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.
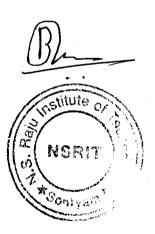
The Curriculum design, delivery, and assessment, the three major pillars of academic system are completely aligned in line with Outcome Based Education (OBE) to assess and evaluate the learning outcomes to facilitate the learners to achieve their Professional and Career Accomplishments.

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. Exhibit new age talents that use critical thinking and problem-solving skills in the rapidly changing tech landscape demands dynamism in addition to the application of fundamental and conceptual knowledge suggesting intelligent solutions that deploy algorithms to think and act humanly, think and act rationally
2. Sustain their satisfactory professional career in their own start-ups or as a team member/team lead in an IT or allied industry
3. Engage in self-directed learning and 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. Design and develop intelligent systems by applying analytical and programming skills to solve real world and engineering problems
2. Apply software tools and machine learning techniques to interpret data to arrive at knowledge to improve the performance of system

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

Semester I

No.	Course Code	Course	POs	Contact Hours				
				L	T	P	C	
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

No.	Course Code	Course	POs	L	T	P	C	
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	2	0	0	-	MC
		Sub-total		17	05	09	19.5	

Semester III

No.	Course Code	Course	POs	L	T	P	C	
01	20BSX16	Mathematical Foundations for Computer Science	1	3	1	0	3.0	BS
02	20AI302	Artificial Neural Networks	1, 3	3	1	0	3.0	PC
03	20CS303	Database Management Systems	1, PSO1	3	1	0	3.0	PC
04	20CS304	Object Oriented Programming through C++	1	3	1	0	3.0	PC
05	20CS305	Computer Organization	1	3	0	0	3.0	PC
06	20AI306	Artