Unit 5: Applications of Deep Neural Networks **9 hours**

Applications: Large-Scale Deep Learning - Computer - Speech Recognition - Natural Language Processing

Healthcare applications

Text Books

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press, UK, 2017
2. Antonio Gulli and Sujit Pal, “Deep Learning with Keras “, Packt Publishing Ltd, Birmingham, UK, 2017

Reference Books

1. Deng & Yu, “Deep Learning: Methods and Applications”, Now Publishers, 2013.
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Web References

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

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List any 4 benefits of artificial neural networks
2. List any 4 features of ANN
3. What are deep neural networks?
4. Define supervised and unsupervised learning
5. Define generalization

L2: Understand

1. Explain the design parameters of deep neural networks
2. Describe the dimensionality reduction techniques
3. Explain backpropagation algorithm
4. Describe any 2 applications of deep networks for image processing
5. Write about any 5 applications of deep networks

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OE 20DSO02Introduction to Data Science 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20DSO02.1	Understand Fundamentals of Data Science Terminology.	-	L1, L2
20DSO02.2	Demonstrate different computing tools involved in data handling.		L1, L2
20DSO02.3	Understand Knime Tool.		L1, L2
20DSO02.4	Understand Machine Learning Concepts		L1, L2
20DSO02.5	Apply domain expertise to solve real world problems using data science		L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction to Data Science **9 Hours**

Analysing the Pieces of the Data Science Puzzle, Exploring the Data Science Solution Alternatives, Defining Big Data by the Three Vs, Grasping the Difference between Data Science and Data Engineering, Making Sense of Data in Hadoop, Identifying Alternative Big Data Solutions, Converting Raw Data into Actionable Insights with Data Analytics, Distinguishing between Business Intelligence and Data Science, Defining Business-Centric Data Science

Identifying Data Science Users; Data Engineering in Action: A Case Study

Unit II: Computing for Data Science - 1 **9 Hours**

Using Python for Data Science, Using Open Source R for Data Science.

Sorting Out the Python Data Types; R's Basic Vocabulary

Unit III: Computing for Data Science - 2 **9 Hours**

Using SQL in Data Science, Doing Data Science with Excel and Knime

Basic SQL Commands; Knime Basics

Unit IV Machine Learning, Probability and Statistical Modelling **9 Hours**

Defining Machine Learning and Its Processes, Considering Learning Styles, Seeing What You Can Do, Exploring Probability and Inferential Statistic, Quantifying Correlation, Reducing Data Dimensionality with Linear Algebra, Modeling Decisions with Multi-Criteria Decision Making, Introducing Regression Methods

Linear Regression

Unit V Applying Domain Expertise to Solve Real-World Problems Using Data Science **9 Hours**

Data Science in Journalism,Delving into Environmental Data Science, Data Science for Driving Growth in E-Commerce, Using Data Science to Describe and Predict Criminal Activity

Applying statistical modeling to natural resources in the raw; Deploying web analytics to drive growthh

Text Books

1. Lillian Pierson and Jake Porway,"Data Science For Dummies", 2nd Edition,For Dummies, 2017

Reference Books

1. Joel Grus, "Data Science from Scratch", 2nd Edition, O'Reilly Media, 2015
2. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020

Web Resources

1. https://www.simplilearn.com/tutorials/data-science-tutorial/
2. https://www.w3schools.com/datascience/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is data science? Identify three areas or domains in which data science is being used
2. Give three examples of structured data formats
3. Name three measures of centrality and describe how they differ
4. What is supervised learning? Give two examples of data problems where you would use Supervised learning

L2: Understand

1. How do data analysis and data analytics differ?
2. Relate likelihood of a model given data, and probability of data given a model. Are these two the same? Different? How?

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OE 20ECO02 IoT for Smart Grids 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20ECO02.1	Demonstrate the Smart Grid concept ,Need for smart grid	-	L1, L2
20ECO02.2	Explain the Energy Management system functions		L1, L2, L3
20ECO02.3	Describe how modern power distribution system functions		L1, L2
20ECO02.4	Explain the Advanced metering infrastructureand AMI protocols		L1, L2, L3
20ECO02.5	Identify suitable communication networks forSmart Grid applications		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Smart Grid **09 Hours**

Introduction - Evolution of Electric Grid, Smart Grid Concept - Definitions and Need for Smart Grid – Functions – Opportunities – Benefits and challenges, Difference between conventional & Smart Grid.

Technology Drivers

Unit II: Energy Management System **09 Hours**

Energy Management System (EMS) - Smart substations - Substation Automation – Feeder Automation, SCADA – Remote Terminal Unit – Intelligent Electronic Devices – Protocols, Phasor Measurement Unit – Wide area monitoring protection and control, Smart integration of energy resources – Renewable, intermittent power sources.

Energy Storage

Unit III: Distribution Management System **09 Hours**

Distribution Management System (DMS) – Volt / VAR control – Fault Detection, Isolation and Service Restoration, Outage management System, Customer Information System, Geographical Information System, Effect of Plug in Hybrid Electric Vehicles.

Network Reconfiguration

Unit IV: Smart Meters **09 Hours**

Introduction to Smart Meters – Advanced Metering infrastructure (AMI), AMI protocols – Standards and initiatives, Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing.

Peak Time Pricing

Unit V: Communication Networks & IoT **09 Hours**

Elements of communication and networking – architectures, standards, PLC, Zigbee, GSM, BPL, Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) – Broadband over Power line (BPL) - IP based Protocols - Basics of Web Service and CLOUD Computing.

Cyber Security for Smart Grid

Textbooks

1. Stuart Borlase, “Smart Grid: Infrastructure, Technology and Solutions”, CRC Press, 2012
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu and Akihiko Yokoyama, “Smart Grid: Technology and Applications”, Wiley, 2012

Reference Books

1. Mini S. Thomas and John D McDonald, "Power System SCADA and Smart Grids", CRC Press, 2015
2. Kenneth C. Budka, Jayant G. Deshpande and Marina Thottan, "Communication Networks for Smart Grids", Springer, 2014

Web Resources

1. https://books.google.co.in/books?isbn=1119969093
2. https://books.google.co.in/books?isbn=135123093X

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	30
L2	35	35
L3	35	35
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define a Smart grid
2. List any three Benefits of Smart grid
3. What is SCADA?
4. List any three Intelligent Electronic Devices
5. Define a Fault Detection

L2: Understand

1. Explain the need of Smart Grid
2. Demonstrate the Smart Grid Concept
3. Explain the Energy Management System (EMS)
4. Classify and explain the Smart integration of energy resources
5. Illustrate Effect of Plug in Hybrid Electric Vehicles

L3: Apply

1. Identify the Outage management System
2. How to utilize the Distribution Management System (DMS)? explain

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OE 20EEO02 Electrical Safety and Management 3 0 0 3

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

Code	Course Outcomes	Mapping with PO's	DoK
20EEO02.1	Understand the Indian electricity rules and their significance	-	L1, L2
20EEO02.2	Explain the safety standard in residential, commercial, and agricultural		L1, L2
20EEO02.3	Learn about electrical safety installation, testing and commission		L1, L2
20EEO02.4	Understand about electrical safety in distribution system		L1, L2
20EEO02.5	Explain flash-overs and corona discharge		L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge			

Unit I: Indian Electricity Regulations and Acts and their Significance **09 Hours**

Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage – earthing of system neutral – Rules regarding first aid and fire fighting facility.

The Electricity Act2003 (Part 1,2,3,4 & 5) and Control Authority Safety Regulations

Unit II: Electrical Safety in Residential, Commercial and Agriculture Installations **09 Hours**

Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

System grounding and Equipment grounding

Unit III: Safety During Installation, Testing and Commissioning, Operation and Maintenance **09 Hours**

Preliminary preparations – safe sequence – risk of plant and equipment –safety documentation – field quality and safety - personal protective equipment – safety clearance notice – safety precautions – safeguards for operators – safety

Magnetic Hot sticks, protective clothing and industrial clothing

Unit IV: Electrical Safety in Hazardous Areas **09 Hours**

Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours.

Hazards associated with currents and voltages

Unit V: Electrical Safety Shocks and their Prevention **09 Hours**

Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

Objectives of Safety and Security Measures

Text Books

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. Pradeep Chaturvedi, "Energy Management Policy, Planning and Utilization", Concept Publishing Company, 1997
3. John M Madden, "Electrical Safety and Law, Planning and Utilization", 5th Edition, Routledge, 2017

Reference Books

1. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
2. Martha J Boss and Gayle Nicoll, "Electrical Safety", 1st Edition, CRC Press, 2014
3. Gupta, B.R., "Electrical Safety", 1st Edition, American Technical Publishers, 2018

Web References

1. https://nptel.ac.in/courses/108/104/108104087/
2. https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/syllabus/
3. https://www.edx.org/course/electricity-and-magnetism-maxwells-equations

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	40
L2	70	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Give the classification of electrical installations.
2. State the disadvantages of low power factor.
3. What is safety documentation system?
4. State preliminary preparations before commencing the installation.

L2: Understand

1. Write the objectives and scope of Indian Electricity Act and Indian Electricity Rule.
2. Explain the importance of earthing system neutral.
3. Write a note on Do's and Don't for safety in the use of domestic electrical appliances.
4. Explain the classification of equipment/enclosure for hazardous locations.

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OE 20MEO02 Fundamentals of Automobile Engineering 3 0 0 3

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

Code	Course Outcomes	Mapping with PO's	DoK
20ME302.1	Introduction to fundamentals of automobiles, lubrication, Tires and safety.	-	L1, L2
20ME302.2	Classify and identify the steering system		L2, L3
20ME302.3	Classify and identify the Transmission system		L2, L3
20ME302.4	Define and compare the suspension, breaking and electrical system.		L2,L4
20ME302.5	Identify and Interpret the specifications and safety precautions..		L2, L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge			

Unit I: Introduction **09 Hours**

Componentsoffourwheelerautomobile–chassisandbody–powerunit–typesofautomobileengines,engineconstruction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps–crank case ventilation–. Types – wheels and tyres. Safety Introduction, safety systems-seat belt, airbags, bumper, anti lock brake system(ABS),windshield, suspension sensors, traction control, mirrors, central locking and electric.

windows, speed control.

Unit II: TRANSMISSION SYSTEM **09 Hours**

Power transmission–rear wheel drive, front wheeldrive,4wheeldrive Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchromesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft – Hotch – Kiss drive.

Torque tube drive, universal joint, differential rear axles.

Unit III: STEERING SYSTEM **09 Hours**

Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism ,steering gears, –types
steeringlinkages.

Unit IV: SUSPENSION, BREAKING AND ELECTRICAL SYSTEM **09 Hours**

SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.
BRAKINGSYSTEM:Mechanicalbrakesystem,hydraulicbrakesystem,mastercylinder,wheelcylindertandemmastercylinderrequire ment of brake fluid
ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, bendixdrivemechanismsolenoidswitch,lightingsystems,horn,wiper,fuelgauge–oilpressuregauge,enginetemperatureindicatoretc.

pneumaticandvacuumbrakes.

Unit V: ENGINESPECIFICATION AND MAINTENANCE **09 Hours**

Introduction-engine specifications with regard to power, speed, torque, no.of cylinders and arrangement, lubrication and cooling etc. engine service, reboring, decarburization ,Nitriding of crankshaft. service details of engine cylinder head, valves and valve mechanism, piston-connecting rod assembly, cylinder block, crank shaft and main bearings, engine reassembly-precautions. Types of pollutants, mechanism of formation, concentrationmeasurement,methodsofcontrolling-enginemodification,exhaustgastreatment-thermalandcatalyticconverters-useof alternative fuels for emission control

NationalandInternationalpollutionstandards.

Text Books

1. AutomotiveMechanics–Vol.1&Vol.2/KirpalSingh/standardpublishers
2. AutomobileEngineering/WilliamCrouse/TMHDistributors
3. AutomobileEngineering/P.SGill/S.K.Kataria&Sons/NewDelhi.
4. AutomobileEngineering/CSrinivasan/McGrawHill

Reference Books

1. Automotive EnginesTheoryandServicing/JamesD.HaldermanandChaseD.MitchellJr.,/Pearsoneducationinc.
2. Automotive Engineering/KNewton,W.Steeds&TKGarrett/SAE
3. Automotive Mechanics: PrinciplesandPractices/ JosephHeitner/VanNostrandReinhold

Web References

1. https://nptel.ac.in/noc

Internal Assessment Pattern

CognitiveLevel	InternalAssessment#1(%)	InternalAssessment#2(%)
L2	40	30
L3	40	30
L4	20	40
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels:

Remember

1. What are the differences between two and four stroke engines.
2. Define the Octane number & Cetane number
3. Explain the significance of governor in automobiles?
4. What is an automotive differential and how does it work?
5. Why are car steering wheels round?
6. Why entropy decreases with the increase in temperature?

Understand

1. Describe the Atkinson cycle..
2. Explain the flywheel with neat sketch.
3. What is an injector pressure in heavy vehicles? Why it is used?
4. Discuss the service the piston – connecting rod assembly with neat sketch.
5. Discuss the magneto ignition.
6. What is 3-way converter?
7. Name the different cooling methods with neat sketches.
8. Describe with P-V diagrams the two used cycles for internal combustion engines.

Analyze

1. In a 4-stroke, 4-stroke cylinder diesel engine running 5000 r.p.m., how many times the fuel will be injected per second.
2. Name the car with engine having 4-valves and 5- valves per cylinder.gas at a pressure of 1.5Mpa ,the gas expands according to the process. Which represented by a straight line on a pressure volume. The final pressure is 0.15MPa. Calculate the work done on a gas by the piston

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Board of Studies (ME)

PC 20CS608 Modern Software Engineering Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with Pos
		PO4
20CS608.1	Implement software engineering methodologies involved in the phases for project development.	3
20CS608.2	Develop a model Software Requirement Specification document for proposed system	3
20CS608.3	Implement high-level design of the system from the software requirements using knowledge of software design process	3
20CS608.4	Implement software models to cater business scenarios	3
20CS608.5	Implement test cases for various white box and black box testing techniques	3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos		
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge		

List of Experiments

Implement for any two projects, with the following exercises

1. Development of problem statement from the user stories
2. Preparation of Software Requirements Document and convert in to use cases
3. Do requirement analysis and develop Software Requirement Specification document for proposed system.
4. Development of Entity Relationship(E-R) diagram
5. Design high-level design of the system
6. Draw Use case and Class diagrams
7. Develop the prototype of the product
8. Write unit and function test cases for the requirements

Sample Projects

1. Online Exam Registration
2. E-book management System.
3. Recruitment system
4. Banking System
5. Airline Reservation System
6. Traffic Monitoring System Project
7. Library Management System
8. Online Mobile Recharge Portal
9. Sentiment analysis for product rating

Reference

1. Lab Manual for Modern Software Engineering Department of Computer Science and Engineering, NSRIT
2. Software Engineering- Sommerville, Pearson Education, 7th edition.
3. The unified modelling language user guide Grady Booch, James Rambaugh, Ivar Jacobson, Pearson Education.

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Board of Studies CSE(AI&ML)

PC 20AI607 Deep Learning Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs	
		PO4	PO5
20AI607.1	Use the packages of Keras and TensorFlow	3	2
20AI607.2	Design and implementation of networks for classification tasks	3	2
20AI607.3	Design and implementation of networks for unsupervised tasks	3	2
20AI607.4	Design and implementation of networks for image applications	3	2
20AI607.5	Design and implementation of networks for video procession application	3	2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

List of Experiments

1. Study of packages in Keras
2. Design and implementation of deep neural network for image classification
3. Design and implementation of deep neural network for classification on medical data set
4. Design and implementation of deep neural network for unsupervised tasks
5. Study of packages in TensorFlow
6. Design and implementation of deep neural network for object detection
7. Design and implementation of deep neural network for face recognition

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PC 20AI608 Artificial Neural Networks Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping withPOs
		PO4, PO5
20AI608.1	Implement different activation functions and analyse their impact	3
20AI608.2	Demonstrate the working of simple perceptron for logic gates	3
20AI608.3	Implement classification with a perceptron on linearly and non-linear data	3
20AI608.4	Implement backpropagation learning	3
20AI608.5	Implement associative memory for simple applications	3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

List of Experiments

1. Write programs to demonstrate the role of different activation functions
2. Write program to demonstrate the working of single artificial neuron
3. Demonstrate the working of perceptron network by implementing logic gates
4. Demonstrate the 2 different learning algorithms on perceptron network
5. Write programs to implement perceptron classifier for linearly separable data
6. Write programs to implement perceptron classifier for non-linear data
7. Write program to demonstrate the working of back propagation algorithm
8. Write program to demonstrate the working of associative memory

Reference

1. Lab Manual for Programming for Artificial Neural Networks Programming Lab Department of Computer Science and Engineering, NSRIT

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SC **20AIS04 Deep Learning Frameworks** 0 0 4 2.0

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

Code	Course Outcomes	Mapping with POs		DoK
		PO4	PO5	
20AIS04.1	Interpret and use different types of data sets for computer vision problem	2	2	L1, L2, L3
20AIS04.2	Interpret and use different types of data sets for NLP applications	2	2	L1, L2, L3,
20AIS04.3	Interpret and use different types of data sets for prediction	2	2	L1, L2, L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge				
Study of Keras – Study of TensorFlow – Study of PyTorch - Implementation of Deep Neural Network models (CNN, RNN) for computer vision problems, NLP problems – 2 projects are to be completed				
Resources				
1. https://data.mendeley.com/ 2. https://deepmind.com/ 3. https://www.kaggle.com 4. https://machinelearningmastery.com/				

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MC 20MCX04 Indian Traditional Knowledge 2 0 0 0.0

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO6	PO7	PO12	
20MCX04.1	Identify the concept of Traditional knowledge and its importance	1	3	3	2	L1, L2
20MCX04.2	Explain the need and importance of protecting traditional knowledge	1	2	3	2	L1, L2
20MCX04.3	Illustrate the various enactments related to the protection of traditional knowledge	1	3	3	2	L1, L2
20MCX04.4	Interpret the concepts of Intellectual property to protect the traditional knowledge	1	2	3	2	L1, L2
20MCX04.5	Explain the importance of Traditional knowledge in Agriculture and Medicine	1	3	3	2	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create

UNIT-I: Introduction to traditional knowledge **4 hours**

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

UNIT-II: Protection of traditional knowledge **4 hours**

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT-III: Legal framework and TK: **4 hours**

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

UNIT-IV: Traditional knowledge and intellectual property: **4 hours**

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

UNIT-V Traditional Knowledge in Different Sectors: **4 hours**

Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

Text Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.

Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.

2. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.

Web Links:

1.https://www.youtube.com/watch?v=LZP1StpYEPM

2.http://nptel.ac.in/courses/121106003/

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PE 20AI007 Bio informatics 3 0 0 3

Pre-requisite Basics of biology

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

Code	Course Outcomes	Mapping with POs	DoK
20AI007.1	Understand the basic concepts of bioinformatics	-	L1, L2
20AI007.2	Describe the methods of data analysis		L1, L2
20AI007.3	Explain various models for bioinformatics		L1, L2
20AI007.4	Explain the different pattern matching visualization methods of bioinformatics		L1, L2
20AI007.5	Understand the concepts of microarray analysis		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction **9 hours**

Need for Bioinformatics technologies – Overview of Bioinformatics technologies Structural bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics - Biological Data Integration System.

Different data formats

Unit II: Data warehousing and mining in Bioinformatics **9 hours**

Bioinformatics data – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics

Data analytical tools for DNA

Unit III: Modelling for Bioinformatics **9 hours**

Hidden markov modelling for biological data analysis – Sequence identification –Sequence classification – multiple alignment generation – Comparative modelling –Protein modelling – genomic modelling – Probabilistic modelling – Bayesian networks – Boolean networks - Molecular modelling

Computer programs for molecular modelling.

Unit IV: Pattern matching and Visualization **9 hours**

Gene regulation – motif recognition – motif detection – strategies for motif detection – Visualization – Fractal analysis – DNA walk models – one dimension – two dimension – higher dimension – Game representation of Biological sequences – DNA, Protein

Amino acid sequences

Unit V: Microarray Analysis **9 hours**

Microarray technology for genome expression study – image analysis for data extraction – pre-processing – segmentation – gridding – spot extraction – normalization, filtering – cluster analysis – gene network analysis – Compared Evaluation of Scientific Data Management Systems – Cost Matrix – Evaluation model - Benchmark – Trade-offs

Text Books

1. Yi-Ping Phoebe Chen (Ed), "BioInformatics Technologies", First Indian Reprint, Springer Verlag,2007.

Reference Books

1. Bryan Bergeron, “Bio Informatics Computing”, Second Edition, Pearson Education, 2003.
2. Arthur M Lesk, “Introduction to Bioinformatics”, Second Edition, Oxford University Press, 2005

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. List out any 4 applications of bio-informatics
2. Draw the warehouse architecture for biological data
3. Describe different data formats to handle biological data

L2: Understand

1. Explain the neural network models to handle biological data
2. Explain evaluation metrics for biological models

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PE 20AI008 Fundamentals of Blockchain 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20AI008.1	Understand and explore the working of Blockchain Technology	-	L1, L2
20AI008.2	Understand the blockchain technology on cryptocurrency and bitcoin		L1, L2
20AI008.3	Learn the fundamentals of Ethereum and working of smart contarcts		L1, L2
20AI008.4	Understand and analze the working of Hyperledger		L1, L2
20AI008.5	Know the various application of blockchain in different domains		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction of Cryptography and Blockchain **9 hours**

What is Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions And Blocks, P2P Systems, Keys As Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain

Blockchain Architecture, Knowledge of Decentralized systems

Unit II: Bitcoin and Cryptocurrency **9 hours**

What is Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain And Digital Currency, Transactional Blocks, Impact Of Blockchain Technology On Cryptocurrency.

Encryption key Techniques

Unit III: Introduction to Ethereum **9 hours**

What is Ethereum, Introduction to Ethereum, Consensus Mechanisms, How Smart Contracts Work, Metamask Setup, Ethereum Accounts, Receiving Ether's What's a Transaction?, Smart Contracts

Benefits of Ethereum Blockchain, Smart Contract fundamnetals

Unit IV: Introduction to Hyperledger **9 hours**

What is Hyperledger? Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer

Fundameentals of Docker, Types of Blockchains

Unit V: Blockchain Applications **9 hours**

Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins

Real Time IOT Applications, Ethereum, Hyperledger Fabric

Text Books

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press (July 19, 2016)

Reference Books

1. Imran Bashir, "Masteering Blockchain", Packt Publishing Ltd.,2017
2. Antonopoulos and G. Wood, "Mastering Ethereum", O'Reilly Media, Inc.,2018

Web References

1. https://nptel.ac.in/courses/106/104/106104220/#
2. https://www.udemy.com/course/build-your-blockchain-az/
3. https://eduxlabs.com/courses/blockchain-technologytraining/?tab=tab-curriculum

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is the difference between Bockchain and Hyperledger?
2. What do you mean by blocks in blockchain technology?
3. What is Cryptography role in blockchain?

L2: Understand

1. Explain different type of Blockchain
2. How is hash generated
3. What is smart Contract and list some of its applications

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PE 20AI009 Big Data Analytics 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20AI009.1	Identify the knowledge of Big Data	-	L1, L2
20AI009.2	Identify the architectural concepts of HDFS in Hadoop ecosystem		L1, L2
20AI009.3	Demonstrate MapReduce Framework, HBase and Spark		L1, L2
20AI009.4	Illustrate Big Data stack and technologies		L1, L2
20AI009.5	Demonstrate Analytics on Big Data		L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Fundamentals of Big Data **9 hours**

Introduction to Big Data, History of Data Management, Evolution of Big Data, Structuring Big Data, Elements of Big Data, Big Data Analytics, Uses of Big Data in Social Networking, Uses of Big Data in Retail Industry, Distributed and Parallel Computing for Big Data, Introducing Hadoop, Cloud Computing and Big Data

Data Management

Unit II: Understanding Hadoop Ecosystem **9 hours**

Hadoop Distributed File System (HDFS), MapReduce, Introducing HBase, HBase architecture, Regions, Storing Big Data with HBase, Interacting with Hadoop Ecosystem, Combining HBase and HDFS, Hive, Pig and Pig Latin

Data Integrity in HBase

Unit III: Understanding MapReduce Fundamentals, HBase and Spark **9 hours**

MapReduce Framework, Techniques to Optimize MapReduce Jobs, Uses of MapReduce, Role of HBase in Big Data Processing, Characteristics of HBase, Introduction to Data Analysis with Spark, Spark Core, Spark SQL, Spark Streaming, MLlib, GraphX, Storage Layers for Spark

Fundamental Role of Spark

Unit IV: Understanding Big Data Technology Foundations **9 hours**

Exploring the Big Data Stack, Data Sources Layer, Ingestion Layer, Storage Layer, Physical Infrastructure Layer, Platform Management Layer, Security Layer, Monitoring Layer, Analytics Engine, Visualization Layer, Big Data Applications, Virtualization and Big Data, Virtualization Approaches

Data and Storage Virtualization

Unit V: Understanding Analytics and Big Data **9 hours**

Comparing Reporting and Analysis, Types of Analytics, Points to Consider during Analytics, Developing an Analytic Team, Understanding Text Analytics, Analytical Approaches and Tools to Analyze Data, Analytical Approaches, History of Analytical Tools

Data Visualization Tools

Text Books

1. DT Editorial Services, "Big Data – Hadoop2, MapReduce, Hive, YARN, Pig, R and Data Visualization" Black Book, DreamTech Publications, 2019
2. Sridhar Alla, "Big Data Analytics with Hadoop 3", Packt Publications, 2018
3. Holden Karau, Andy Konwinski, Patrick Wendell & Matei Zaharia, "Learning Spark", O'Reilly Publications, 1st Edition, 2015

Reference Books

1. Balamurugan Balusamy, Nandhini Abirami R, Seifedine Kadry, Amir H. Gandomi, "Big Data: Concepts, Technology and Architecture", Wiley Publications, 1st Edition, 2021
2. Thomas Erl, Wajid Khattak, Paul Buhler, "Big Data Fundamentals: Concepts, Drivers & Techniques", The Pearson Service Technology Publications,1st Edition, 2016

Web Resources

1. https://www.edureka.co/blog/what-is-big-data/
2. https://hadoop.apache.org/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Big Data and its characteristics?
2. What is Pig and Pig Latin?
3. List out the techniques to optimize MapReduce jobs.
4. List out various Analytical Approaches.

L2: Understand

1. Discuss uses of Big Data in Retail Industry.
2. Explain HDFS with neat diagram.
3. Explain Stack of Layers in Big Data architecture.
4. Explain Text Data Analysis

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Board of Studies (CSE)

PE 20AI010 Soft Computing 3 0 0 3

Pre-requisite

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

Code	Course Outcomes	Mapping with POs	DoK
20AI010.1	Identify soft computing techniques and their roles	-	L1, L2
20AI010.2	Describe soft computing techniques and their roles in building intelligent machines		L1, L2
20AI010.3	Recognize the feasibility of applying a soft computing methodology for a particular problem		L1, L2
20AI010.4	Describe the neuro fuzzy models		L1, L2
20AI010.5	Identify modern software tools to solve real problems using a soft computing approach and evaluate various soft computing approaches for a given problem		L1, L2

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Review of ANN **9 hours**

Basic-concepts-single layer perception-Multi layer perception-Supervised and unsupervised learning back propagation networks, Application.

Reinforcement learning

Unit II: Fuzzy Systems **9 hours**

Fuzzy sets and Fuzzy Reasoning-Fuzzy Matrices-Fuzzy functions-decomposition-Fuzzy automata and languages- Fuzzy control methods-Fuzzy decision making

Washing machines and AC applications

Unit III: Neuro-fuzzy models **9 hours**

Adaptive networks based Fuzzy Interfaces-Classification and Representation Trees-Data dustemp algorithm –Rule base structure identification-Neuro-Fuzzy controls.

Application of fuzzy control system

Unit IV: Genetic Algorithm **9 hours**

Survival of the fittest-pictures computations-cross over mutation-reproduction-rank method-rank space method, Application

Bio-inspired algorithms

Unit V: Review of AI **9 hours**

AI Search Algorithm-Predicate calculus rules of interface – Semantic networks-frames-objects-Hybrid models, applications

Adverseral search

Text Books

1. E – Neuro Fuzzy and Soft computing – Jang J.S.R., Sun C.T and Mizutami, Prentice hall New Jersey, 1998
2. Fuzzy Logic Engineering Applications – Timothy J.Ross, McGraw Hill, NewYork, 1997.
3. Fundamentals of Neural Networks – Laurene Fauseett, Prentice Hall India, New Delhi, 1994.

Reference Books

1. Introduction to Artificial Intelligence – E Charniak and D McDermott, Pearson Education

2. Artificial Intelligence and Expert Systems – Dan W. Patterson, Prentice Hall of India

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define fuzzy logic
2. Give examples for fuzzy functions
3. Define fuzzy relations
4. What are genetic operators
5. Define survival of fittest

L2: Understand

1. Explain neuro fuzzy models
2. Describe the process of fuzzification

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CSE AIML

PE 20AI011 Cyber Threat Analysis 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20AI011.1	Understand the General Cryptography Knowledge, wireless encryption and security, and virtual private network	-	L1, L2
20AI011.2	Know the knowledge on information systems security management		L1, L2
20AI011.3	Know the knowledge of IT risk and security management		L1, L2, L3
20AI011.4	Understand the using of various tools in vulnerability assessment and management		L1, L2, L3
20AI011.5	Identify threats and fully exploring on threat scenarios for analysis		L1, L2, L3, L4

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Information Assurance/Encryption **9 hours**

General Crytography Knowledge, Ancient Ciphers-The Caeser Cipher, ROT 13, Atbash Cipher, Wireless Encryption and Security, Obfuscation, Digital Signatures, Digital Certificates, Device and File Encryption, Virtaul Private Networks

Symmetric Ciphers, Security attacks, Security Mechanisms

Unit II: Information Systems and Security Management **9 hours**

Knowledge of Cyber Threats and Vulnerabilities, Knowledge of Information Technology (IT) Security Principles and Methods, Knowledge of Local Area and Wide Area Networking Principles

Different types of Cyber Attacks, Planning of attacks

Unit III: IT Risk and Security Management **9 hours**

Knowledge of Risk Management Process, Knowledge of Risk Management Framework, Knowledge of Organisation's Risk Tolerance, Knowledge of Risk / Threat Assessment, Knowledge of Confidentiality, Integrity, and Aaiabiity Principles, Knowledge of Collectio / Analysing Techniques and Tools for Chat List, VOIP, WebMail etc.

IT Risk Policies, Procedures, Methods

Unit IV: Vulnerability Assessment and Management **9 hours**

Introduction- Tools, Shodan,Maltego, Nessus, OWASP ZAP, OpenVAS, Metasploit- SMB Scanner, SQL Server Scan, SSH Server Scan, Responding Vulnerability

OWASP 10 Tools

Unit V: Threat Analysis **9 hours**

Introduction, Threat Modelling- STRIDE, DREAD, SQUARE, VAST, PASTA, Business Impact Analysis, Characterizing and Analyzing Network Traffic, Forensic Handling of Incidents

Confidentiality, Integrity, and Availability

Text Books

1. Izzat Alsmadi, Chuck Easttom, Lo'ai Tawalbeh, "The NICE Cyber Security Security Framework" Springer Nature Switzerland AG 2020.

Reference Books

1. Aaron Roberts, "Cyber Threat Intelligence" APress Media, LLC part of Springer Nature, 2021

2. Richard Forward, “Infosecurity 2008 Threat Analysis”, Syngress Publishing, Inc.,Elsevier, Inc.2008

Web References

1. https://nptel.ac.in/courses/106106129
2. https://onlinecourses.nptel.ac.in/noc22_cs23/w

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	40	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Cryptogrraphy?
2. What is difference between symmetric and asymmetric encryption?
3. What is the difference between IDS and IPS?

L2: Understand

1. Explain CIA triad
2. What is the difference between VA(Vulnerability Assessment) and PT(Penetration Testing)?
3. What is a three-way handshake?

L3: Apply

1. Illustrate Privilege Escalation using Nmap
2. Analyze the Network Traffic using Wireshark
3. Apply your knowledge on Threat Modelling using various tools

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Chairman Board of Studies (AIML)

PE 20AI012 Distributed Computing 3 0 0 3.0

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

Code	Course Outcomes	Mapping with POs	DoK
20AI012.1	Design and implement distributed parallel computing and assessing models for distributed systems	-	L1, L2
20AI012.2	Design and implement distributed algorithms		L1, L2
20AI012.3	Experiment with mechanisms such as client/server and P2P algorithms, remote procedure calls(RPC/RMI),and consistency for programming parallel systems		L1, L2
20AI012.4	Differentiate between the major classes of parallel processing systems		L1, L2
20AI012.5	Analyze the efficiency of parallel processing systems and evaluate types of application for which parallel programming		L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Parallel architecture **9 hours**

Key concepts and challenges, overview of parallel computing, Flynn's Taxonomy, Multi core processors, Shared Vs Distributed memory, Introduction to openMP Programming, Instruction level support for parallel computing, SIMD, Vector processing, GPU Architecture

CPU Architecture

Unit II: Parallel Algorithms and Design **9 hours**

Preliminaries, Decomposition Techniques, Characteristics of tasks and interactions, mapping Techniques for load balancing

Unit III: Distributed Mutex & Deadlock **9hours**

Distributed mutual exclusion algorithms- Introduction – Preliminaries – Lamport's algorithm, Ricart-Agrawala algorithm, Maekawa's algorithm, Suzuki–Kasami's broadcast algorithm. Deadlock detection in distributed systems- Introduction – System model, Preliminaries – Models of deadlocks – Knapp 's classification – Algorithms for the single resource model, the AND model

Algorithm for OR model

Unit IV: Recovery & Consensus **9hours**

Check pointing and rollback recovery-Introduction, Background and definitions, Issues in failure recovery, Checkpoint-based recovery, Log-based roll back recovery, coordinated check pointing algorithm – Algorithm for asynchronous check pointing and recovery. Consensus and agreement algorithms- Problem definition, Overview of results, Agreement in a failure - Agreement in synchronous systems with failures.

Agreement in free systems

Unit V: Peer-to-peer computing and overlay graphs **9 hours**

Introduction – Data indexing and overlays, Chord, Content addressable networks – Tapestry. Distributed shared memory- Abstraction and advantages, Memory consistency models, Shared memory Mutual Exclusion.

Differences between memory consistency and inconsistency model

Text Books

1. Distributed Systems Concepts and Design, George Coulouris, Jean Dollimore and Tim Kindberg, Fifth Edition, Pearson Education, 2012.
2. Distributed computing: Principles, algorithms, and systems, Ajay D Kshemkalyani and Mukesh Singhal, Cambridge University Press, 2011

Reference Books

1. Distributed Operating Systems: Concepts and Design, Pradeep K Sinha, Prentice Hall of India, 2007.
2. Advanced concepts in operating systems. Mukesh Singhal and Niranjan G. Shivaratri, McGraw-Hill, 1994.

Web Resources

https://nptel.ac.in/courses/106/106/106106168/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	40	40
L3	20	20
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What are the models that are followed in distributed systems?
2. Discuss various challenges in distributed systems
3. List the characteristics of a distributed system.
4. Mention any five security mechanisms used in distributed computing?
5. What is network transparency?
6. Define marshaling

L2: Understand

1. Define Inter Process Communication
2. Identify system call trap and how it is implemented?
3. Statethe requirements of consensus algorithm to hold for execution
4. Write ashort note on Chandy Misra Haas Algorithm
5. What do you understand by logical time and logical clocks? What is Lamport's contribution?for it?

L3: Apply

1. Point out whether byzantine agreement algorithm can be reached for three generals with one of them faulty, if their generals digitally signed their messages
2. Discriminate the synchronization process with physical and logical clocks

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OE 20CEO03 Disaster Risk Mitigation and Management 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20CEO03.1	Identify various types of disasters, their causes, effects & mitigation measures	-	L1, L2
20CEO03.2	Understand various phases of disaster management cycle and create vulnerability and risk maps		L1, L2
20CEO03.3	Understand the approaches of risk and vulnerability		L1, L2
20CEO03.4	Explain the concept of disaster management and emerging approaches		L1, L2
20CEO03.5	Understand the mitigation measures		L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

UNIT I: Natural Disasters 9 Hours

Natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.
Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation.

Ozone Depletion

Unit II: Disaster Management Principles 9 Hours

Evolution of disaster risk management concept Disaster management cycle – Prevention, Preparedness, Mitigation, Rescue and Recovery Integrated and Comprehensive disaster risk reduction approach, Strategies and Policies.

Disaster management cycle

Unit III: Risk and vulnerability 9 Hours

Hazard, risk and vulnerability: Physical, social and economic dimensions, Vulnerability in changing climate, Climate change and Disasters, Risk Analysis Techniques, Risk: Identification, reduction and transfer, Approaches to mapping social vulnerability, Participatory disaster risk assessment, Action plans, Strategy for survival.

Vulnerability in changing climate

UNIT IV: Disaster Management 9 Hours

Preparedness through (IEC) Information, education & communication, pre-disaster stage (mitigation), Effect to mitigate natural disaster at national and global levels. International strategy for disaster reduction.
Emerging approaches in Disaster Management-Concept of disaster management, national disaster management framework, financial arrangements, role of NGOs, community –based organizations and media.

National disaster management framework

UNIT-V: Risk Mitigation 9 Hours

Definition, Concept, Importance, Guiding Principles, Tools, Approaches, Strategies Sustainable Development, Sustainable Land Use Planning, Technology and the Environment. Emerging Technologies in Disaster Mitigation, Remote Sensing, GIS, Disaster Mapping, Aerial Photography, Land Use Zoning

Emerging technologies in disaster mitigation

Text Books

1. Khanna, B. K., “Disasters: All you wanted to know about”, New India Publishing Agency,New Delhi, 2005
2. Edwards, B., “ Natural Hazards”, Cambridge University Press, U.K., 2005
3. Chakraborty, S. C., “Natural Hazards and Disaster Management”, Pargatishil Prokashak,Kolkata, 2007

Reference Books

1. Sahni, P., "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, NewDelhi, 2002
2. Prashant K. Srivastava, Sudhir Kumar Singh, Mohanty, U. C., Tad Murty, "Techniques for Disaster Risk Management and Mitigation", 2020

Web References

1. https://books.google.com
2. http://cbseacademic.nic.in

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define climatic change
2. List any four effects of natural disasters
3. Define disaster Managemrnt

L2: Understand

1. Explain about risk assessment
2. Outline the principles of disaster management
3. Differentiate between hazard, risk and vulnerability

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OE 20CS404 Operating Systems 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20CS404.1	Describe the structure, components and functionalities of operating system	-	L1, L2
20CS404.2	Describe the process management activities of operating system		L1, L2
20CS404.3	Illustrate the use of process synchronization tools		L1, L2
20CS404.4	Describe the various memory management and allocation techniques		L1, L2
20CS404.5	Demonstrate different secondary storage management strategies and file system		L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction to Operating System Concepts 9 Hours

What Operating System Do, Operating System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments, Operating Systems Services, System Call, Types of System Call, Operating System Generation, System Boot

The Shell, Mobile Operating System, Choice of Interface

Unit II: Process Management 9 Hours

Process Concept: The Process, Process State, Process Control Block, Threads, Process Scheduling: Scheduling Queues, Schedulers, Context Switch, Operations on Processes, Inter Process Communication, Multithread Programming: Overview, Benefits, Multithreading Models, Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

Process Termination, Multiprocess Architecture

Unit III: Synchronization 9 Hours

Background, The Critical-section problem, Peterson's Solution, Synchronization hardware, Semaphores, Classic Problems of Synchronization, Monitors, Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Transactional Memory, Two Phase Locking

Unit IV: Memory Management 9 Hours

Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table, Virtual Memory Management: Background, Demand paging, Page replacement, Thrashing, Mass-Storage Structure: Overview of Mass-Storage Structure, Harddisk Drives, Volatile Memory, HDD Scheduling-FCFS Scheduling, SCAN Scheduling of a Disk-Scheduling Algorithm.

Buddy System, Prepaging

Unit V: File system Interface 9 Hours

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.

Consistency Checking, Malware, Denial of service

Text Books

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", Tenth Edition, John Wiley and Sons Inc., 2018
2. William Stallings, "Operating Systems - Internals and Design Principles", Ninth Edition, Pearson, 2018

Reference Books

1. Andrew S. Tanenbaum, "Modern Operating Systems", Fourth Edition, Pearson, 2015
2. Charles Crowley, "Operating Systems: A Design-Oriented Approach", First Edition, Tata McGraw Hill

Education, 2001
3. Dhananjay M. Dhamdhere, "Operating Systems: A Concept-Based Approach", Third Edition, McGraw Hill Higher Education, 2017

Web Resources

1. http://nptel.ac.in/downloads/106108101/
2. https://www.coursera.org/learn/iot/lecture/MrgxS/lecture-3-1-operating-systems
3. https://www.geeksforgeeks.org/operating-system-introduction-operating-system-set-1/
4. https://www.unf.edu/public/cop4610/ree/Notes/PPT/PPT8E/CH12-OS8e.pdf
5. https://in.udacity.com/auth?next=/course/introduction-to-operating-systems--ud923

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	40
L2	50	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Operating System
2. What are operating system services?
3. List any four types of system calls
4. What is a process? List any four fields of process control block
5. What are the necessary conditions for a deadlock?
6. Differentiate between binary and counting semaphore.
7. What are the various attributes that are associated with an opened file?

L2: Understand

1. Discuss the essential properties of operating systems -Batch, Interactive, Timesharing Real time and Distributive
2. Explain how multiprogramming increases the utilization of CPU
3. Why system calls are needed in operating system?
4. Distinguish between logical address and physical address
5. What is the difference between a process and thread?
6. How does the system detect thrashing? What can the system do to eliminate this problem?
7. Consider the following four processes represented as (Process, Arrival Time, Burst Time) with the length of CPU burst in milliseconds.
   { (P1, 0, 10), (P2, 1, 7), (P3, 2, 13), (P4, 3, 11) }. Using preemptive SJF scheduling: (i) Draw Gantt chart
   (ii) Calculate average waiting time.
8. Why semaphores are important? Suggest the solution for bounded buffer problem with semaphores
9. Explain the steps involved in handling a page fault with a neat sketch

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OE 20AIO03 Fundamentals of AI 3 1 0 3

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

Code	Course Outcomes	Mapping with POs		PO12	DoK
		PO1	PO2		
20AIO03.1	Describe the foundational principles of artificial intelligence	3	2	1	L1, L2
20AIO03.2	Formalise the given problem using different AI methods	3	2	1	L1, L2
20AIO03.3	Explain different concepts of logic	3	2	1	L1, L2
20AIO03.4	Describe the different methods of knowledge representation	3	2	1	L1, L2
20AIO03.5	Explain the priciples and applications of expert systems	3	2	1	L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos					
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge					

Unit 1: Introduction to Artificial Intelligence **9+3 Hours**

Introduction – History - Intelligent systems - Foundations of AI – Applications – Tic-Tac-Tie game playing - Development of AI languages - Current trends in AI

Online agents

Unit II: Problem Solving **9+3 Hours**

Problem solving: State-Space search and Control strategies: Introduction - General problem solving - Characteristics of problem - Exhaustive searches - Heuristic search techniques - Iterativedeepening A* - Constraint satisfaction - Problem reduction and game playing: Introduction - Problem reduction - Game playing - Alphabeta pruning - Two-player perfect information games

Unknown environment

Unit III: Logic concepts **9+3 Hours**

Introduction - Propositional calculus - Proportional logic - Natural deduction system - Axiomatic system - Semantic tableau system in proportional logic - Resolution refutation in proportional logic

Predicate Logic

Unit IV: Knowledge Representation **9+3 Hours**

Introduction - Approaches to knowledge representation - Knowledge representation using semantic network - Extended semantic networks for KR - Knowledge representation using frames - Advanced knowledge representation techniques: Introduction - Conceptual dependency theory - Script structure - Cyc theory - Case grammars

Semantic web

Unit V: Expert Systems **9+3 Hours**

Expert system and applications: Introduction - Phases in building expert systems - Expert system versus traditional systems - Rule- based expert systems - Blackboard systems - Truth maintenance systems - Application of expert systems

List of shells and tools

Text Books

1. Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Fourth Edition, Pearson Education, 2020
2. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007

Reference Books

1. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
2. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
3. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013

Web Resources

1. https://nptel.ac.in

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. State the tasks which are associated with A.I.
2. Give an example of script-arithmetic problem.
3. Define Script
4. Recall Intelligence

L2: Understand

1. Explain Turing Test.
2. Explain the characteristics of production system.
3. Write A* algorithm in detail and explain its functionality to solve 8-puzzle problem.
4. Explain the semantic analysis phase done through case grammars in Natural Language understanding

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OE 20DSO03 Introduction to Big Data 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20DSO03.1	Identify the Knowledge of Big Data	-	L1, L2
20DSO03.2	Demonstrate Hadoop Framework for handling Big Data		L1, L2
20DSO03.3	Illustrate the Architectural Concepts of HDFS in Hadoop Ecosystem		L1, L2
20DSO03.4	Illustrate MapReduce Framework		L1, L2
20DSO03.5	Explain Spark & RDD		L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction to Big Data 9 Hours

What is Big Data, Evolution of Big Data, Types of Big Data, Sources of Big Data,5Vs of Big Data, Big Data Analytics, Big Data Applications, Google File System

Uses of Big Data in Retail Industry

Unit II: Introduction to Hadoop 9 Hours

Introducing Hadoop, Hadoop History, Hadoop-definition,Comparing SQL Databases and Hadoop, Hadoop Cluster, Hadoop Modes, Hadoop Features, The building blocks of Hadoop, NameNode, DataNode, Secondary NameNode, Job Tracker, Task Tracker

Hadoop Cluster

Unit III: Hadoop Ecosystem &HDFS 9 Hours

Hadoop and its Ecosystem, Hadoop Ecosystem Components, Hadoop Ecosystems Tools, Hadoop Distributed File System, Concept of Block in HDFS Architecture, Features of HDFS, HDFS Read and Write Mechanism, Rack awareness in HDFS, Introducing HBase, Hive, Pig

HDFS Read/Write

Unit IV: Introduction to MapReduce 9 Hours

Hadoop MapReduce Framework, Architecure, Phases, Mapreduce Job Types, Uses of MapReduce, Techniques to Optimize MapReduce Jobs, Limitations of MapReduce.

MapReduce Phases

Unit V: Introduction to Spark and RDD 9 Hours

Introduction to Spark, Dataframes - Dataframes role in Spark, Introduction to RDD, RDD operations, Creating RDDs, RDD Operations, Working with Key/Value Pairs.

Dataframes

Text Books

1. DT Editorial Services, “Big Data – Hadoop2, MapReduce, Hive, YARN, Pig, R and Data Visualization”, Black Book, DreamTech Press, 2019.
2. Sridhar Alla, “Big Data Analytics with Hadoop 3” - Packt Publications, 2018.
3. Holden Karau, Andy Konwinski, Patrick Wendell &MateiZaharia, “Learning Spark” O’reilly Publications, 2015.

Reference Books

1. Chuck Lam, “Hadoop in Action”, 1st Edition, MANNING Publications, 2016.
2. Balamurugan Balusamy, Nandhini Abirami R, SeifedineKadry, Amir H. Gandomi, “Big Data: Concepts, Technology, and Architecture” 1st Edition, Wiley Publications, 2021.
3. Thomas Erl, Wajid Khattak, Paul Buhler, “Big Data Fundamentals: Concepts, Drivers &Techniques”, 1st Edition, Pearson Publications, 2016.

Web Resources

1. https://hadoop.apache.org/
2. https://spark.apache.org/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Big Data.
2. List the characteristics of Big Data.
3. Define Hadoop.
4. What are Hadoop components?
5. What are RDD operations?

L2: Understand

1. Explain HDFS Read & Write mechanism.
2. Explain Rack awareness in HDFS.
3. Explain MapReduce workflow in detail.
4. Describe the working with Key/value pairs in RDDs.

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OE 20ECO03 Privacy and Security in IoT 3 0 0 3

Pre- Requisite Embedded Systems, IoT

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

Code	Course Outcomes	Mapping with POs	DoK
20ECO03.1	Understand the basic knowledge of cryptography, networking and web security	-	L1, L2, L3
20ECO03.2	Explain Architecture of IoT and its Applicaations		L1, L2, L3
20ECO03.3	Understand the Attacks against IoT system		L1, L2, L3
20ECO03.4	Explain Secure Bootstrapping for IoT Sytem		L1, L2, L3
20ECO03.5	Understand the IoT system security and Trust zone		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Cryptography and Network Securitys **09 Hours**

Cryptography , networking, Web Security: Secure socket layer and transport layer security, System Security: Intruders , Viruses and related threads, trusted systems.

Secure Shell (SSH)

Unit II: Introduction to IoT **09 Hours**

Internet of Things (IoT) ,Need of IoT,Applications,Architecture,Enabling technologies, IoT security and privacy.

IoT protocols

Unit III: Attacks against IoT **09 Hours**

Attacks against IoT system (hardware + software) ,Aattacks against IoT network protocols ,Attacks against industry IoT

Attacks against Web systems

Unit IV: Secure Bootstrapping for secure IoT system **09 Hours**

Ttrusted boot,Secure boot,TPM and its usages,Remote attestation ,tamper resistant-proof-response hardware and its usage

Bootatraping for IoT

Unit V: IoT System Security and TrustZone **09 Hours**

System security , TrustZone hardware architecture, TrustZone software architectures.

Web security

Text Books

1. Syed Rameem Zahra, Mohammad Ahsan Chishti ,"Security and Privacy in the Internet of Things " 1st Edtion ,Chapman & Hall, 2020
2. Fei Hu ,"Security and Privacy in Internet of Things (IoTs) Models, Algorithms, and Implementations", 1st Edition CRC Press

Reference Books

1. Ravi Ramakrishnan, Loveleen Gaur "Internet of Things Approach and Applicability in Manufacturing " , 1st Edtion ,Chapman & Hall, 2019
2. Vijay Madisetti, Arshdeep Bahga, Internet of Things, "A Hands on Approach", UniversityPress,2015

Web Resources

1. https://lss.at.ufl.edu/help.shtml
2. http://cms.uflib.ufl.edu/ask

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	40	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is cryptography ?
2. List the applications of IoT
3. What is Attacks against IoT system ?

L2: Understand

1. Explain about networking
2. Explain Enabling technologies of IoT
3. Explain Aattacks against IoT network protocols

L3: Apply

1. Discus about web security
2. Write about Architecture of IoT
3. Explain Attacks against industry IoT

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OE 20EEO03 Low-Cost Automation 3 0 0 3.0

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

Code	Course Outcomes	Mapping with PO's		DoK
		PO 1	PO 2	
20EEO03.1	Understanding automation of assembly lines	2	2	L2
20EEO03.2	Automation Using Hydraulic Systems	2	2	L2
20EEO03.3	Describe Automation Using Pneumatic Systems	2	2	L2
20EEO03.4	Explain Automation Using Electronic Systems	2	2	L2
20EEO03.5	Explain Assembly Automation	2	2	L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge				

UNIT I : Automation Of Assembly Lines **12 Hours**

Concept of automation-mechanization and automation - Concept of automation in industry - mechanization and automation - classification, balancing of assembly line using available algorithms -Transfer line-monitoring system (TLMS) using Line Status - Line efficiency - Buffer stock Simulation in assembly line

Transfer line-monitoring system (TLMS) using Line Status ,Line efficiency

UNIT II: Automation Using Hydraulic Systems **12 Hours**

Design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. - Selection of hydraulic fluid, practical case studied on hydraulic circuit design and performance analysis - Servo valves, electro hydraulic valves, proportional valves and their applications.

Servo valves, electro hydraulic valves, proportional valves and their applications.

UNIT-III: Automation Using Pneumatic Systems **12 Hours**

Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design. Pneumatic equipments - selection of components - design calculations -application - fault finding – hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

Low cost automation - Robotic circuits.

UNIT-IV : Automation Using Electronic Systems **12 Hours**

Introduction - various sensors – transducers - signal processing - servo systems - programming of microprocessors using 8085 instruction - programmable logic controllers

programming of microprocessors using 8085 instruction - programmable logic controllers

UNIT-V: Assembly Automation **12 Hours**

Types and configurations - Parts delivery at workstations - Various vibratory and non vibratory devices for feeding - hopper feeders, rotary disc feeder, centrifugal and orientation - Product design for automated assembly.

Product design for automated assembly.

Text Books

1. Anthony Esposito, "Fluid Power with applications", Prentice Hall international, 2009.
2. Mikell P Groover-"Automation, Production System and Computer Integrated Manufacturing", Prentice Hall Publications, 2007.

Reference Books

1. Kuo .B.C, “Automatic control systems”, Prentice Hall India, New Delhi, 2007.
2. Peter Rohner, “Industrial hydraulic control”, Wiley Edition, 1995.
3. Mujumdar.S.R, “Pneumatic System”, Tata McGraw Hill 2006.

Web References

1. https://nptel.ac.in/courses/112102011

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is automation?
2. What is Pneumatic fundamentals?
3. What is transducers?
4. What is switching circuits?
5. What is Buffer stock Simulation?

L2: Understand

1. Explain Line efficiency.
2. Explain Selection of hydraulic fluid.
3. Explain Pneumatic equipments
4. Explain programmable logic controllers.
5. Explain Parts delivery at workstations.

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OE	**20MEO03 Industrial Automation**	**3 0 0 3**

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

Code	Course Outcomes	Mapping with POs	DoK
20MEO03.1	Identify various concepts of automation and work part transport mechanisms.	-	L2
20MEO03.2	Illustrate the assembly systems and their applications.	-	L3
20MEO03.3	Describe the importance of handling systems and identification systems.	-	L3
20MEO03.4	Apply the concepts of part families and machine cells into various production systems	-	L2
20MEO03.5	Recognize the importance of automated inspection and to distinguish the various control systems	-	L2

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

Unit I: Manufacturing and Automation-Over View **11+1 Hours**

Production systems, Automation in production systems, Automation principles and strategies, Reasons for Automation, Manufacturing operations, Functions in Manufacturing, Information processing in Manufacturing plant layout, production facilities. Basic elements of an automated system, levels of automation; Hardware components for automation and process control, programmable logic controllers and personal computers. Automation for machining operations.

Unit II: Assembly Systems and Line Balancing **11+1 Hours**

Process-Assembly lines-manual single stations assembly, Manual assembly line, automated assembly system-Line balancing. Automated Assembly Systems – Design for automated assembly-Types of automated assembly systems-Parts feeding devices

Unit III: Automated Material Handling Systems **11+1 Hours**

Automated Material Handling and storage system: Material Handling and Identification Technologies: Material handling, equipment, Storage systems, performance and location strategies, Automated storage systems, AS/RS, types. Functions, material handling equipment-Conveyors, AGVS, Industrial Robots-Anatomy, Robot configurations, work volume-AS/RS. Automatic identification methods, Barcode technology, RFID

Unit IV: Manufacturing Cells **11+1 Hours**

Manufacturing Systems and Automated Production Lines: Manufacturing systems: components of a manufacturing system, Single station manufacturing cells, Automated production lines, Applications, Transfer lines

Unit V: Control Systems **11+1 Hours**

Control Systems-Process Industries Versus Discrete Manufacturing Industries, Continuous Versus Discrete Control: Continuous Control Systems, Discrete Control Systems, Computer Process Control: Control Requirements, Capabilities of Computer Control.

.

Text Books

1. Milkell P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Kindle Edition, Prentice Hall of India, 2016.

Reference Books

1. C. Roy, “Robots and Manufacturing Automation”, Asfahl John Wiley & Sons. 2. Krishna Kant, “Computer Based Industrial Control”, EEE-PHI, 2nd edition, 2010

Web References

1. www.nptel.iitm.ac.in
2. www.btechguru.com

Internal Assessment Pattern

Cognitive Level	InternalAssessment#1(%)	InternalAssessment#2(%)
L1	40	30
L2	40	30
L3	20	40
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is industrial automation?
2. What are the different costs included in industry in designing the particular product?
3. What is production volume?
4. List the categorization of production system.
5. What are the types of automation?
6. What are the features of Flexible Automation?
7. What is factory type of Integral automation?
8. Define process.
9. What are process variables?
10. What is meant by control system in automation?

L2: Understand

1. Explain Automation principles and strategies
2. Compare Manual assembly line, automated assembly system
3. Illustrate Material handling, equipment, Storage systems, performance and location strategies
4. Demonstrate components of a manufacturing system
5. Compare Continuous Control Systems, Discrete Control Systems

L3: Apply

1. Apply the basic elements of an automated system for industrial automation
2. Apply different types of automated assembly systems for moderate plants
3. Apply the Barcode technology, RFID for industrial automation
4. Discuss Automated production lines, Applications, Transfer lines
5. Design the capabilities of computer control systems

N Viswanadha Reddy

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Board of Studies (ME)

OE 20SHO02 Design Innovations 3 0 0 3

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

Code	Course Outcomes	DoK
20SHO02.1	Explain the fundamentals of Design Thinking and innovation	L2
20SHO02.2	Empathize and analyse model action plan	L2
20SHO02.3	Describe the principles of innovation and idea generation for product design	L2
20SHO02.4	Apply design thinking techniques for given tasks	L2
20SHO02.5	Apply the design thinking techniques for solving problems in various sectors	L3
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge		

Unit I: Introduction to Design Thinking 12 Hours

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry

Unit II: Design Thinking 12 Hours

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development

Unit III: Innovation 12 Hours

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity. Product Design: problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications

Unit IV: Design Thinking for Strategic Innovation 12 Hours

An exercise in design thinking – implementing design thinking for better process. Implement design thinking process in various Industries. Design thinking for Start-ups

Unit V: Design thinking in Various Sectors 12 Hours

Case studies in Information Technology, Finance, Education, Management and Retail sector. Analyze and Prototyping, Usability testing, Organizing and interpreting results

Case study learning outcomes:

1. Make use of practical design thinking methods in every stage of problem with the help of method templates
2. Apply design thinking to a problem in order to generate innovative and user-centric solutions
3. Empathize with end user and initiate a new working culture based on user-centric approach
4. Prototype and run usability tests for unbiased examination of the product in order to identify problem

Text Books

1. Tim Brown, Harper Bollins, Change by Design, 2009
2. David Lee, Design Thinking in the Class Room, Ulysses Press

Reference Books

1. Design the Future, Shrrutin N Shetty, Norton Press
2. William Lidwell, Kritina Holden, Jill Butter, Universal Principles of Design
3. Chesbrough H., The Era of Open Innovation
4. Chitale A. K. and Gupta R. C., Product Design and Manufacturing, Prentice Hall

Web References

1. https://nptel.ac.in/courses/110106124
2. https://onlinecourses.nptel.ac.in/noc19_mg60/preview
3. www.tutor2u.net/business/presentations/. /productlifecycle/default.html
4. https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf
5. www.bizfilings.com › Home › Marketing › Product Development
6. https://www.mindtools.com/brainstm.html
7. https://www.quicksprout.com/. /how-to-reverse-engineer-your-competit
8. www.vertabelo.com/blog/documentation/reverse-engineering https://support.microsoft.com/en-us/kb/273814
9. https://support.google.com/docs/answer/179740?hl=en
10. https://www.youtube.com/watch?v=2mjSDIBaUlM
11. thevirtualinstructor.com/foreshortening.html
12. https://dschool.stanford.edu/.../designresources/.../ModeGuideBOOTCAMP2010L.pdf
13. https://dschool.stanford.edu/use-our-methods/ 6.
14. https://www.interactiondesign.org/literature/article/5-stages-in-the-design-thinking-process 7.
15. https://www.nngroup.com/articles/design-thinking/ 9.
16. https://designthinkingforeducators.com/design-thinking/ 10.
17. www.designthinkingformobility.org/wp-content/.../10/NapkinPitch_Worksheet.pdf

Activity Based Learning (Suggested Activities in Class) / Practical Based learning

http://dschool.stanford.edu/dgift/

Internal Assessment Pattern

Cognitive Level	Internal Assessment # 1 (%)	Internal Assessment # 2 (%)
L1	20	20
L2	50	50
L3	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What do you mean by design thinking?
2. How design thinking works within a product development process

L2: Understand

1. Explain the elements and principles of design
2. Differentiate between creativity and innovation

L3: Apply

1. How design thinking helped financial sector to gain the consumer 'trust'?

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HS 20HSX04 Professional Ethics 3 0 0 3

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

Code	Course Outcomes	Mapping with POs		DoK
		PO8	PO12	
20HSX04.1	Understand the ethics and apply ethics in society	3	1	L1, L2, L3
20HSX04.2	Discuss the ethical issues related to engineering and realize the responsibilities and rights in the society	3	1	L1, L2, L3
20HSX04.3	Know the code of ethics and industrial standards	3	1	L1, L2, L3
20HSX04.4	Understand the rights and responsibilities of an employee at workplace	3	1	L1, L2, L3
20HSX04.5	Understand environmental ethics and CSR of companies	3	1	L1, L2, L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge				

Unit I: Introduction to Ethics 10 Hours

Need and importance of ethics, objectives, morals, values and ethics – integrity – work ethic – service learning – civic virtue – respect for others – living peacefully – honesty – courage – valuing time – cooperation – commitment – empathy – self-confidence.

Unit II: Engineering Ethics 10 Hours

Senses of 'engineering ethics' – variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – consensus and controversy – models of professional roles – self-interest – self respect - customs and religion.

Unit III: Engineering as Social Experimentation 10 Hours

Engineering as experimentation – engineers as responsible experimenters – codes of ethics – industrial standards - a balanced outlook on law.

Unit IV: Safety, Responsibilities and Rights 10 Hours

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis - Safety lessons from Challenge - Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights.

UnitV: Global Issues 10 Hours

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers–Moral Leadershi p– Code of Conduct– Corporate Social Responsibility.

Text Books

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003
2. Govindarajan M., Natarajan S., Senthil Kumar V. S., "EngineeringEthics", Prentice Hall of India, New Delhi, 2004

Reference Books

1. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for PersonalIntegrity and Social Responsibility" McGraw Hill Education, India Pvt. Ltd., New Delhi, 2013, Web References
2. World Community Service Centre, ' Value Education', Vethathiri Publications, Erode, 2011
3. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009

Web References

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	40	30
L3	40	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive

LevelsL1: Remember

1. List the human values and explain
2. Give an overview of Engineering Ethics
3. What is meant by Professional Responsibility?
4. What are the safety lessons one can learn in the Challenger case?
5. What are employee rights?
6. What is the engineer's role in weapon development?

L2: Understand

1. Illustrate the ethical aspect principle of caring or sharing, with an example
2. Explain various actions of an engineer leading to dishonesty
3. Justify the safety and other obligations of professional engineers
4. Discuss the problems with law in engineering practice
5. Explain in detail about the effect of information on risk assessments
6. Explain the role of engineers as 'expert witness' and 'advisors'

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MBA

SC **20AIS05 Datasets and Packages for ML Engineer** 1 0 2 2.0

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

Code	Course Outcomes	Mapping with POs		DoK
		PO4	PO5	
20AIS05.1	Interpret and use different types of data sets for computer vision problem	2	2	L1, L2, L3
20AIS05.2	Interpret and use different types of data sets for NLP applications	2	2	L1, L2, L3,
20AIS05.3	Interpret and use different types of data sets for prediction	2	2	L1, L2, L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge				
Study of Keras – TensorFlow – Implementation of Deep Neural Network models – Implementation of CNN – Implementation of RNN				
Resources				
1. https://data.mendeley.com/ 2. https://deepmind.com/ 3. https://www.kaggle.com 4. https://machinelearningmastery.com/				

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IN	**Summer Internship #2**	**0**	**0**	**0**	**1.5**

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

No.	Course Outcomes
1	Demonstrate the theoretical learning outcomes
2	Integrate theory and practice during graduation
3	Comprehend the industry practices in the relevant and allied field of study
4	Develop communication skills in terms of oral, written, and graphical communications
5	Develop problem solving skills
6	Develop work habits and teamwork in a multidisciplinary setting for a successful career after graduation
Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes	

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HO 20DSH01 Text Analytics

4 0 0 4.0

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

Code	Course Outcomes	Mappingwith POs	DoK
20DSH01.1	Understand the basic concepts of Natural Language Processing	-	L1, L2
20DSH01.2	Understand the text analytics framework.		L1, L2
20DSH01.3	Understand the concepts of Text Summarization.		L1, L2
20DSH01.4	Apply different techniques on Text Similarity		L1, L2, L3
20DSH01.5	Analysing the concepts of Semantic and Sentiment Analysis		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Natural Language Basics **9 hours**

Natural Language: Philosophy of Language,Acquisition and Usage, Language Syntax and Structure,Language Semantics, Natural Language Processing: Machine Translation,Speech Recognition Systems,Question Answering Systems,Contextual Recognition and Resolution,Text Categorization, Text Summarization,Text Analytics

Speech Recognition System versus Contextual Recognition system

Unit II: Text Classification **9hours**

Automated Text Classification,Classification Algorithms: Multinomial Naïve Bayes,Support Vector Machines, Evaluating Classification Models,Building a Multi-Class Classification System,Applications and Uses,Feature Extraction:Bag of Words Model, TF-IDF Mode, Advanced Word Vectorization Models, Understanding Text Syntax and Structure:Parts of Speech (POS) Tagging,Dependencybased Parsing,Shallow Parsing,Constituency-based Parsing

Decision tree

Unit III: Text Summarization **9 hours**

TextSummarization and Information Extraction:Text Normalization,Feature Extraction:Keyphrase Extraction,Weighted Tag–Based Phrase Extraction, Topic Modelling:Latent Semantic Indexing,Latent Dirichlet Allocation, Matrix Factorization, Automated Document Summarization, Latent Semantic Analysis

Non-negative Matrix Factorization

Unit IV: Text Similarity and Clustering9 hours

Information Retrieval (IR), Feature Engineering,Similarity Measures: Analysing Term Similarity,Manhattan Distance,Euclidean Distance, Analyzing Document Similarity: Cosine Distance and Similarity,Document Clustering:K-means Clustering,Ward's Agglomerative Hierarchical Clustering

Hamming Distance, K-NN Clustering

Unit V: Semantic and Sentiment Analysis9 hours

Semantic Analysis:Analyzing Lexical Semantic Relations,Word Sense Disambiguation,Named Entity Recognition, Propositional Logic,First Order Logic.Sentiment Analysis:Supervised Machine Learning Technique, Unsupervised Lexicon-based Techniques,Comparing Model Performances

Semantic Representations

Text Books

1. Dipanjan Sarkar, "Text Analytics with Python : A Practitioner's Guide to Natural Language", 2nd Edition,Apress, 2019
2. Akshay Kulkarni, Adarsha Shivananda, "Natural Language Processing Recipes: Unlocking Text Data with Machine Learning and Deep Learning Using Python", 1stEdition,Apress, 2019

Reference Books

1. Birds.,KlienE. and E.Loper, "Natural Language Processing with python", 1st Edition ,O 'Reilly Media Inc, 2009

Web Resources

1. https://www.tutorialspoint.com/big_data_analytics/text_analytics.htm
2. https://towardsdatascience.com/getting-started-with-text-analysis-in-python-ca13590eb4f7

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	35
L2	40	35
L3	20	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Natural Language Processing?
2. List out the three phases of transfer model in Machine Translation.
3. What is POS tagging?
4. Define k-means clustering
5. What do you mean by natural language and computer language?

L2: Understand

1. Explain the process of multi-document summarization.
2. Discuss about NLP and NLU
3. Describe twoevaluation metrics available for text classification
4. Explain text summarization and multiple document text summarization withneat diagram
5. Explain about Ward's Agglomerative Hierarchical Clustering

L3: Apply

1. Apply the naive Bayes classifier approach to Word Sense Disambiguation inNLP
2. Apply the significance of Word Sense Disambiguation in NLP
3. Evaluate the architecture of an Information Retrieval system with a neatdiagram

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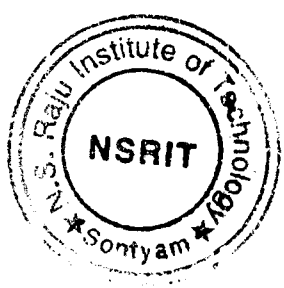

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HO 20AIH02 Advanced Data Structures and Algorithms 4 0 0 4

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

Code	Course Outcomes	Mapping with POs	DoK
20AIH02.1	Understand the importance of algorithms in computing	-	L1, L2
20AIH02.2	Design efficient algorithms for the given problem		L1, L2
20AIH02.3	Choose appropriate data structures for the given problem		L1, L2
20AIH02.4	Apply graph algorithms to solve real-time problems		L1, L2
20AIH02.5	Choose and implement appropriate design strategy		L1, L2
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit 1: Role of algorithms in Computing **9 hours**

Algorithms – Algorithms as a Technology- Insertion Sort – Analysing Algorithms – Designing Algorithms- Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions- Recurrences: The Substitution Method – The Recursion-Tree Method

Unit 2: Hierarchical Data Structures **9 hours**

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of Btrees – Basic operations on B-Trees – Deleting a key from a B-Tree- Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree

Unit 3: Algorithm Design Strategies **9 hours**

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence-Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy – Activity Selection Problem

Unit 4: String Matching algorithms **9 hours**

Naive String Matching, Rabin-Karp algorithm, matching with finite Automata, Knuth- Morris - Pratt algorithm

Unit 5: NP Complete and Hard **9 hours**

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducability – NP-Completeness Proofs – NP-Complete Problems

Text Books

1. Cormen T. H., Leiserson C.E., Rivest R. L. and Stein. C., “Introduction to Algorithms”, Third Edition, PHI

Reference Books

1. Ellis Horowitz, Satraj Sahni and Rajasekharam, “Fundamentals of Computer Algorithms”, Galgotia publications pvt. Ltd.
2. Parag Himanshu Dave, Himanshu Bhalchandra, “Design and Analysis Algorithms”, Dave Publisher, Pearson
3. Goodrich M. T., and Tomassia R., “Algorithm Design: Foundations, Analysis and Internet examples “, John Wiley and sons.

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

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HO 20AIH03 Game Theory 4 0 0 4

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

Code	Course Outcomes	Mapping with POs	DoK
20AIH03.1	Understand the fundamentals of game theory	-	L1, L2
20AIH03.2	Describe the principles of computer graphics		L1, L2
20AIH03.3	Explain the basic principles of game designing		L1, L2
20AIH03.4	Explain game engine design methods		L1, L2
20AIH03.5	Design and develop simple games		L1, L2, L3
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit 1: Introduction **9 hours**
Elements of Game Play – Artificial Intelligence – Getting Input from the Player - Sprite Programming – Sprite Animation - Multithreading – Importance of Game Design – Game Loop

Unit 2: 3D Graphics for Game Programming **9 hours**
Coordinate Systems, Ray Tracing, Modelling in Game Production, Vertex Processing, Rasterization, Fragment Processing and Output Merging, Illumination and Shaders, Parametric Curves and Surfaces

Unit 3: Game Design Principles **9 hours**
Character Development, Story Telling, Narration, Game Balancing, Core mechanics, Principles of level design, Genres of Games, Collision Detection, Game Logic, Game AI, Path Finding, Case study : Tetris

Unit 4: Game Engine Design **9 hours**
Renderers, Software Rendering, Hardware Rendering, and Controller Based Animation, Spatial Sorting, Level of Detail, Collision Detection, Standard Objects

Unit 5: Game Development **9 hours**
Developing 2D and 3D Interactive Games Using OpenGL, DirectX – Isometric and Tile Based Games, Puzzle Games, Single Player Games, Multi-Player Games

Text Books

1. David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, Second Edition, Morgan Kaufmann, 2010.
2. 2. Jung Hyun Han, “3D Graphics for Game Programming”, First Edition, Chapman and Hall/CRC, 2011

Reference Books

1. Jonathan S. Harbour, “Beginning Game Programming”, Course Technology, Third Edition PTR, 2009.
2. Ernest Adams and Andrew Rollings, “Fundamentals of Game Design”, Third Edition, Pearson Education, 2014.
3. Scott Rogers, “Level Up: The Guide to Great Video Game Design”, First Edition, Wiley, 2010.
4. Jim Thompson, Barnaby Berbank-Green, and Nic Cusworth, “Game Design: Principles, Practice, and Techniques - The Ultimate Guide for the Aspiring Game Designer”, First Edition, Wiley, 2008

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

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HO 20DSH04 Recommender Systems 4 0 0 4.0

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

Code	Course Outcomes
20DSH04.1	Design recommendation system for a particular application domain.
20DSH04.2	Evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy,diversity, product coverage, and serendipity.
20DSH04.3	Explain User-based recommendation, knowledge-based recommender system.
20DSH04.4	Define Opportunities for hybridization, Monolithic hybridization.
20DSH05.5	Identify hybridization design, Weighted, Switching, Mixed, Pipelined hybridization.
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos	
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge	

Unit I:Introduction **9 + 3 hours**

Overview of Information Retrieval, Retrieval Models, Search andFiltering Techniques: Relevance Feedback, User Profiles, Recommender system functions,Matrix operations, covariance matrices, Understanding ratings, Applications of recommendationsystems, Issues with recommender system.

Information Retrieval

Unit II: Content-based Filtering **9 + 3 hours**

High level architecture of content-based systems,Advantages and drawbacks of content-based filtering, Item profiles, Discovering features ofdocuments, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.

Pre-processing

Unit III: Collaborative Filtering **9+ 3 hours**

User-based recommendation, Item-based recommendation,Model based approaches, Matrix factorization, Attacks on collaborative recommender systems.Types of Recommender Systems: Recommender systems in personalized web searchknowledge-based recommender system, Social tagging recommender systems, Trust-centricrecommendations, Group recommender systems

Matrix factorization

Unit IV: Hybrid Approaches **9+ 3 hours**

opportunities for hybridization, Monolithic hybridizationdesign: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted,Switching, Mixed, Pipelined hybridization design: Cascade, Meta-level, Limitations ofhybridization strategies.

Feature augmentation

Unit V: Evaluating Recommender System **9+ 3 hours**

Introduction, General properties of evaluationresearch, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability,serendipity, Evaluation on historical datasets, Offline evaluations

Evaluation on historical datasets

Text Books

1.Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction,Cambridge University Press (2011), 1st ed.
2. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer (2016), 1st ed.

Reference Books

1.Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook,Springer(2011), 1st ed.

2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems ForLearning, Springer (2013), 1st ed.

Web Resources

1. www.geeksforgeeks.com
2. www.sanfoundary.com

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HO 20AIH05 Video Analytics 4 0 0 4.0

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

Code	Course Outcomes
20AIH05.1	Understand the need for video Analytics
20AIH05.2	Understand the basic configuration
20AIH05.3	Understand the functional block of a video analytics
20AIH05.4	Get exposed to the various applications of video analytics
20AIH05.5	Design custom made video analytics system for the given target application
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos	
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge	

Unit I: Video Analytic components **9 hours**

Need for Video Analytics-Overview of video Analytics- Foreground extraction- Feature extraction- classifier - Preprocessing-edge detection- smoothening- Feature space-PCA-FLD-SIFT features

Edge detection

Unit II: foreground extraction **9hours**

Background estimation-Averaging-Gaussian Mixture Model-Optical Flow based-Image Segmentation-Region growing-Region splitting -Morphological operations-erosion-Dilation Tracking in a multiple camera environment

Morphological operations

Unit III: Classifiers **9 hours**

Neural networks (back propagation)- Deep learning networks-Fuzzy classifier-Bayesian classifier-HMM based classifier

Fuzzy classifier

Unit IV: Video analytic for security **9 hours**

Abandoned object detection- human behavioral analysis -human action recognition- perimeter security- crowd analysis and prediction of crowd congestion

Human action recognition

Unit V: Video Analytics for business intelligence and Traffic Monitiring and assistance **9 hours**

Customer behavior analysis- people counting- Traffic rule violation detection- traffic congestion identification for route planning-driver assistance – lane change warning

Traffic congestion identification

Text Books

1. Graeme A. Jones (Editor), Nikos Paragios (Editor), Carlo S. Regazzoni (Editor) Video-Based Surveillance Systems: Computer Vision and Distributed Processing , Kluwer academic publisher, 2001
2. Caifeng Shan (Editor), Fatih Porikli (Editor), Tao Xiang (Editor), Shaogang Gong (Editor) Video Analytics for Business Intelligence, Springer, 2012

Reference Books

1. Nilanjan Dey (Editor), Amira Ashour (Editor) and Suvojit Acharjee (Editor), Applied Video Processing in Surveillance and Monitoring Systems (IGI global) 2016

2. Zhihao Chen (Author), Ye Yang (Author), Jingyu Xue (Author), Liping Ye (Author), Feng Guo (Author), The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite, CreateSpace Independent Publishing Platform, 2014

Web Resources

1. https://docs.opencv.org/3.4/d8/d83/tutorial_py_grabcut.html
2. https://www.sciencedirect.com/topics/computer-science/video-analytics
3. https://www.sciencedirect.com/topics/computer-science/video-analytics

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	35
L2	40	35
L3	20	30
Total (%)	100	100

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HO 20AIH06 Game Programming 4 0 0 4

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

Code	Course Outcomes
20AIH06.1	Explain the game logic and game theory
20AIH06.2	Discuss the concepts of Game design and development
20AIH06.3	Explain the Core architectures of Game Programming
20AIH06.4	Explain the Concepts of software and hardware rendering
20AIH06.5	Create interactive Games

Unit 1: Introduction **9 hours**

Introduction, Game Logic, Game AI, Path Finding, Game Theory, Character development, Story Telling, Narration, Game Balancing, Core mechanics, Principles of level design, Genres of Games, Collision Detection

Unit 2: 3D Graphics for Game Programming **9 hours**

Coordinate Systems, Ray Tracing, Modelling in Game Production, Vertex Processing, Rasterization, Fragment Processing and Output Merging, Illumination and Shaders, Parametric Curves and Surfaces

Unit 3: Game Engine Design **9 hours**

Game engine architecture, Engine support systems, Resources and File systems, Game loop and real-time simulation, Human Interface devices, Collision and rigid body dynamics, Game profiling

Unit 4: Game Programming **9 hours**

Renderers, Software Rendering, Hardware Rendering, and Controller Based Animation, Spatial Sorting, Level of Detail, Collision Detection, Standard Objects

Unit 5: Game Development **9 hours**

Developing 2D and 3D Interactive Games Using OpenGL, DirectX – Isometric and Tile Based Games, Puzzle Games, Single Player Games, Multi-Player Games

Text Books

1. Mike Mc Shaffrfy and David Graham, “Game Coding Complete”, Fourth Edition, Cengage Learning, PTR, 2012.
2. Jason Gregory, “Game Engine Architecture”, CRC Press / A K Peters, 2009.
3. David H. Eberly, “3D Game Engine Design, Second Edition: A Practical Approach to Real-Time Computer Graphics” 2 nd Editions, Morgan Kaufmann, 2006.

Reference Books

1. Ernest Adams and Andrew Rollings, “Fundamentals of Game Design”, 2 nd Edition Prentice Hall / New Riders, 2009.
2. Eric Lengyel, “Mathematics for 3D Game Programming and Computer Graphics”, 3 rd Edition, Course Technology PTR, 2011.
3. Jesse Schell, The Art of Game Design: A book of lenses, 1 st Edition, CRC Press, 2008.

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

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HO 20DSH07 Data Analysis with MATLAB 4 0 0 4.0

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

Code	Course Outcomes
20DSH07.1	Identify how to prepare the data for analysis
20DSH07.2	Describelinear regression analysis
20DSH07.3	Apply the Fourier analysis and calculate FFT
20DSH07.4	Illustrate about time series objects and methods
20DSH07.5	Demonstrate time series tools
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos	
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge	

Unit I Preparing Data for Analysis: **9 hours**

MATLAB for Data Analysis: Introduction, Calculations on Vectors and Matrices, MATLAB GUIs for Data Analysis Related Toolboxes, Importing and Exporting Data, Plotting Data: Introduction, Example-Loading and Plotting Data, Removing and Interpolating Missing Values: Representing Missing Data Values, Calculating with NaNs, ,Removing NaNs from the Data, Interpolating Missing Data, Removing Outliers

Example-Using MATLAB Data Statistics

Unit II Linear Regression Analysis: **9 hours**

Linear Regression: Introduction, Residuals and Goodness of Fit, When to Use the Curve Fitting Toolbox, Correlation Analysis: Introduction, Covariance, Correlation Coefficients, Interactive Fitting: The Basic Fitting GUI, Preparing for Basic Fitting, Opening the Basic Fitting GUI, Programmatic Fitting: MATLAB Functions for Polynomial Models

Example-Data Fitting Using MATLAB Functions

Unit III Fourier Analysis: : **9 hours**

Fourier Analysis-Introduction: Function Summary, Calculating Fourier Transforms, Example-Using FFT to Calculate Sunspot, Magnitude and Phase of Transformed Data

FFT Length versus Performance

Unit IV Time Series Objects and Methods: **9 hours**

Time Series Objects: Introduction: Time Series Data Sample ,Example — Using Time Series Objects and Methods: Creating Time Series Objects, Viewing Time Series Objects, Modifying Time Series Units and Interpolation Method, Defining Events, Time Series Methods**:** General Methods, Data and Time Manipulation Methods, Event Methods

Statistical Methods

Unit V Time Series Tools: **9 hours**

Introduction **:**Opening Time Series Tools, Getting Help, Time Series Tools Window **,** Time Series Tools Workflow, Generating Reusable M-Code, Importing and Exporting Data: Types of Data You Can Import, How to Import Data , Changes to Data Representation During Import,Importing Data with Missing Values, Plotting Time Series :Types of Plots in Time Series Tools, Creating a Plot

Histograms, XY Plots

Text Books

1. " Matlab 7 Data Analysis",The MathWorks 2007

Reference Books

1. Irfan Turk, "Practical MATLAB", Apress 2019
2. ArashKarimpour,"Fundamentals of Data Science with MATLAB", ArashKarimpour 2020

Web Resources

1. https://in.mathworks.com/videos/matlab-for-data-analytics-1525861909298.html

2. https://in.mathworks.com/products/matlab/data-analysis.html
3. https://in.mathworks.com/videos/data-analytics-with-matlab-99066.html?s_tid=vid_pers_recs

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	35	40
L3	35	40
Total (%)	100	100

L1: Remembering

1. Give steps to import and export data inMATLAB?
2. How do you perform operations on vectors in MATLAB?
3. How do you represent missing values in MATLAB?
4. Explain classical time series forecasting method Moving Average

L2: Understanding

1. How MATLAB is used in data analytics?
2. Discuss briefly about removing outliers and filtering data with an example
3. Explain how FFT can be used to calculate sunspot
4. How to create time series objects in MATLAB?
5. Describe in detail about time series methods

L3: Applying

1. How do you analyze time series data in MATLAB?
2. Consider the following sample of ordered pairs (x,y) where y = the purity of oxygen produced in a chemical distillation process, and x = the percentage of hydrocarbons that are present in the main condenser of the distillation unit.

Observation Number	Hydrocarbon Level x (in %)	Purity y (in %)	Observation Number	Hydrocarbon Level x (in %)	Purity y (in %)
1	0.99	90.01	11	1.19	93.65
2	1.02	89.05	12	1.15	92.52
3	1.15	91.43	13	0.98	90.56
4	1.29	93.74	14	1.01	89.54
5	1.46	96.73	15	1.11	89.85
6	1.36	94.45	16	1.2	90.39
7	0.87	87.59	17	1.26	93.25
8	1.23	91.77	18	1.32	93.41
9	1.55	99.42	19	1.43	94.98
10	1.4	93.65	20	0.95	87.33

(i) Enter above data either as a single 20x2 matrix or as two 20x1 vectors. Be sure to preserve the ordering of the pairs
(ii)Create a scatterplot of this data. Label both the x and y axis and title the graph “scatterplot”. Labels can be added on the graph itself.
(iii) Determine the correlation coefficient.

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HO 20AIH08 Natural Language Preocessing 4 0 0 4

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

Code	Course Outcomes
20AIH08.1	Understand of the field of natural language processing.
20AIH08.2	model linguistic phenomena with formal grammars
20AIH08.3	Design, implement and test algorithms for NLP problems
20AIH08.4	Understand the mathematical and linguistic foundations underlying approaches to the various areas in NLP
20AIH08.5	Apply NLP techniques to design real world NLP applications

UNIT I INTRODUCTION
Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance

UNIT II WORD LEVEL ANALYSIS
Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT III SYNTACTIC ANALYSIS
Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures

UNIT IV SEMANTICS AND PRAGMATICS
Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

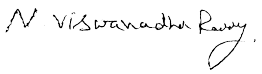
UNIT V DISCOURSE ANALYSIS AND LEXICAL Resources
Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC)

Reference Books:

1. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press (2008).
2. Daniel M Bikel and Imed Zitouni Multilingual natural language processing applications Pearson, 2013
3. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor) The Handbook of Computational Linguistics and Natural Language Processing ISBN: 978-1-118-
4. Steven Bird, Ewan Klein, Natural Language Processing with Python, OReilly
5. Brian Neil Levine, An Introduction to R Programming
6. Niel J le Roux, Sugnet Lubbe, A step by step tutorial : An introduction into R application and programming

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100



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HO 20AIH09 3D Graphics and Animation 4 0 0 4

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

Code	Course Outcomes
20AIH09.1	Design three-dimensional graphics
20AIH09.2	Apply three dimensional transformations
20AIH09.3	Design animation sequences
20AIH09.4	Explain the computer graphics realism
20AIH09.5	State the applications of animation

Unit 1: Introduction to 3D Graphics **9 hours**
Three dimensional Concepts, Three Dimensional Object Representations – Polygon Surfaces- Polygon Tables- Plane Equations - Polygon Meshes, Curved Lines and Surfaces, Quadratic Surfaces, Blobby Objects

Unit 2: 3D Transformation and Viewing **9 hours**
Three Dimensional Geometric and Modeling Transformations – Translation, Rotation, Scaling, Composite Transformations; Three-Dimensional Viewing – Viewing Pipeline, Viewing Coordinates, Projections, Clipping; Visible Surface Detection Methods

Unit 3: Animation **9 hours**
Design of Animation Sequence – Animation Function – Raster Animation – Key Frame Systems – Motion Specification – Morphing – Tweening – Types of Animation – Fractals – Tools for Animation Creation

Unit 4: Animations and Realism **9 hours**
Tiling the plane – Recursively Defined Curves – Koch curves – C curves – Dragons – Space filling Curves – fractals – Grammar Based Models – Fractals – Turtle Graphics – Ray Tracing

Unit 5: Applications of Animation **9 hours**
3D Computer Animation for Applications Such as Games and Virtual Environments – Character Animation Techniques Such as Synthesizing their Body Movements – Facial Expressions and Skin Movements – Behaviors in Crowded Scenes.

Text Books

1. Donald Hearn and Pauline Baker M, ―Computer Graphics", Prentice Hall, New Delhi, 2007
2. F.S. Hill, Jr., Stephen M. Kelley, Jr., "Computer graphics using OpenGL", Pearson Prentice Hall, Third Edition, 2007

Reference Books

1. Alan Watt, "3D Computer Graphics", Third Edition, Pearson Addison Wesley,2000
2. Alan Watt, Mark Watt, "Advanced Animation and Rendering Techniques: Theory and Practice", Addison Wesley, 1992.

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	30	50
L3	30	10
Total (%)	100	100

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HO **20DSH10 Data Preparing and Cleaning** **4 0 0 4.0**

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

Code	Course Outcomes
20DSH10.1	Describe the basic concepts of Data Preparation
20DSH10.2	Identify Data Preparation Techniques
20DSH10.3	Able to Handle Messy Data
20DSH10.4	InterpretFeature Selection on different types of Data
20DSH10.5	Able to apply Data Transformation & Data Reduction Techniques
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos	
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge	

Unit I: Data Preparation Basics **9 hours**

Introduction to Data Preparation, Choosing correct Data Preparation Techniques, Importance of Data Preparation, Preparation of Raw Data, Predictive Modeling, Real-time & Scalability Issues in Data Preparation

Feature Engineering

Unit II: Data Preparation Techniques **9hours**

Data Preparation Techniques, Common Data Preparation Tasks, Data Cleaning, Feature Selection, Data Transforms, Feature Engineering, Dimensionality Reduction, Data Preparation without Leakage, Problems with Naïve Data Preparation, Data Preparation with Train & Test Sets, Data Preparation with Cross-Validation

Cross Validation

Unit III: Data Cleaning **9 hours**

Data Cleaning Introduction, Messy Datasets, Identify & Delete Columns that contains a single value, Consider Columns that have very few values, Removing Columns that have low variance, Identify & remove rows that contain a duplicate value, Outlier Identification & Removal, Handling Missing Data, KNN Imputation

Handling Missing Data

Unit IV: Feature Selection **9 hours**

Feature Selection Introduction, Statistics for Feature Selection, Feature Selection for any Datatype, Selecting Categorical Input Features, Selecting Numerical Input Features, Selecting Features for Numerical Output

Feature Selection for any Datatypes

Unit V: Data Transformation& Dimensionality Reduction **9 hours**

Scaling Numerical Data, Scaling Data with Outliers, Encoding Categorical Data, Transforming Numerical Data to Categorical Data, Problems with many Input Variables, Dimensionality Reduction, Techniques for Dimensionality Reduction, PCA Dimensionality Reduction

Dimensionality Reduction

Text Books

1. Jason Brownlee, “Data Preparation for Machine Learning- Data Cleaning, Feature Selection & Data Transforms in Python”, Edition v1.1, Machine Learning Mastery Publications, 2020

Reference Books

1. Tamraparni Dasu, Theodore Johnson, “Exploratory Data Mining & Data Cleaning”, Edition 1, Wiley Publications, 2003.

Web Resources

1. https://www.techtarget.com/searchbusinessanalytics/definition/data-preparation
2. https://www.techtarget.com/searchdatamanagement/definition/data-scrubbing

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HO 20AIH11 Digital Forensics 4 0 0 4

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

Code	Course Outcomes
20AIH11.1	Understand the essential elements of forensic analysis
20AIH11.2	Describe the security issues in forensic analysis
20AIH11.3	Explain the intrusion detection system
20AIH11.4	Understand the methods of preparing forensic reports
20AIH11.5	Explore open source tools available

Unit 1
Introduction to Digital Forensics and Digital Evidences Digital Forensic ,Rules for Digital Forensic The Need for Digital Forensics, Types of Digital Forensics, Ethics in Digital Forensics, Digital Evidences : Types and characteristics and challenges for Evidence Handling 6 CO2

Unit II
Introduction to Computer Security Incident Goals of Incident response, Incident Response Methodology, Formulating Response Strategy, IR Process – Initial Response, Investigation, Remediation, Tracking of Significant, Investigative Information, Reporting Pre Incident Preparation, Incident Detection and Characterization. Live Data Collection : Live Data Collection on Microsoft Windows Systems: Live Data 11 CO3 Collection on Unix-Based Systems

Unit III
Introduction to Intrusion Detection systems, Types of IDS Understanding Network intrusion and attacks , Analyzing Network Traffic, Collecting Network based evidence, Evidence Handling. Investigating Routers

Unit IV
Forensic Investigation Report :Goals of Report, Layout of an Report and Forensic Tools Investigative Report, Guidelines for Writing a Report, sample for writing a forensic report . Computer Forensic Tools : need and types of computer forensic tools, task performed by computer forensic tools

Unit V
Study of open source Tools like SFIT, Autopsy etc. to acquire, search, analyze and store digital evidence 7 CO6

Reference Books:

1. Clint P Garrison Digital Forensics for Network, Internet, and Cloud Computing A forensic evidence guide for moving targets and data , Syngress Publishing, Inc. 2010
2. Bill Nelson,Amelia Phillips,Christopher Steuart, Guide to Computer Forensics and Investigations . Cengage Learning, 2014
3. Debra Littlejohn Shinder Michael Cross Scene of the Cybercrime: Computer Forensics Handbook, 2nd Edition Syngress Publishing, Inc.2008.
4. Marjie T. Britz, Computer Forensics and Cyber Crime, Pearson, Third Edition.

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

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HO 20AIH12 Augmented Reality and Virtual Reality 4 0 0 4

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

Code	Course Outcomes
20AIH12.1	Demonstrate the concepts of augmented reality
20AIH12.2	Identify augmented reality contents and interactions
20AIH12.3	Explain the components of virtual reality
20AIH12.4	Explain the modeling tools of virtual reality
20AIH12.5	State the applications of virtual and augmented reality

Unit 1: Introduction to Augmented Reality **9 hours**
Introduction, The Relationship Between Augmented Reality and Other Technologies-Media, Applications of Augmented Reality Augmented Reality, Ingredients of an Augmented Reality Experience

Unit 2: Augmented Reality Content and Interaction **9 hours**
Content – Creating visual content – 3D objects – 2D images – Visual elements, Interaction in Augmented Reality –Interaction in Real World – Manipulation – Navigation –Multi Person Augmented Reality Application

Unit 3: Introduction to Virtual reality **9 hours**
The three I's of virtual reality - Commercial VR technology and the Five Classic Components of a VR System - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional Position Trackers, Navigation and Manipulation-Interfaces and Gesture interfaces-Output Devices: Graphics Displays-Sound Displays & Haptic feedback.

Unit 4: VR Development Process **9 hours**
Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.

Unit 5: Applications **9 hours**
Medical applications-Military Applications - Robotics Applications- Advanced Real Time Tracking- Other applications- Games, Movies, Simulations, Therapy

Text Books

1. C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008
2. *Jason Jerald, The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA., 2015*

Reference Books

1. Dieter Schmalstieg & Tobias Hollerer, Augmented Reality: Principles and Practice (Usability) by Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016.
2. Steve Aukstakalnis, Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability), Addison-Wesley Professional; 1 edition, 2016.

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

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MI 20CSM01 E-Commerce 3 0 0 3.0

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

Code	Course Outcomes	Mapping withPOs	DoK
20CSM01.1	Explain the role of new internet economy in E-Commerce	-	L1,L2
20CSM01.2	Explain the architecture of World Wide Web		L1,L2
20CSM01.3	Describe the E-Commerce process models and E-Payment System		L1,L2
20CSM01.4	Illustrate the network models in customization and internal commerce		L1,L2
20CSM01.5	Explain the E-commerce models in advertising and marketing of business		L1,L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit I:Introduction **9 hours**

Electronic Commerce- Architectural Frame work, anatomy of E-commerce applications, E-Commerce consumer applications, E-commerce organization applications

E-Commerce and media convergence

Unit II: World Wide Web & Network security **9 hours**

Client-Server Network security, World Wide Web(WWW) as the architecture, Web background: Hypertext Publishing, Technologybehind the web, Security and the web

Emerging Client-Server Security Threats

Unit III: E-Payment Systems **9 hours**

Consumer Oriented Electronic Commerce- Mercantile Process models, E-Payment systems- Digital Token-Based, smart cards, credit cards, risk and E-Payment systems.

Designing E-Payment Systems

Unit IV:EDI Implementation and Intraorganizational E-Commerce **9 hours**

Standardization and EDI, EDI Software implementation, Value added networks, Intra organizational E-Commerce- Workflow Automation and Coordination, Customization and Internal Commerce, Supply chain management (SCM).

EDI Envelope for Message Transport

Unit V: Advertising and Marketing on the Internet **9 hours**

Corporate Digital Library- Document Library, digital document types, corporate data warehouses, Advertising and marketing-Information based marketing, Advertising on Internet, online marketing process, market research.

Charting the Online Marketing Process

Text Books

1. Ravi Kalakota and Andrew B. Whinston., "Frontiers of electronic commerce", First Edition, Pearson Education ,2011
2. Jaiswal S.," E-Commerce", Second Edition,Galgotia,2010

Reference Books

1. Dave Chaffey., "E-business & E- commerece management- strategy, implementation and Practice", Fifth edition, Pearson Education, 2015.
2. Kenneth C, "E-Commerce: Business.Technology.Society", First Edition, Pearson Education, 2008

Web References

1. https://www.techopedia.com/definition/18226/corporate-data-warehouse-cdw
2. http://ecmrce.blogspot.com
3. http://data.conferenceworld.in

Internal Assessment Pattern

CognitiveLevel	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive LevelsL1: Remember

1. Write any four important E-Commerce organization Applications
2. Write about any four requirements of EDI
3. Write short notes on Risks in E-Payment systems
4. Write short notes on Market research
5. What are the factors for design of electronic payment system?

L2: Understand

1. How enterprise resource planning and supply chain management software differs in their goals and implementations
2. How product or service customization is adopted in intraorganizational commerce?
3. Explain Merchantile's model from the Merchant's perceptive
4. Explain in detail about E-Payment systems
5. Discuss about mercantile transaction using credit cards

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MI 20MEM01 Biomaterials **3 0 0 3**

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

Code	Course Outcomes	Mapping withPOs	DoK
20MEM01.1	Classify various biomaterials	-	L1,L2
20MEM01.2	Identify the Metallic implant materials		L1,L2, L3
20MEM01.3	Describe the failure modes of implant materials		L1,L2
20MEM01.4	Apply Ceramic implant materials		L1,L2, L3
20MEM01.5	Develop the Biocompatibility & Toxicological properties in of biomaterials		L1,L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

Unit I: Introduction **09 Hours**

Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Biological responses (extra and intra- vascular system). Surface properties of materials.

physical properties of materials, mechanical properties.

Unit II: Metallic implant materials **09 Hours**

Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress-corrosion cracking. Host tissue reaction with bio metal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant: Orthopedic implants, Dental implants. Soft tissue replacement implants: Percutaneous and skin implants.

Vascular implants, Heart valve implants-Tailor made composite in medium.

Unit III: Polymeric implant materials **09 Hours**

Polyolefin's, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetyls. (Classification according to thermo sets, thermoplastics and elastomers).Viscoelastic behavior: creep-recovery, stress-relaxation, strain rate sensitivity. Importance of molecular structure, hydrophilic and hydrophobic surface properties, migration of additives (processing aids), aging and environmental stress cracking. Physiochemical characteristics of biopolymers. Biodegradable polymers for medical purposes, Biopolymers in controlled release systems.

Synthetic polymeric membranes and their biological applications.

Unit IV: Ceramic implant materials **09 Hours**

Definition of bio ceramics. Common types of bio-ceramics: Aluminum oxides, Glass ceramics, Carbons. Bio resorbable and bioactive ceramics. Importance of wear resistance and low fracture toughness. Host tissue reactions: importance of interfacial tissue reaction (e.g. ceramic/bone tissue reaction).

Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out).

Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions.

Unit V: Biocompatibility & Toxicological screening of biomaterials **09 Hours**

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situimplantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization.

carcinogenicity, mutagenicity and special tests.

Text Books

1. Biomaterials Science: An Introduction to Materials in Medicine, By Buddy D. Ratner, et. al. AcademicPress, San Diego, 1996.
2. Sujata V. Bhat, Biomaterials, Narosa Publishing House, 2002.
3. J B Park, Biomaterials – Science and Engineering, Plenum Press, 1984.
4. Comprehensive structural interity, Vol.9: Bioengineering Editors: Mithe, Ritchie and Karihalo, ElsevierAcademic Press, 2003.

Reference Text books

1. Biomaterials Science: An introduction to Materials in Medicine, Edited by Ratner, Hoffman, Schoet and Lemons, Second Edition: Elsevier Academic Press, 2004.

Web References

1. https://nptel.ac.in/content/syllabus_pdf/113104009.pdf
2. RBM603 BIOMATERIALS Syllabus free download
3. UP Technical University BE BM Syllabus
4. RBM603 Syllabus, BM Unit-wise Syllabus – BE 6th Semester

Internal Assessment Pattern

CognitiveLevel	InternalAssessment#1(%)	InternalAssessment#2(%)
L1	10	10
L2	30	30
L3	60	60
Total(%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Write about classification of biomaterials?
2. State the applications of biomaterials?
3. List the advantages and disadvantages biomaterials?
4. Write about Effects of physiological fluid on the properties of biomaterials?
5. Define Importance of stress-corrosion cracking?

L2: Understand

1. Surface properties of materials
2. Comparison of properties of some common biomaterials
3. Corrosion behavior and the importance of passive films for tissue adhesion
4. Visco elastic behavior: creep-recovery, stress-relaxation, strain rate sensitivity

L3: Apply

1. Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibers, fibers pull out). Polymers filled with osteogenic fillers (e.g. hydroxyapatite). Host tissue reactions

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MI **20EEM01 Basic Control Systems** **3 0 0 3**

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

Code	Course Outcomes	Mapping with PO's	DoK
20EEM01.1	Determine time response specifications of second order systems		L1-L2
20EEM01.2	Determine error Constants for different types of input signals		L1-L2
20EEM01.3	Understand various levels of illuminosity produced by differentilluminating sources.		L1-L3
20EEM01.4	Design different lighting systems by taking inputs and constraints in view for different layouts.		L1-L3
20EEM01.5	Understand the speed/time characteristics of different types oftraction motors.		L1-L3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge			

Unit I: Introduction to Control Systems **09 Hours**

Classification of control systems, open loop and closed loop control systems and their differences, Feedback characteristics, transfer function of linear system, differential equations of electrical networks, translational and rotational mechanical systems

Differences between Closed loop and Open Loop Control Systems

Unit II: Time Response Analysis **09 Hours**

Standard test signals time response of first and second order systems time domain specifications, steady state errors and error constants

Definitions of Time domain Specifications

Unit III: Stability **09 Hours**

The concept of stability, Routh's stability criteria – Limitations of Routh's stability, effect of addition of poles and zeros, introduction to root locus.

Basics of Routh's Criteria

Unit IV: Frequency response **09 Hours**

Introduction to frequency domain specifications, basics of bode plot, Phase margin, Gain Margin. Introduction to Polar plots, its phase margin and gain margin. Introduction to Nyquist stability criteria

Definitions of Frequency domain Specifications

Unit V: State Space Analysis **09 Hours**

Concepts of state, state variables and state model, state space representation of transfer function, diagonalization, solving the time invariant state equations, State Transition Matrix and its Properties, concepts of controllability and observability.

Basics of Matrix operations

Text Books

1. I.J.Nagarath and M.Gopal, "Control Systems Engineering", Newage International Publications, 5th Edition, 2014.
2. Kotsuhiko Ogata, Modern Control Engineering, Prentice Hall of India, 5th edition, 2014

Reference Books

1. S.Palani, "Control Systems Engineering", Tata Mc Graw Hill Publications, 3rd Edition, 2012.

Web References

1. https://nptel.ac.in/courses/107/106/107106081/
2. https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1(%)	Internal Assessment #2(%)
L1	30	30
L2	40	30
L3	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive LevelsL1: Remember

1. What are the various standard test signals?
2. Define concept of observability.
3. What is state transition matrix? Write its properties.

L2: Understand

1. Explain how Routh Hurwitz criterion can be used to determine the absolute stability of a system
2. Explain about feedback characteristics.
3. Describe the effect of addition of poles and zeros.

L3: Apply

1. The characteristic polynomial of a system is.$s^5+2s^6+3s^5+s^4+5s^3+2s^2+s+7=0$. Determine the the stability of thesystem using Routh's stability criteria.
2. Determine range of K for stability of unit feedback system whose open loop transfer function is G(s) = K/s(s+1)(s+2).
3. For a system having G(s) = 25/s(s+10) and units negative feedback, find its time response specifications.

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Board of Studies (EEE)

MI 20ECM01 Semiconductor Devices and Circuits 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20ECM01.1	Classify different types of semiconductors with energy band diagrams	-	L1, L2
20ECM01.2	Explain the operation and characteristics of PN junction diode and special diodes		L1, L2
20ECM01.3	Classify and Analyze different types of rectifiers		L1, L2, L3
20ECM01.4	Demonstrate the flow of current in different configurations of the transistor & the concept of DC biasing and transistor stabilization		L1, L2, L3
20ECM01.5	Analyze and Design the small signal low frequency amplifiers		L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Semiconductor Physics **09 Hours**

Atomic structure, Neil Bohr's atomic theory, definition of conductors, insulators and semiconductors, energy level diagrams. Semiconductors: Classification and types, intrinsic and extrinsic, P-type and N-type semiconductors, majority and minority carriers, recombination, effect of temperature.

Fermi Level, Charge Densities in Semiconductors

Unit II: Semiconductor Diodes and Special Diodes **09 Hours**

Formation of depletion region, barrier potential, reverse breakdowns, PN junction as diode, symbol, biasing modes, V-I characteristics, diode current equation, effect of temperature on diode current, ideal diode. Special Diodes: Zener diode, Photo Diode, LED - Working, characteristics and applications.

Diode Switching times, Varactor diode, Tunnel Diode

Unit III: Rectifiers and Filters **09 Hours**

Half wave Rectifier, Full wave rectifier, Bridge Rectifier - Operation, Input and output wave forms. Filters: Inductor filter, Capacitor filter, π filter, Comparison of various filter circuits in terms of ripple factors.

LC filter, Multi section π filter

Unit IV: Transistors and Biasing Techniques **09 Hours**

Junction transistor, Transistor current components, Transistor configurations, Transistor as an amplifier, characteristics of transistor in CB and CE configurations. Need for biasing, operating point, Load line analysis, fixed bias and self bias, Stabilization against variations in VBE, Ic, and β, Stability factor, Thermistor and Sensistor bias compensation techniques, Thermal runaway.

Ebers-Moll model of a transistor, Punch through/reach through, Thermal stability

Unit V: Small Signal Low Frequency Transistor Amplifier Models **09 Hours**

BJT: Two port network, Transistor hybrid model, Determination of h-parameters, Generalized analysis of transistor amplifier model using h-parameters, Exact and approximate analysis of CB and CE amplifiers, Comparison of transistor amplifiers.

Effects of emitter bypass capacitor (C_e) on low frequency response

Textbooks

1. Lal Kishore K., "Electronic Devices and Circuits", 4th Edition, Bright Sky Publications, 2016
2. Millman J. and Christos C. Halkias, "Electronic Devices and Circuits", 4th Edition, Tata Mc-Graw Hill, 2010
3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2009
4. Boylestad R. L. and Louis Nashelsky, "Electronic Devices and Circuits", 10th Edition, Pearson Publications,2009

Reference Books

1. Salivahanan S., Suresh Kumar and Vallavaraj N. A., "Electronic Devices and Circuits", 2nd Edition, Tata Mc-Graw Hill, 2012
2. Donald A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2010
3. Millman J. and Halkias C., "Integrated Electronics", 2nd Edition, Tata Mc-Graw Hill, 2009
4. Singh B. P. and Rekha, "Electronic Devices and Integrated Circuits", 3rd Edition, Pearson publications, 2009
5. Mittal G. K., "Electronic Devices and Circuits", 3rd Edition, Khannan Publishers, 2008

Web Resources

1. www.elprocus.com/p-n-junction-diode-theory-and-working/
2. http://fourier.eng.hmc.edu/e84/lectures/ch4/node3.html
3. http://nptel.ac.in/courses/117103063/11

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	35
L2	40	35
L3	20	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Semiconductor
2. What is ideal diode?
3. List any three applications of Zener diode
4. What is rectifier?
5. Define ripple factor
6. What is BJT?
7. What is thermal runaway?
8. Define stability

L2: Understand

1. Describe the formation of P type semiconductor
2. Draw and explain V-I characteristics of PN junction diode
3. Describe the construction and operation of Photo diode
4. With neat circuit diagram describe the operation of bridge rectifier
5. Explain, why Zener diode is used in reverse bias with the help of characteristics
6. Draw and explain the input and output Characteristics of Common base configuration
7. With neat sketches explain the V-I characteristics of NPN transistor in common emitter configuration
8. Write a short note on Thermal Runaway
9. Explain thermister compensation technique

L3: Apply

1. Show that the efficiency of half wave rectifier is 40.6%
2. Show that the efficiency of full wave rectifier is 81.2%
3. Obtain an expression of stability factor for fixed bias
4. With suitable expressions explain self bias of BJT
5. Obtain the expressions for voltage gain and current gain of small signal low frequency common emitter amplifier

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MI 20AIM01 Fundamentals of Neural Networks 3 0 0 3

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

Code	Course Outcomes	Mapping with POs	DoK
20AIM01.1	Describe the concepts of artificial neural networks	-	L1, L2
20AIM01.2	Compare functions of biological and artificial neural networks		L1, L2
20AIM01.3	Explain the architecture and functioning of Single Layer feed forward networks		L1, L2
20AIM01.4	Describe architecture and functioning of Multi-layer networks		L1, L2
20AIM01.5	Explain associative memory networks		L1, L2
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge			

Unit 1: Introduction to Neural Networks **9 hours**

Introduction - Humans and Computers - Organization of the Brain – Biological Neuron - Biological and Artificial Neuron Models - Characteristics of ANN - McCulloch-Pitts Model - Historical Developments - Potential Applications of ANN

Unit 2: Essentials of ANN **9 hours**

Artificial Neuron Model - Operations of Artificial Neuron - Types of Neuron Activation Function - ANN Architectures - Classification Taxonomy of ANN – Connectivity - Learning Strategy (Supervised, Unsupervised, Reinforcement) - Learning Rules

Unit 3: Single Layer Feedforward Networks **9 hours**

Introduction - Perceptron Models: Discrete - Continuous and Multi-Category - Training Algorithms: Discrete and ContinuousPerceptron Networks – Limitations of the Perceptron Model

Unit 4: Multi - Layer Feedforward Networks **9 hours**

Generalized Delta Rule - Derivation of Backpropagation (BP) Training - Summary of Backpropagation Algorithm - Kolmogorov Theorem, Learning Difficulties and Improvements

Unit 5: Associative Memory Networks **9 hours**

Paradigms of Associative Memory - Pattern Mathematics - Hebbian Learning - General Concepts of Associative Memory - Bidirectional Associative Memory (BAM) Architecture - BAM Training Algorithms: Storage and Recall Algorithm - BAM Energy Function

Text Books

1. S. N. Sivanandam, S. Sumathi, S. N. Deepa, “Introduction to Neural Networks Using MATLAB 6.0”, Tata McGraw-HillCompanies, 2006
2. Simon Haykin, “Neural Networks: A Comprehensive Foundation”, Second Edition, Pearson Education, Asia
3. James A. Freeman, David M. Skapura, “Neural Networks: Algorithms, Applications, and Programming Techniques”, Addison-Wesley Publishing Company

Reference Books

1. B. YagnaNarayana, “Artificial Neural Networks”, Prentice Hall India, 2013
2. Satish Kumar, “Neural Networks: A classroom approach”, Tata McGraw Hill, 2004.
3. Laurene Fausett, “Fundamentals of Neural Networks”, Pearson Education

Web Resources

1. https://www.tutorialspoint.com/artificial_neural_network/index.html

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

5. Define Neural Computing
6. Define ANN and Neural Computing
7. List any 4 design parameters in the design of Artificial Neural Network
8. What kinds of transfer functions can be used in each layer?
9. Define Pattern Association
10. What is Adaline Model?
11. What are the types of Learning?
12. What is simple artificial neuron?
13. List any 4 applications of Artificial Neural Network
14. Define Delta Learning rule

L2: Understand

4. Describe on the process of assigning and updating weights in a artificial neural network
5. What are the design steps to be followed for using ANN for your problem?
6. Describe least square algorithm with example
7. Why XOR Problem cannot be solved by a single layer perceptron? Write an alternative solution for it
8. Explain Back Propagation Network with necessary diagrams and equations
9. Write the differences between Hetero Associative Memories and Interpolative Associative Memories

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MI **20DSO03 Introduction to R Programming** **3 0 0 3.0**

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

Code	Course Outcomes	Mapping withPOs	DoK
20DSO03.1	Understand the basic concepts of R programming	-	L1, L2
20DSO03.2	Understand about Scalars and Vectors		L1, L2,
20DSO03.3	Implement Lists and data Frames		L1, L2, L3
20DSO03.4	Implement Tables and Statistical Distributions		L1, L2 , L3
20DSO03.5	Implement Functions in R programming		L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge			

Unit I: Introduction **9 Hours**

Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

Variable Scope & Default Arguments

Unit II: Control Structures And Vectors **9 Hours**

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes

Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations

Higher-Dimensional Arrays

Unit III: Lists **9 Hours**

Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, Data Frames, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations

Merging Data Frames

Unit IV: Factors and Tables **9 Hours**

Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables

, Extracting a Sub table, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

Aaggregate () Function, Set Operations

Unit V: Functions **9 Hours**

Scripts to Functions, Making the Script, Transforming the Script, Using the Function, Reduce the number of Lines, Adding more Arguments, Dots, Using Functions as Arguments, Crossing the Boarders, Choices with If-Else Statements, vectorizing Choices, Looping Through Values

Coping and Scoping of Functions

Text Books

1. Norman Matloff, " The Art of R Programming- A Tour of Statistical Software Design ", 2011
2. Roger D. Peng, " R Programming for Data Science " , 2012

Reference Books

1. Garrett Grolemund, Hadley Wickham, "Hands-On Programming with R: Write Your Own Functions andSimulations", 1st Edition, 2014
2. Andrie de Vries, Joris Meys, "R For Dummies", 2nd Edition, 2015

Web References

1. https://swayam.gov.in/nd1_noc19_ma33/preview
2. https://data-flair.training/blogs/object-oriented-programming-in-r/
3. http://www.r-tutor.com/elementary-statistics
4. https://www.tutorialspoint.com/r/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive LevelsL1: Remember

1. Write about vectors in R
2. Write any three type conversions in R
3. What is a data structure in R?
4. Write any two Boolean operators in R
5. Write any two linear vector algebra operations

L2: Understand

1. Explain the importance of data frame
2. How to apply same functions to all rows and columns of a matrix? Explain with example
3. Explain about Finding Stationary Distributions of Markov Chains
4. Describe R functions for Reading a Matrix or Data Frame from a File
5. Explain different matrix operation function in R

L3: Apply

1. Implement binary search tree with R
2. Write R script to create a line graph
3. Create a R language code to generate first n terms of a Fibonacci series
4. Apply R program to implement quicksort
5. Apply R code to the function by using if else commandf(x) = x if
   x<1/2
   = (1-x) if 1/2<x<1
   = 0 otherwise

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MI 20SHM01 Psychology 3 0 0 3

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

Code	Course Outcomes
20SHM01.1	Focuses on classical/operant conditioning, reinforcement schedules, and observational learning to help students obtain an understanding of learning and conditioning
20SHM01.2	Understand the properties of Senses
20SHM01.3	Understand the state of Consciouness, Sleep & Dreams
20SHM01.4	Understand the importance of learning
20SHM01.5	Understanding the components of memory, language, cognition, problem solving, and the many forms of memory will be the focus of this course

Unit I: Introduction 9 Hours

Definition of Psychology, Psychology as a Science: Methods of psychology, Different schools of Psychology and modern perspectives of psychology - Scope and branches of psychology

Unit II: Sensation and Perception 9 Hours

General Properties of Senses, subliminal stimuli, Selective Attention, Physiological correlates of Attention, Internal influences on Perception - Learning, Set, Motivation and Emotion, External influences on perception - Figure Ground separation, Movement, organization, illusions, Perceptual constancies, Depth perception, Binocular and Monocular Depth, Perception; Perceptual defense and perceptual vigilance, sensory deprivation, sensory bombardment

Unit III: Consciousness 9 Hours

Fundamental Process, Active and passive roles of consciousness, Sleep and Dreams, Meditation, Hypnosis, Psi Phenomena, Alternate states of consciousness, Natural and Drug induced

Unit IV: Learning 9 Hours

Definition of learning, Theories of learning, Classical conditioning, Operant conditioning, Cognitive Learning, Social Learning

Unit V: Memory 9 Hours

Meaning and nature of memory, Theories of memory: Information processing theories - sensory register, short term memory, rehearsal; Levels of processing theories, Long term memory - organizations, TOT, semantic and episodic memory, encoding and storing long term memories, role of organization, role of imagery, role of constructive processes; Retrieval from long term memory, Forgetting- Motivated forgetting, Interference, Decay through disuse, Techniques of improving memory

Text Books

1. Morgan C. T., King, R. A., Weisz, J. R. and Schopler J., Introduction to Psychology, 7th Edition, Singapore: Mcgraw - Hill, 2007
2. Myers D. G., Psychology, 5th Edition, Worth Publishers: New York, 2004
3. Kalat J., Introduction to Psychology, 8th Edition, Wordsworth Pub. Co., 2007

Reference Books

1. Feldman R. S., Understanding Psychology, 6th Edition, Tata McGraw - Hill, New Delhi, 2006
2. Kosslyn S. M. and Rosenberg R. S., Psychology in Context, 3rd Edition, Pearson Education Ltd., 2006

Web References

1. https://www.all-about-psychology.com/learn-psychology.html
2. https://study-uk.britishcouncil.org/plan-studies/choosing-course/subjects/psychology
3. https://www.youtube.com/watch?v=k-P1BEk6hhE

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MI 20SHM02 Statistical Methods 3 0 0 3

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

Code	Course Outcomes
20SHM02.1	Demonstrate statistical techniques in real life problems
20SHM02.2	Gain statistical knowledge on measures of central tendency and variation
20SHM02.3	compute sample space, event, relative frequency, probability, conditional probability, independence
20SHM02.4	familiar with some standard discrete and continuous probability distributions
20SHM02.5	Understand the theory of sampling techniques and their practical applications

Unit I: Introduction 9 Hours

Definition and classification of statistics, Stages in statistical investigation, Definition of some basic terms, Applications, uses and limitations of statistics, Scales of measurement, methods of data collection and presentation, Diagrammatic and graphical presentation of data

Unit II: Treatment of Data 9 Hours

Frequency distributions, stem-leaf displays, measures of central tendency (mean,median,mode,quantiles), measures of variation (range, quartile deviation, mean deviation, standard deviation), standard scores, moments (about origin and mean) skewness and kurtosis

Unit III: Elementary Probability 9 Hours

Introduction, definitions of random experiment, samplespace, events, types of events, countingrules, permutation and combinations rule, definition of probability in several approaches, some probability rules, conditional probability and independence, bayes theorem

Unit IV: Probability Distributions 9 Hours

Definition of random variables and probability distributions, Introduction to expectation: mean and variance of a random variable, Common discrete probability distributions: Binomial and Poisson, Common continuous probability distributions: normal, t and chi-square distributions

Unit V: Sampling Techniques 9 Hours

Basic concepts: population, sample, parameter, statistic, sampling frame, sampling units , Reasons for sampling, Sampling and non sampling errors, probability sampling techniques (simple, stratified, systematic), Non probability sampling methods

Text Books

1. Bluman A. G., Elementary Statistics: A Step by Step Approach, 2nd Edition, Wm. C. Brown Communications, Inc., 1995
2. Spiegel M. R. and Stephens L. J., Schaum's Outline of Statistics, Schaum's Outline Series , 4th Edition, 2007
3. Gupta C.B. and Gupta, V., An Introduction to Statistical Methods, Vikas Publishing House, Pvt. Ltd., India, 2004

Reference Books

1. Richard A., Gupta C. B.", Probability and Statistics for Engineers", Miller & Fruend ,Pearson's Edition, 2010
2. Freund, J. E. and Simon G. A., Modern Elementary Statistics, 9th Edition, 1998
3. Snedecor G.W. and Cochran W. G.,Statistical Methods, 7th Edition, 1980
4. David S. M., McCabe P. and Craig B., Introduction to the Practice of Statistics, 6th Edition, W. H. Freeman, 2008

Web References

1. https://onlinecourses.nptel.ac.in/noc21_ma74/preview
2. https://archive.nptel.ac.in/courses/111/105/111105077/
3. http://www.nitttrc.edu.in/nptel/courses/video/111105077/L10.html

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MI 20MBM01 General Management 3 0 0 3

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

Code	Course Outcomes
20MBM01.1	Understand basic functions of management
20MBM01.2	Understand the planning process and strategic formulation
20MBM01.3	Know the nature of the organization process
20MBM01.4	Understand the staffing objectives and functions
20MBM01.5	Understand the directing process and controlling methods

Unit I: Management Introduction 10 Hours

Concept, Nature, Process and Significance of Management, Managerial Roles (Mintzberg), An Overview of Functional areas of Management - Marketing, Finance, Production, HRM, IT,R & D, Development of Management Thought - Classical, Neo – classical

Unit II: Planning 10 Hours

Process and Types, Decision - making concept and process, Bounded rationality, Management by objectives, Corporate Planning - Environment analysis and Diagnosis, Strategy Formulations

Unit III: Organizing 10 Hours

Concept, Nature, Process and Significance, Authority and Responsibility relationships - Delegation, Decentralisation, Departmentation basis and formats (Project and Matrix), Formal and Informal Organisation, Changing patterns in organisation structures in the knowledge economy

Unit IV: Staffing 10 Hours

Human Resource Planning, Objectives, Factors influencing Human Resource Planning, HR Planning Process, Job Analysis, Recruitment, Process and Sources of Recruitment, Selection, Process of selection and Techniques, Errors in selection Retention of employees

Unit V: Directing and Control 10 Hours

Motivating and Leading People at work - basic concepts, Communication - nature, process, networks and barriers, Effective Communication Managerial Control - Concept and process, Designing an Effective Control System, Techniques –Traditional and Modern (PERT and CPM)

Note: Discuss case studies from every unit

Text Books

1. Singh B. P. and Chhabra T. N., Management Concepts and Practices, Dhanpat Rai, New Delhi
2. Singh B. P. and Singh A. K., Essentials of Management, Excel Books, New Delhi
3. Dwivedi R. S. Management – An Integrated Approach, National Publishing House

Reference Books

1. Weihrich, Heing and Harold Koontz, Management a Global Perspective, Mc - Graw Hill, New Delhi
2. Stoner, James A. F., Freeman A. E. and Gilbert D. A., (Jr.), Management, Prentice Hall of India Pvt. Ltd.
3. Ivancevich, John M., Donnelly J. H. and Gibson J. L., Management: Principles and Functions, AITBS, New Delhi
4. Luthans, Fred, Introduction to Management, Mc - Graw Hill
5. Jones, Gareth R and Jennifer M., George, Contemporary Management, Tata Mc-Graw Hill

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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MI 20MBM02 Human Resource Planning 3 0 0 3

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

Code	Course Outcomes
20MBM02.1	Understand staffing concept Write sound job descriptions, job specifications
20MBM02.2	Develop a structured, job - related interview for talent acquisition across all the verticals
20MBM02.3	Know the training and development strategies of a firm
20MBM02.4	Understand compensation management and performance management process
20MBM02.5	Understand the role of trade unions in a firm

Unit I: Introduction 10 Hours

Human resource planning concepts, Concept of Staffing, Factors affecting Staffing, Staffing Process.
Job Analysis -- Concept, Job - Specifications, Job - Description, Process and Methods, Advantages of Job Analysis.
Job Designing: Introduction, Definition, Modern Techniques, Factors affecting Job Design

Unit II: Talent Acquisition 10 Hours

Recruitment and Selection: Needs-recruitment process - alternative to recruitment, Concept of Selection, Criteria for Selection, Process. Screening – Pre and Post Criteria for Selection, Interviewing – Types and Guidelines for Interviewer & Interviewee, Types of Selection Tests, Selection Hurdles and Ways to Overcome Them, Current trends in Recruitment and Selection

Unit III: Training & Development 10 Hours

Induction – Concept, Types - Formal/Informal Induction, Advantages of Induction, Training Vs Development, Need, Process of Training, Methods of Training, Development techniques, need for development, Career Planning, training and development policies, linking training and development to company's strategy

Unit IV: Compensation and Performance Management 10 Hours

Compensation management process, Forms of pay, Financial and non – financial compensation - Factors influencing Wage fixation, Performance Appraisal System, Methods of Performance Appraisal, Performance management process

Unit V: Managing Industrial relations 10 Hours

Managing Industrial Relations – Components of IR - Trade Unions, Functions of Trade Union – Employee Participation – Importance and Schemes, Collective Bargaining – Grievance Redressal, Industrial Dispute – Settlement mechanism

Note: Discuss case studies from every unit

Text Books

1. Subba Rao P., Human Resource Management, Himalaya, Mumbai
2. Aswathappa K., Human Resources and Personnel Management, Tata McGraw-Hill
3. Armstrong M., Performance Management: Key Strategies and practical Guidelines, Kogan Page, London

Reference Books

1. Gary Dessler, Human Resources Management. Pearson Publication
2. Mammoria C. B., Personnel Management
3. Recruitment and Selection: Theories and Practices, Dipak Kumar Bhattacharyya, Cengage, India

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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MI 20CEM02 Climate Change Mitigation and Adaptation 3 0 0 3

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

Code	Course Outcomes
20CEM02.1	Understand the concept of climate change scenarios
20CEM02.2	Outline the causes for the changes in the climate
20CEM02.3	Identify the impacts of climate change on various sectors
20CEM02.4	Adopt the methodologies in finding the changes in climate
20CEM02.5	Demonstrate the climate change adaptation and mitigation options for securing sustainable development

Unit I: Fundamentals of Climate Change **9 Hours**

Greenhouse gases, radiative forcing potential, carbon dioxide equivalency, natural climate forcing factors, emissions sources and sinks

Unit II: Observed Changes and its Causes **9 Hours**

Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change –-Evidences of Changes in Climate and Environment – on a Global Scale and in India.

Unit III: Impacts of Climate Change **9 Hours**

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios -Projected Impacts for Different Regions- Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

Unit IV: Clean Technology and Energy **9 Hours**

Clean Development Mechanism -Carbon Trading- examples of future Clean Technology -Biodiesel – Natural Compost – Eco-Friendly Plastic – Alternate Energy – Hydrogen – Biofuels -Solar Energy – Wind – Hydroelectric Power.

Unit V: Adaptation and Mitigation Responses **9 Hours**

Policy, Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC, Concept framework of urban adaptation to climate change, Mitigation Efforts in India and Adaptation funding.

Text Books

1. Jan C. Van Dam, “Impacts of Climate Change and Climate Variability on Hydrological Regimes”, Cambridge University Press, 2003
2. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007

Reference Books

1. Pielke, R., “Lifting the taboo on adaptation”, Nature 445 (7128), 597-598, 2007
2. Bulkeley, H., “Cities and Climate Change”, Routledge, London, 2013

Web References

1. IPCC Fourth Assessment Report – The AR4 Synthesis Report
2. https://www.coursera.org/learn/climate-change-mitigation
3. https://www.usc.edu.au/study/courses-and-programs/courses/course-library/ens/ens204-climate-change-mitigation-and-adaptation

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MI 20CSM02 Knowledge Discovery and Databases 3 0 0 3

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

Code	Course Outcomes
20CSM02.1	Illustrates the basic concepts of database management system
20CSM02.2	Able to summarize mining and preprocessing of data
20CSM02.3	Outline the functionalities of data mining(characterization)
20CSM02.4	Able to explain the processes of association analysis
20CSM02.5	Illustrate the features of various clustering techniques

Unit I: Introduction to Database and Data Warehouse 9 Hours

Overview of Data, What is Database and What is Database Management Base System, Meaning of Entity, Relation, Database Design and ER diagrams, Attributes, DMBS Software's available in Market, Structured Query Language (SQL)
What is Data Warehouse, Types of Data Warehouse, On-Line Analytical Processing (OLAP)

Unit II: Data Mining Introduction 9 Hours

Introduction to Data Mining Systems, Knowledge Discovery Process, Data Mining Techniques, Issues, Data Objects and Attribute Types, Statistical Description of Data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and Discretization, Data Visualization

Unit III: Classification 9 Hours

Introduction and Basic Concepts of Classification, What is Training Data, Supervisory Learning and Unsupervisory Learning. Decision Tree Induction, Working of Decision Tree and Building a Decision Tree, Bayes' Theorem, Classification by Back Propagation

Unit IV: Association 9 Hours

What is Association Analysis, Frequent Item Set Generation, Association Rule Generation using Apriori Algorithm.

Unit V: Clustering and Outlier Analysis 9 Hours

What is Cluster Analysis, Different Types of Clusters, Partition Method – K-Means Algorithm, Hierarchical Methods – Hierarchical Cluster Algorithm, Density Based Method- DBSCAN and Outlier Analysis, What is Outlier Analysis?

Practicing Tool: SQL, Weka, Python and R

Text Books

1. Raghurama Krishnan, Johannes Gehrke, "Data base Management Systems", Third Edition, TATA McGraw Hill, 2008.
2. Jiawei Han and MichelineKamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Pearson,2016

Reference Books

1. Alex Berson, Stephen J.Smith, —"Data Warehousing, Data Mining & OLAPll", Tata McGraw – Hill Edition, 35th Reprint 2016.
2. K.P. Soman, ShyamDiwakar and V. Ajay, — "Insight into Data Mining Theory and Practicell", Eastern Economy Edition, Prentice Hall of India, 2006.
3. Ian H.Witten, Eibe Frank, — "Data Mining: Practical Machine Learning Tools and Techniques", Second Edition, Elsevier.

Web Resources

1. https://www.tutorialspoint.com/
2. https://www.coursera.org/learn/

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Board of Studies (CSE)

MI 20MEM02 Micro Electromechanical Systems 3 0 0 3.0

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

Code	Course Outcomes	DoK
20MEM02.1	Acquire the operation of micro devices, micro systems and their applications	L1, L2
20MEM02.2	Ability to design the micro devices, micro systems using the MEMS fabrication process.	L2
20MEM02.3	Acquire basic approaches for various sensor design	L2
20MEM02.4	Acquire basic approaches for various actuator design	L2
20MEM02.5	Gain the technical knowledge required for computer-aided design, fabrication, analysis and characterization of nano-structured materials, micro- and nano-scale devices.	L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Unit I: Basic Concepts 11+1 Hours

Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA. MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology..

Unit II: Thermal Sensors And Actuators 11+1 Hours

Thermal energy basics and heat transfer processes, thermisters, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

Unit III: Micro-Opto-Electro Mechanical Systems 11+1 Hours

Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.
MAGNETIC SENSORS AND ACTUATORS: Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device

Unit IV: Micro Fluidic Systems 11+1 Hours

Applications, considerations on micro scale fluid, fluid actuation methods, dielectro phoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, micro fluid dispenser, micro needle, molecular gate, micro pumps. RADIO FREQUENCY (RF) MEMS:RF – based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

Unit V: Chemical And Bio Medical Micro Systems 11+1 Hours

Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemo resistors, chemo capacitors, chemo transistors, electronic nose (E-nose), mass sensitive chemo sensors, fluorescence detection, calorimetric spectroscopy

Text Books

1. Nitaigour Premchand Mahalik, “MEMS” TMH Publishing co.

Reference Books

1. Chang Liu ,”Foundation of MEMS”, Prentice Hall Ltd.
2. Sergey Edwrd Lyshevski, “MEMS and NEMS”, CRC Press, Indian Edition.
3. Tai-Ran Hsu, “MEMS and Micro Systems: Design and Manufacture”, TMH Publishers.
4. Thomas M Adams, “Richard A Layton Introductory MEMS”, Springer International Publishers.

Web References

1. https://nptel.ac.in/courses/117/105/117105082/

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Board of Studies (ME)

MI 20EEM02 Basics of Electrical Machines and Drives 3 0 0 3.0

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

Code	Course Outcomes
20EEM02.1	Understand the basic concepts of different types of electrical drives
20EEM02.2	Able to explain the performance characteristics of electrical drives
20EEM02.3	Study the different methods of starting D.C motors and induction motors
20EEM02.4	Study the conventional and solid-state D.C. drives
20EEM02.5	Study the conventional and solid-state A.C. drives

Unit I: Introduction **12 Hours**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

Power electronics, power calculations

Unit II: Drive Motor Characteristics **12 Hours**

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound – single phase and three phase induction motors

Principle And Operation of DC Motors And Induction Motors.

12 Hours

Unit III: Starting Methods

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors

Types Of Motors and Starter Operation

Unit IV: Conventional and Solid State Speed Control of D.C. Drives **12 Hours**

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system – Using controlled rectifiers and DC choppers –applications.

Speed Control Methods - Field Control And Armature Control

Unit V: Conventional and Solid State Speed Control of A.C. Drives **12 Hours**

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme Using inverters and AC voltage regulators – applications

Power Electronics Converters and Operation

Textbooks

1. Nagrath .I.J. & Kothari .D.P, “Electrical Machines”, Tata McGraw-Hill, 2006
2. Vedam Subrahmaniam, “Electric Drives (Concepts and Applications)”, Tata McGraw-Hill, 2010

Reference Books

1. Partab. H., “Art and Science and Utilisation of Electrical Energy”, Dhanpat Rai and Sons, 2017
2. Pillai.S.K “A First Course on Electric Drives”, Wiley Eastern Limited, 2012
3. Singh. M.D., K.B.Khanchandani, “Power Electronics”, Tata McGraw-Hill, 2006.

Web References

1. https://link.springer.com/book/10.1007/978-3-319-72730-1

2. https://www.routledge.com/Electrical-Machine-Drives-Fundamental-Basics-and Practice/Franchi/p/book/9781138099395

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	40	40
L2	60	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define Electric Drives
2. Name the basic elements of Electric Drives
3. Write the classification of Electric Drives
4. Give the necessity of power rating
5. What happens if the motor is selected at highest load handling capacity at continuous duty variable?
6. What is short time rating?

L2: Understand

1. Describe the method of estimating equivalent continuous power rating of a motor for short time load applications
2. Explain the advantages of electrical drives
3. Discuss about overload current capability of motor

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Chairman
Board of Studies (EEE)

MI 20ECM02 Digital Electronics 3 0 0 3

Pre- Requisite: Semiconductor Devices and Circuits

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

Code	Course Outcomes
20ECM02.1	Utilize theory of Boolean algebra & the underlying features of various number systems
20ECM02.2	Choose the concepts of Boolean algebra for the minimization of switchingfunctions
20ECM02.3	Design of various combinational logic circuits using basic gates
20ECM02.4	Design various simple programmable logic devices to complexprogrammable logic devices & arrays
20ECM02.5	Develop of various sequential logic circuits

Half adder and full adder

Text Books

1. Taub, H. and Schilling, D., "Digital Integrated Electronics", McGraw Hill, 1977
2. Hodges, D. A. and Jackson, H. G., "Analysis and Design of Digital Integrated Circuits", International Student Edition, McGraw Hill, 1983
3. Hill, F. J. and Peterson, G. L., "Switching Theory and Logic Design", John Wiley, 1981
4. Anand Kumar, A., "Switching Theory and Logic Design", 3rd Edition, PHI Learning, 2016

Reference Books

1. Kohavi, Z., "Switching and Finite Automata Theory", McGraw Hill,1970
2. Jain, R. P., "Modern Digital Electronics", 3rd Edition, Tata McGraw Hill, 2003
3. Charles Roth, H. and Larry Kinney, L. Jr., "Fundamentals of Logic Design", 7th Edition, Cengage Learning, 2014

Web References

1. https://onlinecourses.nptel.ac.in/noc19_ee51/preview
2. https://nptel.ac.in/courses/117/105/117105080/
3. https://gate.iitkgp.ac.in/gate_syllabus.html
4. https://www.ee.iitb.ac.in/web/academics/courses/EE221

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	33	33
L2	33	33
L3	34	34
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. State De-Morgan's theorem and mention its use.
2. Define 'Minterm' and ' Maxterm'.
3. State Distributive law and Duality principle.
4. Define Flip-Flop.

L2: Understand

1. Why totem pole outputs cannot be connected together?
2. How to connect NAND gates to get an AND gate and OR gate?
3. Explain the terms Prime Implicant and Essential prime implicants.

4. Explain the working of 8:1 MUX with the help of a combinational logic circuit.

L3: Apply

1. Express the function Y= A+ BC in canonical POS.
2. Simplify the following Boolean expression into one literal. W'X(Z'+YZ) + X(W+Y'Z).
3. Convert $(115)_{10}$ and $(235)_{10}$ into hexadecimal numbers.
4. Convert the given decimal numbers to their binary equivalent 108.364, 268.025.

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Board of Studies (ECE)

MI 20AIM02 Machine Learning with Python 3 0 0 3

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

Code	Course Outcomes At the end of the course, the students will be able to
20AIM02.1	Solve simple computational problems with python
20AIM02.2	Identify and use appropriate functions to handle data in python code
20AIM02.3	Describe the foundational concepts and terminologies of machine learning
20AIM02.4	Explain various unsupervised learning algorithms
20AIM02.5	Evaluate the performance of the machine learning algorithm

Unit 1: Basics of Python Programming **9 hours**

Introduction to Python: evolution, features – Python IDE installation – Syntax – Comments – Variables – Data types – Numbers – Strings – Booleans – Operators – Control statements – Data structures: lists, dictionary, tuples, sets, arrays – Functions

Unit 2: Python modules for ML **9 hours**

NumPy – Pandas – SciPy – MatPlotLib

Unit 3: Introduction to Machine Learning **9 hours**

Machine Learning essentials: data set, mean, median, mode, standard deviation, percentile, data distribution, normal distribution – Types of learning: supervised, unsupervised – Supervised learning: classification and regression – Classification algorithms: KNN, Naïve Bayes classifier, Decision trees, Linear models, SVM

Unit 4: Unsupervised Learning and Pre-processing **9 hours**

Types of unsupervised learning – Challenges in unsupervised learning – Pre-processing and Scaling – Dimensionality reduction: Principal Component Analysis – Clustering: k-means, agglomerative, DBSCAN

Unit 5: Data representation and Model evaluation **9 hours**

Categorical variables: one-hot encoding – Binning – Discretization – Automatic feature selection – Model evaluation: cross-validation – Grid search – Evaluation metrics and scoring

Text Books

1. Andreas C. Miller and Sarah Guido, “Introduction to Machine Learning with Python – A guide for Data Scientist”, O.Reilly Publisher, 1st edition, 2016
2. Peter Flach, “Machine Learning – The art and science of algorithms that make sense of data”, Cambridge Press, 2012
3. Tom Michell, “Machine Learning”, McGraw Hill, 2014

Reference Books

1. Peter Harington, “Machine Learning in Action”, Cengage Publications, 2012
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar “Foundations of Machine Learningll, MIT Press, 2012

Web Resources

1. https://www.tutorialspoint.com/python
2. https://www.w3schools/python

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	30
L2	20	40
L3	60	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define data set
2. List any 4 types of data
3. What are tuples? Give examples
4. What are dictionaries? Give examples
5. Define classification
6. Define clustering
7. What is regression?
8. What is cross-validation?
9. What is meant by training?
10. Define testing

L2: Understand

1. Describe the overall process involved in supervised learning
2. Explain liner regression with appropriate example
3. Explain decision tree algorithm
4. Describe the unsupervised learning process
5. Explain about any 2 dimensionality reduction techniques

L3: Applying

1. Write a python script to illustrate use of for loop
2. Write a python script to print prime numbers within the given range
3. Write a python script to illustrate the use of NumPy functions
4. Write a python script to add 2 matrices
5. Write python script to illustrate the use of MatPlotLib functions

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Board of Studies (CSE)

MI 20DSM02 Data Management and Analysis 3 0 0 3

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

Code	Course Outcomes
20DSM02.1	Understand database and be familiar with relational database concepts
20DSM02.2	Demonstrate knowledge of terms, methods of ER Modelling
20DSM02.3	Demonstrate knowledge of trends in data management in Entity Clustering
20DSM02.4	Demonstrate how to acquire, transform, analyse in SQL
20DSM02.5	Demonstrate how to solve problems in accounting using Transactions

Unit I: Database Concepts and Design Concepts 9 Hours

Why Databases? Data Versus Information, Why Database Design is Important? Evolution of File System Data Processing, Problems with File System Data Processing, Database Systems.
Relational Database Model- A Logical View of Data, Keys, Integrity Rules, Relational Algebra, Relationships within the Relational Database, Data Redundancy

Unit II: Entity Relationship (ER) Modeling 9 Hours

Entities, Attributes, Relationships, Connectivity and Cardinality, Existence Dependence, Relationship Strength, Weak Entities, Relationship Participation, Relationship Degree, Recursive Relationships, Associative Entities, Developing an ER diagram

Unit III: Entity Clustering 9 Hours

Entity Integrity: Selecting Primary Keys, Natural Keys and Primary Keys, Primary Key guidelines, when to use Composite Primary Keys, when to use Surrogate Primary Keys, Design Cases: Learning Flexible Database Design

Unit IV: Introduction to SQL 9 Hours

Data Definition Commands, Data Manipulation Commands, SELECT Queries, Additional Data Definition Commands, Additional SELECT Query Keywords, Creating VIEW, Joining Database Tables

Unit V: Transaction Management and Concurrency Control 9 Hours

What is Transaction? Concurrency Control, Concurrency Control with Locking Methods, Concurrency Control with Time Stamping Methods, Concurrency Control with Optimistic Methods

Text Books

1. Carlos Coronel and Steven Morris," Database Systems: Design, Implementation, & Management", 13th Edition, Cengage Learning, 2019
2. Sholom M. Weiss, Nitin Indurkhya, Tong Zhang, and Fred Damerau, "Text Mining: Predictive Methods for Analyzing Unstructured Information", 1st Edition, Springer, 2020

Reference Books

1. Hector Garcia-Molina, Jeffrey Ullman D, and Jennifer Widom, "Database Systems: The Complete Book", 2nd Edition, Pearson, 2001
2. Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Elsevier, 2006

Web Resources

1. https://www.niti.gov.in/verticals/data-management-and-analysis
2. https://searchdatamanagement.techtarget.com/definition/data-management
3. https://nptel.ac.in/courses/110/104/110104094/

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Board of Studies(CSE-DS)

MI 20SHM03 English for the Media 3 0 0 3

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

Code	Course Outcomes
20SHM03.1	Understand what media literacy is and its importance
20SHM03.2	Introduce the essential requirements of writing for the media
20SHM03.3	Familiarise the learners with the process of writing for the media
20SHM03.4	Make them familiar with the specific use of english in the field of media
20SHM03.5	Generate interest in various aspects of media and thereby equip them with the basic writing skills required for the same

Unit I: Introduction to Media Literacy 9 Hours

Understand what media literacy is and its importance, analyze and interpret media messages through guided questions, Practice reading strategies to preview a text & skimming and scanning when you read
Practice reading for the main idea, Define and accurately use content - related vocabulary in course activities and games, Apply comprehension strategies as you read, watch, and listen to a variety of texts and multimedia sources Demonstrate your understanding of these texts and key course ideas through comprehension check quizzes and a discussion board response

Unit II: Writing for the Print Media 9 Hours

Newspaper: Writing headlines – Analysing newspaper articles- Practising interview skills – Planning and writing a newspaper article
Magazine: Composing magazine covers – Planning the contents of a magazine – Giving instructions for a photo shoot – Planning and writing a true life story

Unit III: Writing for Radio, Television and Film 9 Hours

Radio: Understanding the language of radio presenters – Understanding the production process – Planning a newslist – Giving post production feedback.
Television: Understanding the pre-production process – Organising a filming schedule **–** Filming on location – Editing a TV documentary
Film: Writing a screenplay – Pitching successfully – Organizing a shoot – Writing a film review

Unit IV: Writing for Advertisements 9 Hours

Advertisement : Creating a print advert –Creating a screen advert –Presenting a finished advert- Analysing market trends – Setting up a marketing communication strategy – Organising the relaunch of a product – Evaluating the success of a Relaunch

Unit V: Writing for the New Media 9 Hours

New Media: Briefing a website designer – Analysing problems and providing solutions – Planning and writing a blog – Creating a podcast-Vlogs – Graphic novel [It is suggested for students to follow the different styles of reporting in various media and to familiarize themselves with the emerging trends in the new media]
Core Reading: Ceramella, Nick and Elizabeth Lee. Cambridge English for the Media. CUP, 2008

Text Books

1. Ryan, Michael and James W Tankard, Writing for Print and Digital Media, McGraw-Hill, 2005
2. Allen, Victoria, Karl Davis et. al., Cambridge Technicals Level 3 Digital Media, Hodder, 2016
3. Hayward, Susan. Cinema studies: The Key Concepts, Routledge, 1996

Reference Books

1. Parthasarathy, Rangaswami, Here is the News! Reporting for the Media.Sterling Publications, 1998
2. Axford, Barrie and Richard Huggins. New Media and Politics, Sage, 2001

Web References

1. https://www.google.co.in/books/edition/Designing_New_Media/
2. https://www.google.co.in/books/edition/AS_Media_Studies
3. https://www.google.co.in/books/edition/Social_Media_and_Democracy

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PC 20SHM04 Statistical Inference 3 0 0 3

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

Code	Course Outcomes
20SHM05.1	Understand the concept of sampling distribution for large and small samples
20SHM05.2	calculate the estimator of a parameter using point estimation and interval estimation
20SHM05.3	Familiar with tests of significance using large samples concerning means,proportions
20SHM05.4	understand the framework of hypothesis testing for carrying out statistical inference for small samples using t,F,chisquare
20SHM05.5	carry out the NP tests with due regard to the assumptions underlying these procedures

Unit I: Sampling distribution **9Hours**

Population, samples,Parameter and statistics ,standard error,sampling distribution of a statistic, sampling distribution of mean (known and unknown variance) for large and small samples, sampling distribution of difference of means,Central limit theorem

Unit II: Estimation **9 Hours**

Definition of point estimator **,** General properties of estimators, Uniformly minimum variance unbiased estimators, Sufficient statistics, Factorization theorem, CR rao inequality, Cramer-Rao lower bound and UMVUE, Methods of finding point estimators by ML estimation,method of moments. Notion of interval estimation , ,confidence Intervals, Confidence interval for the mean **,** Confidence interval for the variance , Confidence interval for the difference between two means

Unit III: Tests of significance for large samples **9 Hours**

Statistical hypothesis, null and alternative hypothesis, Simple and composite hypotheses,Test of hypothesis, critical region, type I and type II errors and their probabilities ,Simple null hypothesis versus simple alternative, Neyman-Pearson lemma, , Tests on the means, proportions,Tests concerning one and two means.

Unit IV: Testing of significance for small samples **9 Hours**

Students t test for single mean,difference of means,paired sample t test,Snedecor's F test for equality of two population variances,Chi-square test-goodness of fit,independence of attributes,population variance

Unit V: Non-parametric methods **9 Hours**

Introduction,assumptions of Np methods,advantages and disadvantages **,**Testing a hypothesis about median, Test for randomness,sign test,Wilcoxon signed rank test **,**Manwhitney U test

Text Books

1. Gupta,V.K, Kapoor " Fundamentals of Mathematical Statistics" sultan Chand Publications,New Delhi
2. Rao, C.R.. Linear statistical Inference and its Applications. Wiley Eastren Publications

Reference Books

1. Richard.A,Gupta C.B ", Probability and Statistics for Engineers",Miller &Fruend,Pearson's Edition 2010
2. Rohatgi, V.K. Statistical Inference. Dover Publications;2003
3. Iyengar, T.K.V,Krishna Gandhi.B,Prasad.M.V.S.S.N "Probability and Statistics" revised Edition,2012
4. Wasserman.L "A concise course in Statistical Inference"Springer Publications2004

Web References

1. https://archive.nptel.ac.in/courses/111/105/111105043/
2. https://onlinecourses.nptel.ac.in/noc20_ma19/preview
3. https://onlinecourses.swayam2.ac.in/cec20_ma01/preview

MI 20MBM03 Organizational Behaviour 3 0 0 3

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

Code	Course Outcomes
20MBM03.1	Understand basic concepts of organizational behavior and its nature
20MBM03.2	Understand the basic concepts personality, values and motivation
20MBM03.3	Understand inter personal behavior and its significance
20MBM03.4	Know the group behavior and its dynamics
20MBM03.5	Know about organizational climate, culture and organizational change

Unit I: Introduction 10 Hours

Organisational Behaviour - Concept and Emergence of OB Concept, Nature and Theoretical frameworks, Disciplines contributing to the field of OB, Historical Background - Hawthorne Studies, Psychological foundations

Unit II: Individual Behaviour 10 Hours

Personality, Learning, Values and Attitudes, Perception, Learning-Behaviourist, cognitive and social learning; Stress at work. Motivation -Maslow's Need Hierarchy, Herzberg's Two Factors Theory

Unit III: Inter - Personal Behaviour 10 Hours

Interpersonal communication and Feedback, Transactional Analysis (TA), Johari Window. Managingmis behaviour at work, Substance abuse, cyber slacking, Aggression, and Violence

Unit IV: Group Behaviour 10 Hours

Group Dynamics, Cohesiveness and Productivity, Management of Dysfunctional groups, Group Decision Making, Organisational Politics.

Leadership- Concept and Styles, Fielder's Contingency Model, House's Path - Goal Theory, Leadership Effectiveness

Unit V: Organizational Process 10 Hours

Organizational Climate: Concept, Determinants, Organization Culture - Concept, Forming, Sustaining, and Changing a Culture, Organizational effectiveness - concept and measurement, Organizational change - resistance and management.

Note: Discuss case studies from every unit

Text Books

1. Singh B. P. and Chhabra T. N., Management Concepts and Practices, Dhanpat Rai, New Delhi
2. Singh B. P. and Singh A. K., Essentials of Management, Excel Books, New Delhi
3. Dwivedi R. S. Management – An Integrated Approach, National Publishing House

Reference Books

1. Udai Pareek, Organizational Behavior, 3rd Edition, Oxford University Press, 2011
2. Subba Rao P., "Management and Organizational Behavior", 3rd Edition, Himalaya Publishing House, 2017
3. Ghuman, K. and Aswathappa K., Management: Concepts, Practice and Cases, Tata Mc - Graw Hill

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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MI 20MBM04 Compensation Management & Employee Welfare Laws 3 0 0 3

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

Code	Course Outcomes
20MBM04.1	Understand different pay structures and pay levels
20MBM04.2	Know about wage act 1936 and its implications
20MBM04.3	Understand the factors influence the wage fixation
20MBM04.4	Understand the components of bonus act 1965
20MBM04.5	Understand various incentive plans and international compensation concept

Unit I: Compensation Management 9 Hours

Compensation management process, forms of pay, financial and non - financial compensation. Compensation Strategies, Assessing job values, pay structures, designing pay levels, construction of optimal pay structure. Paying for performance, skills and competence. International pay systems: comparing costs and systems

Unit II: The Payment of Wages Act, 1936 9 Hours

Objects, Application, Responsibility for payment of wages, Fixation of wage periods, time - limits, Deduction from wages, Remedies available to worker, Powers of authorities, Penalty for offences

Unit III: The Minimum Wages Act, 1948 9 Hours

Objects, application, minimum fair and living wages, determination of minimum wage, taxation of minimum wage, advisory board, remedy to worker for non - payment of minimum wages

Unit IV: The Payment of Bonus Act, 1965 9 Hours

Objects, Scope and Application, Definitions, Calculation ofamount payable as Bonus, Eligibility and Disqualifications for Bonus, Minimum & maximum Bonus, Application of Act in Establishment in Public Sector, Bonus linked with Production or Productivity

Unit V: Incentives Incentive Plan 9 Hours

Individual incentives, pay for performance, compensation of special group Benefits, legally required benefits: Retirement, medical and other benefits, Employee profit sharing, employee stock option, gain sharing International Compensation: Recognizing variation, the social contract, Culture and pay, Preliminary considerations of international compensation

Text Books

1. Belchor, David W., “Compensation Administration”, Prentice Hall, Englewood Cliffs. NT.
2. Henderson R. I., Compensation Management in a Knowledge Based World, New Delhi: Pearson Education
3. Milkovich G., Newman J. and Ratnam C. S. V., Compensation, Tata Mc – Graw Hill, Special Indian Edition

Reference Books

1. Armstrong M.& Murlis H., Reward Management: A Hand book of Salary administration, London: Kegan Paul
2. Sharma J. P., An Easy approach to Company and Compensation Laws, New Delhi: Ane Books Pvt. Ltd.
3. Malik P. L., Hand book of Labourer and Industrial Law, Eastern Book Company
4. Government of India Report of the National Commission on Labour Ministry of Labour and Employment, New Delhi. (latest)

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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MI 20CEM03 Sustainability and Pollution Prevention Practices 3 0 0 3

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

Code	Course Outcomes
20CEM03.1	Concept of sustainability and its goals
20CEM03.2	Sources and effects of environmental pollution
20CEM03.3	Identify the prevention measures for environmental protection
20CEM03.4	Approach for analysis and assessment of developmental activities and their impacts on environment
20CEM03.5	Objectives and components of environmental management

Unit -I Concept of sustainability and development **9 Hours**

Sustainability and its goals, Growth and development, Development and environment, Causes for industrialization, Changing life styles, Regulatory aspects of industrialization, Overall impact of industrialization and Urbanization on quality of human life , Global environmental issues

Unit -II Pollution, Monitoring and Control **9 Hours**

Definition, types and sources of pollution, Quality standards for air, water, soil; types of pollutants; Methods of monitoring and control of air, water, soil Pollution (Physicochemical and bacteriological sampling and analysis); effects of pollution on plants, animals and Human beings.

Unit-III Measures for Environmental Protection **9 Hours**

Formal and informal environmental education, awareness for nature conservation and protection, environmental ethics and morality, conservation of natural habitats, National parks and wild life sanctuaries, role of youth and women, role of NGO's, urban planning and land-use pattern

Unit-IV Environmental Impact Assessment **9 Hours**

Definition, significance and scope of impact assessment, Need & objective, types of environmental impacts, methods of environmental impacts, major steps in impact assessment procedure, generalised approach to impact analysis

Unit-V Environmental Management **9 Hours**

Objectives and components of environmental management need for training, Environmental Impact Statement and Environment Managemental Plan, Role of remote sensing in environmental management, Sustainable use of natural resources, management of soil, wildlife and its methods, agriculture management, Public participation in resource management

Text Books

1. Lars F. Niklasson, "Improving the Sustainable Development Goals: Strategies and the Governance Challenge", 2009
2. Herman Koren, "Best Practices for Environmental Health: Environmental Pollution, Protection, Quality and Sustainability", 21 April, 2017
3. McCully, P, "Rivers no more: the environmental effects of dams (pp. 29-64)", Zed Books, 1996
4. McNeill, John R, "Something New Under the Sun: An Environmental History of the Twentieth Century", 2000

Reference Books

1. Environmental Chemistry - A.K. De, New Age Int. Pub. Co., New Delhi, 1990
2. Lave, L.B and Upton, "Toxic Chemicals, Health and the Environment", The Hopkins Press Ltd., London, 1987
3. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. "Environmental and Pollution Science. Academic Press", 2011

Web References

1. http://mcic.ca
2. https://www.drishtiias.com
3. https://www.jica.go.jp

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Board of Studies(CE)

MI 20CSM03 Database Security 3 0 0 3

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

Code	Course Outcomes
20CSM03.1	Explain the Cossets DBMS
20CSM03.2	Explain the Constrains in Database
20CSM03.3	Describe different Database Schemas
20CSM03.4	Illustrate Desecrate Data Models and Water Marking Processes
20CSM03.5	Explains Geospatial Data Models and Access Methods

Unit I: Database Introduction **9 Hours**

Introduction to Database – Relational Database & Management System, Data Abstraction (Physical Level, Logical Level & View Level) - Multi-level Database, Distributed Database, Database Architecture.

Unit II: Database Securities **9 Hours**

Security issues in Database – Integrity constraints, Access Control (Grant & Revoke Privileges) - Statistical Database, Differential Privacy. Distributed Database Security.

Unit III: Schema Models **9 Hours**

Security in Data Warehouse & OLAP – Introduction, Fact table, Dimensions, Star Schema, Snowflake Schema, Multi-Dimension Range Query, Data Cubes.

Unit IV: Data Mining Introduction **9 Hours**

Data Mining – Introduction - Randomization methods, Data Swapping, Database Watermarking – Basic Watermarking Process - Discrete Data, Multimedia, and Relational Data, Different Data Migration Techniques.

Unit V: Geospatial Database **9 Hours**

Geospatial Database Security – Geospatial data models – Geospatial Authorization, Access Control Models: Geo-RBAC, Geo-LBAC

Text Books

1. Michael Gertz, Sushil Jajodia, “Handbook of Database Security: Applications and Trends”, ISBN-10: 0387485325, Springer, 2007
2. Osama S. Faragallah, El-Sayed M. El-Rabaie, Fathi E. Abd El-Samie, Ahmed I. Sallam, and Hala S. El-Sayed, “Multilevel Security for Relational Databases”, ISBN 978-1-4822- 0539-8, CRC Press, 2014.

Reference Books

1. Bhavani Thuraisingham, “Database and Applications Security: Integrating Information Security and Data Management”, CRC Press, Taylor & Francis Group, 2005.
2. Elmasri navrate, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education, 2016.
3. Peter Rob & Carlos Coronel, “Database Systems Design, Implementation and Management,” Tenth Edition, Pearson Education, 2013.

Web Resources

1. http://www.nptelvideos.in/2012/11/database-managementsystem.html
2. https://www.ibm.com/in-en/cloud/learn/database-security
3. http://data.conferenceworld.in

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MI 20MEM03 Surface Engineering 3 0 0 3

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

Code	Course Outcomes
20MEM03.1	Decide the surface preparation methods suitable for different substrate materials.
20MEM03.2	Apply knowledge on properties offered by different Coatings based on the application requirement.
20MEM03.3	Interpret the testing &evaluation of metallic coatings.
20MEM03.4	Explain the effect of process parameters on the properties & microstructure of the surface coating processes.
20MEM03.5	Explain the importance & role of surface modifications to achieve several technological properties.

Unit I: Fundamentals of Surface Engineering 9 Hours

Introduction to surface engineering, Scope of surface engineering for different engineering materials, Surface Preparation methods such as Chemical, Electrochemical, Mechanical: Sand Blasting, Shot peening, Shot blasting, Hydro-blasting, Vapor Phase Degreasing etc.,
Coatings: Classification, Properties and applications of Various Coatings

Unit II: Chemical Conversion Coating 9 Hours

Chromating, Phosphating, and Anodizing, Thermochemical processes: Methodology used, mechanisms, important reactions involved, Process parameters and applications.

Unit III: Coating from Vapor Phase 9 Hours

PVD, and CVD: Various Methods used, mechanisms, important reactions involved, Process parameters and applications.

Unit IV: Metallic coating 9 Hours

Hot Dipping, Galvanizing, Electrolytic and Electro less plating: Methodology used, mechanisms, important reactions involved, Process parameters and applications. Testing/ evaluation of metallic coatings.

Unit V: Thermal spray coatings 9 Hours

Processes, Types of spray guns, Comparison of typical thermal spray processes, Surface Preparation, Finishing Treatment, Coating Structures and Properties, Applications.

Text Books

1. J. R. Davis, “Surface Engineering for Corrosion and Wear Resistance”, 1st Edtion, 1997.
2. George J, “Rudzki -Surface Finishing Systems metal and non-metal finishing handbook-guide”, 1st Edition, Metals Park: ASM, 1983.
3. James A. Murphy, “Surface Preparation and Finishes for Metal, McGraw-Hill”, New York 1971.
4. P. G. Sheasby and R. Pinner, “Surface treatment and finishing of Aluminium and its alloy”, 1st Edition, ASM, Metals Park, 1987.

Reference Books

1. Friction Stir Welding and Processing, Rajiv Sharan Mishra, Partha Sarathi De, Nilesh Kumar, International 2006.
2. Friction Stir Welding and Processing, R.S. Mishra and M.W. Mahoney, ASM International, 2007.
3. Advances in Friction-Stir Welding and Processing, M-K Besharati-Givi and P. Asadi, ASM International 2008.

Web References

1. www.nptel.iitm.ac.in
2. www.btechguru.com
3. www.ocw.mit.edu
4. www.corrosion-doctors.org

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Board of Studies (ME)

MI **20EEM03 Electrical Engineering Material Science** **3 0 0 3**

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

Code	Course Outcomes
20EEM03.1	Understand the phenomena of metal conductivity
20EEM03.2	Explain the properties of di-electric properties
20EEM03.3	Understand the magnetic properties of materials
20EEM03.4	Explain the types of semi-conductors
20EEM03.5	Understand the modern techniques used for studying the material science

Unit I: Conductivity of Metal **9 Hours**

Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, energy levels of a molecule, emission of electrons from metals, thermionic emission, photo electric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials

Unit II: Dielectric Properties **9 Hours**

Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, frequency dependence of permittivity, dielectric losses, significance of the loss tangent, dipolar relaxation, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system,

Unit III: Magnetic Properties of Materials **9 Hours**

Introduction, Classification of magnetic materials, diamagnetism, paramagnetism, ferromagnetism, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials

Unit IV: Semiconductors **9 Hours**

Energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, thermal conductivity of semiconductors, electrical conductivity of doped materials

Unit V: Modern Techniques for Materials Studies **9 Hours**

Optical microscopy – Electron microscopy – Photo electron spectroscopy – Atomic absorption spectroscopy – Introduction to Biomaterials and Nanomaterials

Text Books

1. Joseph Le Roy Hayde Proteus Steinmetz, “Radiation, Light and Illumination: A Series of Engineering Lectures Delivered at Union College”, BiblioLife, 2019
2. Jack L. Lindsey,, “Applied Illumination Engineering”, 4th Edition, PHI, 2011
3. John Matthews, “Introduction to the Design and Analysis of Building Electrical Systems”, 2nd Edition, Springer, 2013.

Reference Books

1. M.A. Cayless, “Lamps and Lighting”, 5th Edition, Routledge, 2016.
2. Leopold Bloch, “Science of Illumination: An Outline Of The Principles Of Artificial Lighting”, Kessinger Pub, 2018.

Web References

1. https://nptel.ac.in/courses/108/105/108105060/

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Board of Studies (EEE)

MI 20ECM03 Analog Electronic Circuits 3 0 0 3

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

Code	Course Outcomes
20ECM03.1	Demonstrate the concept of DC biasing and transistor stabilization leading to the design of amplifiers
20ECM03.2	Classify, analyze types of multistage amplifiers
20ECM03.3	Classify, analyze and design different types of feedback amplifiers and Oscillators
20ECM03.4	Analyze the response of different signals for linear and Nonlinear wave shaping circuits
20ECM03.5	Understand the internal operation of Op-Amp and its Applications

Unit I: Transistor Biasing **9 Hours**

Need for biasing, operating point, BJT biasing methods, basic stability, fixed bias, collector to base bias, self-bias, Stabilization against variations in VBE, Ic, and β, Stability factors, (S, S', S'').

Unit II: BJT and Multistage Amplifiers **9 Hours**

BJT: Transistor at high frequencies, Hybrid- π common emitter transistor model, Hybrid π conductance, Hybrid π capacitances, Multistage Amplifiers: Classification of amplifiers, methods of coupling, cascaded transistor amplifier.

Unit III: Feedback Amplifiers and Oscillators **9 Hours**

Feedback Amplifiers: Feedback principle and concept, types of feedback, classification of feedback amplifiers. Oscillators: Oscillator principle, condition for oscillations, types of oscillators, RC-phase shift and Wien bridge oscillators with BJT, generalized analysis of LC Oscillators, Hartley and Colpitt's oscillators using BJT.

Unit IV: Linear Wave Shaping **9 Hours**

Linear wave shaping: High pass, low pass RC circuits, response for sinusoidal, step, pulse, square, ramp and exponential inputs. RC network as differentiator and integrator; Attenuators, Diode clippers.

Unit V: Linear Applications of Op-Amp **9 Hours**

Internal Block Diagram of various stages of Op-Amp and Roll of each Stage, Characteristics of Op-Amp, Ideal and Practical Op-Amp specifications, Inverting and Non-inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier.

Text Books

1. Robert, L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory", 10th Edition, Prentice Hall of India, 2009.
2. Millman, J, TaubH, Mothiki Surya Prakash Rao and Millman's, "Pulse Digital and Switching Waveforms", 2nd Edition, Tata McGraw-Hill, 2008.
3. Ramakanth A. Gayakwad, "Op-Amps & Linear ICs", Prentices Hall of India, 1987.

Reference Books

1. Donald A. Neaman, "Electronic Circuit Analysis and Design", 3rd Edition, Tata Mc Graw-Hill, 2010
2. Paul Gray, Hurst, Lewis and Meyer, "Analysis and Design of Analog Integrated Circuits", 4th Edition, John Willey &Sons, 2005
3. Anand Kumar, A., "Pulse and Digital Circuits", 2nd Edition, Prentice Hall of India, 2005
4. Sanjay Sharma, "Operational Amplifiers & Linear Integrated Circuits", 2nd Edition, S. K. Kataria & Sons, 2010.

Web Resource

1. https://nptel.ac.in/courses/108102112
2. https://www.udemy.com/course/analog-electronics-basic-concepts/

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Board of Studies (ECE)

MI 20AIM03 Interpretable Machine Learning 3 0 0 3

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

Code	Course Outcomes
20AIM03.1	Introduction to interpretability
20AIM03.2	Different interpretable models
20AIM03.3	Explain the software's for interpretable models.
20AIM03.4	Illustrate plotting of prediction changes.
20AIM03.5	Explains individual predictions of any black box classification model.

Unit I: Introduction **9 Hours**

Importance of Interpretability, Taxonomy of Interpretability Methods, Scope and evaluation of Interpretability, Properties of Explanations, Human-friendly Explanations

Unit II: Interpretable Models-I **9 Hours**

Data Sets-Regression, Text Classification. Interpretable Models -Linear Regression, Logistic Regression, Decision Tree, Decision Rules, Decision Rule Fit

Unit III: Interpretable Models-II **9 Hours**

Generalized Linear Models (GLM) - Non-Gaussian Outcomes, Advantages; Generalized Additive Models (GAM) - Nonlinear Effects, Advantages and software; Other interpretable Models: Naive Bayes Classifier, K-Nearest Neighbors

Unit IV: Model Agnostic Methods **9 Hours**

Partial Dependence Plot (PDP), Accumulated Local Effects (ALE) Plot, Feature Interaction, Functional Decomposition, Permutation Feature Importance, Global Surrogate.

Unit V: Local Model Agnostic Methods **9 Hours**

Individual Conditional Expectation (ICE), Local Surrogate (LIME), Counterfactual Explanations, Scoped Rules (Anchors), Shapley Values.

Text Books

1. "Interpretable Machine Learning, A Guide for Making Black Box Models Explainable", By Christoph Molnar · 2020
2. "Interpretable Machine Learning with Python, Learn to Build Interpretable High-performance Models with Hands-on Real-world", By Serg Masís · 2021

Reference Books

1. "Explainable AI: Interpreting, Explaining and Visualizing Deep Learning", By Andrea Vedaldi, Grégoire Montavon, Klaus-Robert Müller, Lars Kai Hansen, Wojciech Samek,2019.
2. "Interpreting Machine Learning Models, Learn Model Interpretability and Explainability Methods", By Anirban Nandi, Aditya Kumar Pal · 2021

Web References

1. https://christophm.github.io/interpretable-ml-book/index.html
2. https://ai.googleblog.com/2021/12/interpretable-deep-learning-for-time.html
3. https://arxiv.org/abs/2103.10689

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MI 20DSM03 Data Governance 3 0 0 3

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

Code	Course Outcomes
20DSM03.1	Understanding of the role computation can play in solving problems and optimization techniques
20DSM03.2	Understanding the usage of computational techniques.
20DSM03.3	Understanding Stochastic programming and statistical thinking
20DSM03.4	Identify the problem using Monte Carlo simulations
20DSM03.5	Plotting with the pylab package

Unit I: Introduction, Data Literacy and Concepts **9 Hours**

Data is an asset, Data governance and governance, Data management, The governance "V", Solutions Other terms, Some final core concepts

Unit II: Overview: A Day in the life of a Data Governance Program and its Capabilities **9 Hours**

What does it look like? - The scope of data governance and data management, Business model, Content, Development methods -Federation, Elements of data governance programs, Principles, Policies, Metrics, The critical success factors for data governance

Unit III: The Data Governance Business Case **9 Hours**

The business case, Objectives of the business case for data governance, Components of the business case - The big picture (vision), Program risks, Business alignment, Costs of data quality issues, Costs of missed opportunities, Data debt, Obstacles, impacts, and changes, Presentation of the case. The process to build the business case - Fully understand business direction, identify possible opportunities, identify usage opportunities, define business benefits, confirm business benefits, quantify costs, Prepare the business case documentation, Approach considerations

Unit IV: Overview of Data Governance Development and Deployment **9 Hours**

Types of approaches, The data governance delivery framework, Process overview, Engagement, Strategy, Architecture and design, Implementation, Operation, and changes

Unit V: Engagement **9 Hours**

Initiation- Obtain program approval, Develop DG rollout team structure. Definition- Define DG for your organization, identify business units (subject to DG), Identify business capabilities that need data governance (and don't have it). Scope- Define scope and constraints with the initial plan for DG, Approve scope and constraints. Assessment- Information maturity, Change capacity, Data environment

Text Books

1. John Ladley, "Data Governance", Academic Press, Second Edition, 2012.

Reference Books

1. EvrenEryuek, Uri Gilad, "Data Governance: The Definitive Guide", O'Reilly Media, Inc., 2021.

Web Resources

1. https://nptel.ac.in/courses/110/106/110106072/
2. https://nptel.ac.in/courses/110/104/110104094/

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Board of Studies CSE(DS)

MI 20SHM06 Journalism 3 0 0 3

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

Code	Course Outcomes
20SHM01.1	Understand the concepts of mass communication in general and journalism in particular
20SHM01.2	Impact fundamentals of journalism, evolutionary process, basics concepts, practices and recent trends
20SHM01.3	Get exposed to different faces of journalism
20SHM01.4	Get trained to develop inquisitive and analytical skills to be successful in media
20SHM01.5	Prepare the report for the representation

Unit I: Introduction **9 Hours**

Journalism: Meaning, Definition Nature, Scope, Functions; Truth,Objectivity, verification. independent monitor, forum for criticism and comment, watch dog role of press and democracy principles of journalism will stop types of journalism: print, broadcast and online

Unit II: Process Control and Capability Analysis **9 Hours**

Mass Media And Development - Early Journalism in the world, India and Karnataka global context Colin rise of advocacy journalism, professionalism, modern journalism and mobile journal journalism. Community journalism, rural journalism, yellow journalism, penny press, tabloid press, and citizen journalism

Unit III: Process-monitoring and Control Techniques **9 Hours**

Journalism as a profession, responsibilities and criticism, do you know any his interest understanding the public taste, press as a tool in social service relationship between press and other mass media

Unit IV: Acceptance Sampling **9 Hours**

Normative theories of press enter relevance to the present day; wire services- Indian and international news agencies

Unit V: Reliability and Life Testing **9 Hours**

Photojournalism- caption writing, photo feature, visual composition- case studies Danish Siddiq, Jimmy Nelson, Margaret Brooke-white, Philip JonesGriffits, Rathika Ramaswami Raghu Rai exercise assignments analysis of daily newspaper in the classroom practice of writing new stories on various topics writing reports on civic problems incorporating information from civil organization based on interviews prepare questions for a specific interview rewriting news stories from newspapers for magazine filing report of more press conferences filing report for an actual press conference practice of writing to wall journal twice a week

Text Books

1. Keval J. Kumar (2001), Mass Communication in India, Jaico Publication, New Delhi
2. Seema Hasan (2010), Mass Communication – Principles and Concepts, CBS Publishers and distributors, New Delhi
3. V S Gupta & Vir Bala Aggarwal (2001), Handbook of Journalism and Mass Communication, Concept Publishing Company, New Delhi

Web References

3. http://wikipedia.org//wiki//media_of_india#cite
4. http://wikipedia.org//wiki//mass%2520_media__of_india#cite
5. http://wikipedia.org//wiki//mass_media_of_india#cite-buzzle

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Board of Studies

MI 20SHM07 Statistical Quality Control 3 0 0 3

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

Code	Course Outcomes
20SHM08.1	Identify application of various Statistical quality tools
20SHM08.2	Use control chart techniques for quality improvement
20SHM08.3	planning, establishing, and operating SQC procedures
20SHM08.4	Design a procedure testing incoming batches
20SHM08.5	Carry out reliability testsand perform statistical analysis

Unit I: Introduction **9 Hours**

Quality Improvement in the Modern Business Environment, Modeling Process Quality, Methods and Philosophy of Statistical Process Control

Unit II: Process Control and Capability Analysis **9 Hours**

Control Charts for Variables, Control Charts for Attributes, Process and Measurement System Capability Analysis

Unit III: Process-monitoring and Control Techniques **9 Hours**

Cumulative Sum and Exponentially Weighted Moving Average Control Charts , Univariate Statistical Process Monitoring and Control Techniques

Unit IV: Acceptance Sampling **9 Hours**

Concepts of acceptance sampling, Lot-by-lot acceptance sampling for attributes, Other acceptance sampling techniques

Unit V: Reliability and Life Testing **9 Hours**

Common models and distributions, Estimation of mean life with complete samples, Reliability Estimation, Types of reliability tests

Text Books

1. Montogomery D. C. (2005) Introduction to Statistical Quality Control (5th Edition) Wiley eastrenLtd.
2. Gupta.V,Kapoor,V.K Fundamentals of Applied Statistics Sultan chand Publications,New Delhi

Reference Books

1. Chang D. and Macmillan S. (1992). Statistical Quality Design and Control. Contemporary Concepts and Methods
2. Mahajan M. Statistical Quality Control,Danpatrai& Co Delhi
3. Gupta R.C Statistical quality Control and Quality management,10th Edition,Kanna Publishers,New Delhi

Web References

6. https://www.digimat.in/nptel/courses/video/112107259/L01.html
7. https://freevideolectures.com/course/4539/nptel-operations-management/49
8. https://freevideolectures.com/course/4384/nptel-engineering-metrology/48

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MI 20MBM05 Entrepreneurship and Business Venture Planning 3 0 0 3

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

Code	Course Outcomes
20MBM05.1	Know the role of entrepreneurship development in economy
20MBM05.2	Understand the entrepreneurship and creativity
20MBM05.3	Understand the concept of project planning
20MBM05.4	Understand the sources of financing to ventures
20MBM05.5	Know the methods of entrepreneurship training

Unit I: Introduction 9 Hours

Concept of Entrepreneurship, Role of entrepreneurship in economic Development; factors impacting emergence of entrepreneurship, types of entrepreneurs. Characteristic of successful entrepreneurs; Women Entrepreneurs, Social entrepreneurship, Entrepreneurial challenges

Unit II: Entrepreneurship Development 9 Hours

Types of start-ups, Entrepreneurial class Theories, Entrepreneurial training; EDP Programme, Characteristics of entrepreneurial leadership, Components of Entrepreneurial Leadership, Source of innovative ideas, Entrepreneurship and creativity.

Unit III: Project Planning 9 Hours

Concept of Project and classification of Project, Identification, Project Formulation, Project Report, Project Design, Project Appraisal, Profitability Appraisal, Social cost benefit analysis, Financial analysis, Developing a Marketing plan-customer analysis, sales analysis, steps in marketing research, Marketing Mix; business plan preparation, elements of a business plan; Business plan failures

Unit IV: Project Financing &Venture Capital 9 Hours

Financing Stages; Sources of Finance; Venture Capital; Criteria for evaluating new-venture proposals; Evaluating the Venture Capital-process; Sources of financing for Indian entrepreneurs.

Unit V: Entrepreneurship Training 9 Hours

Designing appropriate training programmers to inculcate entrepreneurial spirit, significance of entrepreneurial training, training for new and existing entrepreneurs, role of entrepreneurship development institutes, MSMES in providing entrepreneurial training.

Note: Discuss case studies from every unit

Text Books

1. Kumar, Arya and Entrepreneurship: Creating and Leading an Entrepreneurial Organization, Pearson, India.
2. Hishrich, Peters, Entrepreneurship: Starting, Developing and Managing New Enterprise, Irwin.

Reference Books

1. Allen K. R., Launching New Ventures: An Entrepreneurial Approach, Cengage Learning.
2. Rama Chandran K., Entrepreneurship Development, Tata McGraw-Hill, India.
3. Roy, Rajeev, Entrepreneurship, Oxford University Press
4. Vasant, Desai, Small – Scale Industries and Entrepreneurship, Himalya Publication, India

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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MI 20MBM06 Performance Management and Talent Management 3 0 0 3

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

Code	Course Outcomes
20MBM06.1	Know about performance management process
20MBM06.2	Understand the performance management system
20MBM06.3	Understand the issues and challenges in implementation of performance management system
20MBM06.4	Understand the talent management approaches
20MBM06.5	Understand the talent management practices and process of companies

Unit I: Introduction 9 Hours

Performance management process, Objectives of performance management system; Historical development in India, Performance management and performance appraisal, Linkage of performance management system with other HR practices

Unit II: Performance Management System 9 Hours

Performance planning, Ongoing support and coaching, Performance measurement and evaluation, Performance management and appraisal; Methods of performance appraisal, Appraisal Communication; Counselling, Identifying potential for development, Linking pay with performance

Unit III: Issues in Performance Management 9 Hours

Implementing performance management system - Strategies and challenges, Role of HR professionals in performance management, Performance management as an aid to learning and employee empowerment, Performance management documentation, Performance management audit, Ethical and legal issues in performance management

Unit IV: Talent Management 9 Hours

Concept and approaches, Frame work of talent management, Talent identification, integration and retention

Unit V: Talent Management Practices and Process 9 Hours

Building the talent pipeline, Managing employee engagement, Key factors and different aspects of talent management, using talent management processes to drive culture of excellence

Note: Discuss case studies from every unit

Text Books

1. Bhattacharyya, D. K., “Performance Management Systems and Strategies”, Pearson Education
2. Robert B, “Performance Management”, McGraw-Hill Education, India
3. ASTD, “Talent Management: Strategies for success from six leading companies”, Cengage Learning

Reference Books

1. Armstrong M, & Baron A, “Performance Management and Development”, Jaico Publishing House, Mumbai
2. Rao T. V, “Hurconomics for Talent Management: Making the HRD missionary business – driven”, Pearson Education

Web References

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://onlinecourses.swayam2.ac.in/nou20_cs14/

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Full Semester Internship **0 0 0 6**

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

No.	Course Outcomes
1	Recognizes and articulates the conceptual knowledge involved in the task undertaken
2	Search and professionally use the appropriate resources required to accomplish the task
3	Demonstrate the theoretical learning outcomes of the domain in task undertaken
4	Communicate well in various forms appropriately
5	Demonstrate a professional behaviour with improved inter-personal skills
6	Coordinate with people from inter and multi-disciplinary setting
Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes	

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Capstone Project/Interdisciplinary Project **0 0 0 6**

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

No.	Course Outcomes
1	Demonstrate the application of theoretical concepts of domain
2	Identify the appropriate tools and methodologies for accomplishing the project
3	Illustrate the use of project management principles
4	Demonstrate the various forms of communication
5	Exhibit professional behaviour with inter and multi-disciplinary settings
Note: All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes	

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ICC 20ICC01 Competitive Programming 2 0 8 6

Duration	240 hours (2 hours theory and 14 hours practical per week) as specified above
Industry Collaborator	M/s. Demy Software Solutions, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC07.1	Understand the basics of Programming	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.2	Explain various types of Operators, operations, relations, and techniques in programming	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.3	Demonstrate gaming basics	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.4	Execute various Operations on Linked lists	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.5	Explore various applications of the techniques.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.6	Solving various problems of Binary Trees, insertion, deletion and updation.	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

WEEK 1 - Introduction- Execution of a program, Decimal - Binary conversion, Ranges of Data Types and constraints, Complexity Analysis of Algorithms, Big-O Notation, Time & Space Analysis and Constraints, Importance of constraints

WEEK 2 - Bit-Manipulation, Bitwise operators, Bit-masking, Modular Arithmetic, Recursion, Thinking Recursively, Recurrence Relations, Sorting Techniques, Two Pointer Technique

WEEK 3 - Binary Search, Applications of Binary Search, Lower Bound & Upper Bound, Finding Frequency, Optimization problems, Hashing, Hashing Techniques, Collision Resolutions, Inbuilt Libraries

WEEK 4 - Maps and Sets, Subarrays and Sub sequences, String matching, Sieve of Eratosthenes, Segmented Sieve, Game Theory, Nims Game, Counting Game

WEEK 5 - Prefix and Suffix concepts, Collecting water, Stacks, Balanced Parentheses, Largest Histogram Area, Queues, Sliding Window Maximum

WEEK 6 - Linked Lists, Various Operations on linked lists, LRU Cache, Cloning Linked list with random pointer, Doubly-linked list

WEEK 7 - Binary Trees, BT and FBT, Traversals, Various operations on Binary Trees, Binary Search Trees, Insertion, Updating and Deletion

WEEK 8 - More Problems on Binary Trees, Iterative Traversals, Least Common Ancestor, Heaps, Quick Select, Running Median, Trie, Introduction and Implementation

WEEK 9 - Problems on Tries, Maximum XOR pair, Partitioning of string, 1D Dynamic Programming, Approaching DP problem, Problems on Overlapping subproblems, Problems on Optimal Substructure, Longest Increasing Subsequence

WEEK 10 - 2D Dynamic Programming, Compute NCR, Knapsack, Matrix chain multiplication, Graphs, Introduction and Implementation, Dijkstra, Topological sort**.**	
Assessment	
Mode of Delivery	Offline / Online
No. of transferable credits for redemption	9 (Nine)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC02 Web Technologies – Transferring to Practice 2 0 8 6

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Demy Software Solutions, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC02. 1	Learn the basics and application of HTML	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 2	Understand the CSS3 module operation	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 3	Explain JAVA script and its application	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 4	Demonstrate the basics of jQuery	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 5	Study the basics of Bootstrap and its application	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC02. 6	Understand the basics of Angular JS	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Module 1

Introduction HTML, HTML Basics, HTML Elements, HTML5 Semantic, HTML Attributes, HTML Headings, HTML Paragraph, HTML Styles, HTML Formatting, HTML Quotations, HTML Computer Code, HTML Comments & Colours, HTML CSS, Links and Images, HTML Lists, HTML Blocks, HTML Classes, HTML Layout, HTML Responsive, HTMLI frames, HTML JavaScript, HTML Head, HTML Entities and URI Code, HTML Symbols and XHTML, HTML Charset and Forms

Module 2

Introduction CSS3, CSS3 Syntax, CSS3 How To, CSS3 Colours, CSS3 Backgrounds, CSS3 Boarders, CSS Padding, CSS Height/Width, CSS3 Gradients, CSS3 Shadows, CSS3 Text, CSS3 Fonts, CSS3 2D Transforms, CSS3 3D Transforms, CSS Links, CSS Lists, CSS Tables, CSS Box Model, CSS Outline, CSS Display, CSS Max- width, CSS Position, CSS Float, CSS Inline-block, CSS Align, CSS Combinators, CSS Pseudo-class, CSS Pseudo- element, CSS Navigation Bar, CSS Dropdowns, CSS Tooltips, CSS3 Images, CSS Attr Selectors, CSS Forms, CSS Counters, CSS3 Animations, CSS3 Buttons, CSS3 Pagination, CSS3 Multiple Columns, CSS3 User Interface, CSS3 Box Sizing, CSS3 Filters, CSS3 Media Queries, CSS3 Responsive

Module 3:

Introduction to JavaScript, Java Script Language Basics, JavaScript Objects, JavaScript Scope, JavaScript Events, JavaScript Strings, JavaScript Numbers, JavaScript Math, JavaScript Arrays, JavaScript Boolean, JavaScript Comparisons, JavaScript Conditions, JavaScript Switch, JavaScript Loops, JavaScript Type Conversion, JavaScript RegExp, JavaScript Errors, JavaScript Debugging, JavaScript Hoisting, JavaScript Strict Mode, JavaScript Functions, JavaScript Objects, JavaScript Forms, JavaScript HTML DOM, JavaScript BOM

Module 4:

Introduction to jQuery, jQuery Syntax, jQuery Selectors, jQuery Events, jQuery Effects, jQuery HTML, jQuery Traversing, jQuery AJAX, jQuery Misc.

Module 5:

Introduction to Bootstrap, Bootstrap Basics, Bootstrap Grids, Bootstrap Themes, Bootstrap CSS, Bootstrap JS

Module 6:

Introduction to AngularJS, AngularJS Expressions, AngularJS Modules, AngularJS Data Binding, AngularJS Scopes, AngularJS Directives & Events, AngularJS Controllers, AngularJS Filters, AngularJS Services, AngularJS HTTP, AngularJS Tables, AngularJS Select, Fetching Data from MySQL, AngularJS Validation, AngularJS API, AngularJS Animations, AngularJS i18n and i10n

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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Board of Studies

ICC 20ICC03 Java Spring boot 2 0 8 6

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Demy Software Solutions, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC03.1	Understand the JAVA programming.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.2	Execute various methods in JAVA programming	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.3	Study and execute the OOPS concept	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.4	Demonstrate the debugging and testing of units	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.5	Learn the basics of Spring Boot	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC03.6	Explore the applications of Spring Boot and JAVA	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Java

Introduction to the course, software tools set up, Introduction about programming, Hello World Project and defining the main method. Variables, Starting with out expressions, Primitive data types, byte short, float, char, Boolean, double, casting.

Operators, operands, expressions. If else statement, Bit wise Operator, Ternary operator, Operator precedence and operator challenge. Keywords and expressions, statements white space and Indentation, code blocks, if then else statement.

Methods in Java, final Method. Code problems on JAVA - HACKERRANK. Method Overloading and Over riding, Control flow statements - if else, while do while, Problems on coding - Prime Number, Even Number, Fibonacci series

OOPS concept - classes, constructors and inheritance, composition, encapsulation, polymorphism, Arrays, Java list, Auto boxing and unboxing. Inner and Abstract classes and interfaces, Java Generics, Naming conventions and package, static and final keywords.

Java Collections, Debugging and unit testing, Data Bases. Basic input and output including Java.util, Concurrency in Java, Lambda expression, regular expressions

Spring Boot:

Introduction to Spring Boot - Build a hello world API, Understanding Spring boot project, Auto configuration. Create a Spring boot web application development, overview of spring boot project. Annotations, step by step code and debugging

Introduction to Junits, Mockito. Spring boot deep dive with rest API

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC04 Robotic Process Automation 2 0 8 6

Duration	240 hours (2 hours theory and 14 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC04.1	Explore the Robotic Automation Process	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 2	Understand the Process Flow and basic inputs and outputs	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 3	Demonstrate the functioning of Business Objects	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 4	Demonstrate the application of Object Studio attributes	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 5	Explain the Case management and additional features	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC04. 6	Understand the functioning of Error management	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Module: 1 – Robotic Automation Process Studio

Running a Process, Basic Skills, Process Validation, Decision Stage, Calculation Stage, Data Items

Module: 2 – Process Flow

Decisions, Circular Paths, Controlling Play, Set Next Stage, Breakpoints, Collections and Loops, Layers of Logic, Pages for Organization

Module: 3 – Inputs and outputs

Input Parameters, Stepping and Pages, Data Item Visibility, Data Types, Output Parameters, Start-up Parameters, Control Room, Process Outputs

Module: 4 – Business Objects

Object Studio, Business Objects, BLUE PRISM CONTENT, Action Stage, Inputs and Outputs, The Process Layer

Module: 5 – Object Studio

Creating a Business Object, Application Modeler, Spying Elements, Attributes, Attribute Selection, Launch, Wait, , Timeouts, Terminate, Write, Press, Attach and Detach, Read, Actions, Action Inputs and Outputs, Data Items as Inputs

Module: 6 – Error Management

Exception Handling, Recover and Resume, Throwing Exceptions, Preserving the Current Exception, Exception Bubbling, Exception Blocks, Exception Handling in Practice.

Module: 7 – Case Management

Queue Items Commercial in Confidence, BLUE PRISM CONTENT, Work Queue Configuration, Defer, Attempts, Pause and Resume, Filters Reports **Module: 8 – Additional Features** Safe Stop, Collection Actions, Choice Stage, Logging, Log Viewer, System Manager, Process/Business Object , Grouping, Process and Object References, Export and Import **Module: 9 – Consolidation Exercise** Order System Process
Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC05 Information Security and Forensics 2 0 8 6

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC05. 1	Understand the basic terminology of various servers, networking, security and hacking.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 2	Explore the web applications, testing, debugging, hacking, etc.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 3	Understand the coding techniques	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 4	Demonstrating the usage of tools for testing, hacking, etc.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 5	Execute the code using various algorithms	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC05. 6	Perform various case studies to dive deep.	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Domain 1 – Introduction & Terminology

Global Anonymous: Proxy Server, TOR Browser, VPN, SOCKS, RDP, Psiphon, Surface Web, Deep Web, Dark Web, etc., Terminology about Web, Servers, Systems, Network Programming Languages, Hacking, IT Security, Intro to OWASP Top 10 Vulnerability. Intro to Bug Bounty & Enterprise Security and Risk Management with IT Security Life Cycle, Case Studies of Hacking, IT Security & C Forensics. Phishing + Live Hacking Impact Demonstration

Domain 2 – Hacking to Explore

Web Application Penetration Testing based in OWASP TOP 10 Vulnerabilities with Live Ex. Live Demonstration of SQLi, XSS, CSRF, and other bugs with tools and with Manual Testing. Bug Bounty, Latest CMS Exploitation, Cryptography & Practical Implementation, SSL Vulnerabilities & Live Testing, Mobile Hacking, Sniffing, Virus, Ransomware, Intro to Carding & Luhn algorithm

Domain 3 – Defence in Depth

Secure Code Review & Code Brabbing Techniques, Enterprise Security, Risk Management & Report, Tools & Web Apps Penetration Testing, Hacking Attacks & Case Studies, WAF, Firewall, Honeypots, UTM, Introduction to Security Compliance, Introduction to Mobile Apps Pen testing, Defence for Vulnerabilities

Domain 4 – Hacking Automation

Virtualization, Tools for Penetration Testing & Hacking, Kali Linux & It's Applications with Uses, Cloud Security & It's Fundamentals, SQLMAP, Metasploit, nmap etc, Exploits & Incident Response Analysis, Intro to Exploit Development & Research.

Assessment	
Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC06 Battery System – Design Engineering 2 0 8 6

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Vihaan Electrix, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC06. 1	Determine specifications of the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.2	Design the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.3	evaluate each design option based on parameters such as safety, performance and cost	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.4	Testing and validation of the design	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.5	perform safety test to minimize overcharging and overheating	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC06.6	perform failure mode and effect analysis of the Battery System	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Determining specifications of the Battery system

Electric Vehicle level specifications, EV specifications into Battery System level specifications, Battery potential and load requirement based on Electric Vehicle specification, list various design options / specifications available at each component level of the Battery system, selection of battery system specifications to suit specifications of cells and modules, Battery system circuit based on Battery application, electrical, mechanical or thermal interface requirements, statistical modelling and state diagrams for the battery operations.

Designing the Battery system:

Cross-functional partners to integrate the battery into the final system, designing, building, and testing code to satisfy design requirements, hardware, and software systems for battery protection, charging and gauging, design connections between anode / cathode terminals through use of suitable busbars, simulations of the designed circuit, charging and discharging ofthe battery in a controlled manner.

Testing and validation of the design:

design areas where checking and testing is essential, requirements for continuous automation test case, correct application for activation, using technologies of traction battery and battery charger.

Performing safety test:

test plans for batteries at the component and system level, safety test to minimize overcharging and overheating.

Performing cycle test:

failure mode and effect analysis (FMEA) of the battery system, SoC for determining electrolyte's specific gravity in each cell

by using hydrometer. **Performing load test:** load testing to remove AMPS from a battery, electrical worst-case (circuit performance), rigorous failure /root cause on battery related problems.
Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC07 Block Chain Technology 2 0 8 6

Duration	150 hours (2 hours theory and 14 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC07.1	Learn basics of Blockchain	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.2	Understand various Types of Blockchain	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.3	Demonstrate the concepts of Blockchain	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.4	Study the basics of Ethereum	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.5	Learn Solidity	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC07.6	Implement the Dapp	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Introduction to Blockchain

Definition of Blockchain, History of Blockchain, Explaining Distributed Ledger, Blockchain ecosystem, Explaining Distributed Ledger

Types of Blockchain

Private/Consortium/Permission-less, Public/Permissioned implementation difference, What Blockchain has to offer across Industry? Companies currently using Blockchain, Overview of what we are going to study in this course,

Key Concepts of the Blockchain

Mining -Mining algorithm, Node, peer, and block explanation, Merkle tree and Blockchain, Consensus Mechanisms- proof of work, proof of stake, How Bitcoin Blockchain works? What is Transaction?

Introduction to Ethereum

Ethereum: Blockchain with smart contract, What is Ether? Bitcoin vs Ethereum Blockchain, What is Ethereum wallet? What is Smart Contract? Ethereum clients, Geth Introduction, Setting up Private Blockchain using Geth.

Learn Solidity

Introduction to solidity, Hands on solidity, Understand and implement different use cases, Implement and deploy smart contract on Blockchain.

Implement Dapp

Setting up the environment, Tools to install - Truffle, MetaMask ,Testrpc, Implement and deploy your first Dapp, Different use cases for implementation of Dapp.

Future Scope

Talk about the future of the Blockchain, What is Hyperledger? What is Hash graph? Discussion on current

research on Blockchain, Understand current industry challenges and needs.	
Assessment	
Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC08 Network Administration 2 0 8 6

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC08.1	Understand the processes of updation, Installation of Operating System.	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.2	Understand the mapping of Hardware devices	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.3	Demonstrate the management of group and Computer accounts	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.4	Explain the File System Management	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.5	Study the server administration	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC08.6	Explore the disaster recovery	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Overview of Networking.

Installing or Upgrading a Network Operating System, Preparing for installation, Installing from different installation mediums, Upgrade process, Identifying setup errors

Managing Hardware Devices

Understanding device drivers and PnP. Adding new devices. Hardware resource settings and driver signing, Hardware profiles

Creating and Managing Accounts

User authentication. User profiles. Creating, managing and troubleshooting user accounts.

Implementing Group and Computer Accounts

Creating group objects. Group types and scopes. Build-in groups. Creating and managing computer accounts.

Managing File Access

Introduction to file systems. Creating and managing shared folders. Managing shared folder permissions. NTFS permissions

Managing Disks and Data Storage

Disk management concepts. Managing partitions and volumes. Fault tolerant disk strategies. Monitoring disk health. Disk utilities.

Advanced File System Management

File and folder attributes. Advanced attributes. Disk quotas The distributed file system.

Implementing and Managing Printers

Installing and sharing printers, Configuring and managing printer resources. **Using Group Policy** Creating and editing group policy objects. Group policy inheritance. **Server Administration** Procedures and standards. Terminal services and remote administration. Delegating administrative authority. Software update services. **Monitoring Server Performance and Disaster Recovery** Task manager, event viewer and performance console. Planning disaster recovery. Backing up data. Automated system recovery.
Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC09 Product Engineering 2 0 14 9

Duration	240 hours (2 hours theory and 14 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC09.1	Understand the basics of Manufacturing Process	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.2	Explain the Manufacturing Design	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.3	Explore various Production Processes	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.4	Demonstrate various Production Machine Operations	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.5	Study the Product monitoring	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC09.6	Execute the Product Logistics	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Deliverables

Manufacturing Process Overview

Product concepts, Market feasibility, Engineering design, Prototyping, Production, Marketing/sales

Manufacturing Design

Product analysis: Materials, Cost

Production methods: Assembly lines, Work cells, Inventory, Work flow

Quality control: Production monitoring, Product testing

Production Processes

Machine and process overviews: Boring and machining, Presses, Molding/Casting, Welding, Finishing, Assembly

Materials: Applicable types, Cost, Availability

Production Machine Operations

Presses, Molding/Casting, Drilling/Boring, Machining, Welding, Finishing, Advanced Intelligence, Automation, Programmable Logic Controllers

Production Monitoring

Monitoring production processes: Baselines, Environmental control

Quality improvement: Production improvement

Finished Product Logistics

Delivery methods, Delivery options, Customer interaction

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC10 Machine Learning Engineer 2 0 8 6

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Vihaan Electrix, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC10.1	Evaluate the existing Machine Learning (ML) processes	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.2	Analyse large and complex datasets to extract insights and select the appropriate technique to be used	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.3	Develop models to achieve the business objectives	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.4	Analyses the machine learning algorithms that could be used to solve a given problem	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.5	Perform statistical analysis to resolve data set problems	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC10.6	Train models and optimize their hyper-parameters	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

Deliverables

Prepare to Develop Machine Learning (ML) Systems:

Machine Learning (ML) processes, appropriate datasets and data representation methods, large and complex datasets to extract insights, need of retraining the existing machine programs based on objectives, data validation strategies, pre-processing or feature engineering for a given dataset, data augmentation pipelines, models to achieve the business objectives, along with the relevant metrics to track.

Develop and Assist in the Implementation of Machine Learning (ML) Systems:

Machine learning algorithms, Logistic Regression, and Naive Bayes, based on statistical modelling procedures, data cleaning to remove the irrelevant data and ensure its quality and accuracy, data acquisition process, prepare the data by transforming textual and graphical data into numbers for use in the machine learning system, create data pipeline depending on the machine learning application needs Linear Regression, , differences in data distribution, statistical analysis to resolve data set problems, solve complex problems with multi-layered data sets, use data modelling and evaluation strategy to find patterns and predict unseen instances, evaluate and transform data science prototypes.

Perform machine learning tests:

Design machine learning systems/applications and self-running Artificial Intelligence (AI) software to automate predictive models, carry out machine learning tests, interpret the test results and make appropriate adjustments based on test results, carry out research and implement best practices to improve the existing machine learning infrastructure, optimize existing machine learning libraries and frameworks based on testing, create useful information from unstructured data by auto-tagging images and text-to-speech conversions.

Train and retrain models:

Train models and optimize their hyper-parameters, analyses the errors of the model and develop appropriate strategies to rectify them, retrain the existing systems based on new machine learning model, document the machine learning processesas per the organizational policy, follow the latest machine learning developments and technologies**.**	
Assessment	
Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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ICC 20ICC11 Data Scientist 2 0 8 6

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. Vihaan Electrix, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC11. 1	Determine specifications of the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11. 2	Design the Battery system	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11. 3	evaluate each design option based on parameters such as safety, performance and cost	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11. 4	Testing and validation of the design	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11. 5	perform safety test to minimize overcharging and overheating	1, 2, 3, PSO #1	3	L1, L2, L3
20ICC11. 6	perform failure mode and effect analysis of the Battery System	1, 2, 3, PSO #1	3	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

Deliverables

Determining specifications of the Battery system

Electric Vehicle level specifications, EV specifications into Battery System level specifications, Battery potential and load requirement based on Electric Vehicle specification, list various design options / specifications available at each component level of the Battery system, selection of battery system specifications to suit specifications of cells and modules, Battery system circuit based on Battery application, electrical, mechanical or thermal interface requirements, statistical modelling and state diagrams for the battery operations.

Designing the Battery system:

Cross-functional partners to integrate the battery into the final system, designing, building, and testing code to satisfy design requirements, hardware, and software systems for battery protection, charging and gauging, design connections between anode / cathode terminals through use of suitable busbars, simulations of the designed circuit, charging and discharging ofthe battery in a controlled manner.

Testing and validation of the design:

design areas where checking and testing is essential, requirements for continuous automation test case, correct application for activation, using technologies of traction battery and battery charger.

Performing safety test:

test plans for batteries at the component and system level, safety test to minimize overcharging and overheating.

Performing cycle test:

failure mode and effect analysis (FMEA) of the battery system, SoC for determining electrolyte's specific gravity in each cell by using hydrometer. **Performing load test:** load testing to remove AMPS from a battery, electrical worst-case (circuit performance), rigorous failure /root cause on battery related problems.
Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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N Viswanadha Raju

Chairman
Board of Studies

ICC 20ICC12 Industrial IoT 2 0 8 6

Duration	150 hours (2 hours theory and 8 hours practical per week) as specified above
Industry Collaborator	M/s. HMI Engineering Services, Visakhapatnam

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

Code	Course Outcomes	Mapping with POs		DoK
		POs / PSOs	Weight	
20ICC12.1	Understand the basics of IIOT & IOT	1, 2, 3 & PSO1	3	L1-L3
20ICC12.2	Demonstrate the components of IIOT & IOT	1, 2, 3 & PSO1	3	L1-L3
20ICC12.3	Describe the Communication Technologies of IIoT	1, 2, 3 & PSO1	3	L1-L3
20ICC12.4	Analyze the Visualization and Data Types of IIoT	1, 2, 3 & PSO1	3	L1-L3
20ICC12.5	Describe the methods of Retrieving the data	1, 2, 3 & PSO1	3	L1-L3
20ICC12.6	Explain the Control & Supervisory Level of Automation	1, 2, 3 & PSO1	3	L1-L3

Deliverables

MODULE 1: Introduction & Architecture

Theory

IIoT and connected world, the difference between IoT and IIoT, Architecture of IIoT, IOT node, Challenges of IIOT.

Practice

Introduction to Arduino, ESp8266, Introduction to raspberry Pi.

MODULE 2: IIOT Components

Theory

Fundamentals of Control System, introductions, components, closed loop & open loop system.

Introduction to Sensors (Description and Working principle): Sensor, Types of sensors, working principle of basic Sensors - Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11). Digital switch, Electro Mechanical switches.

Practice

Measurement of temperature & pressure values of the process using raspberry pi/node mcu.

Modules and Sensors Interfacing (IR sensor, Ultrasonic sensors, Soil moisture sensor) using Raspberry pi/node mcu.

Modules and Actuators Interfacing (Relay, Motor, Buzzer) using Raspberry pi/node mcu.

MODULE 3: Communication Technologies of IIoT

Theory

Communication Protocols: IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, BLE, NFC, RFID

Industry standards communication technology (LoRAWAN, OPC UA, MQTT), connecting into existing Modbus and Profibus technology, wireless network communication.

Practice

Demonstration of MQTT communication.

Demonstration of LoRa communication.

MODULE 4: Visualization and Data Types of IIoT

Theory

Front-end EDGE devices, Enterprise data for IIoT, Emerging descriptive data standards for IIoT, Cloud data base, Cloud computing, Fog or Edge computing. Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

Practice

Visualization of diverse sensor data using dashboard (part of IoT's 'control panel')

Sending alert message to the user. ways to control and interact with your environment)

MODULE 5: Retrieving Data

Theory

Extraction from Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

Practice

Device control using mobile Apps or through Web pages.

Machine to Machine communication.

MODULE 6: Control & Supervisory Level of Automation

Theory

Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA). HMI in an automation process, ERP & MES.

Practice

Digital logic gates programming using ladder diagram.

Implementation of Boolean expression using ladder diagram.

Simulation of PLC to understand the process control concept.

MODULE 7: Application of IIOT

Case study: Health monitoring, Iot smart city, Smart irrigation, Robot surveillance.

Assessment

Mode of Delivery	Offline / Online
No. of transferable credits for redemption	6 (Six)
Credits validity	7 years from the date of registration of the program and remains NIL after redemption for the award of the degree.
Dedicated certificate by the collaborating industries	Yes

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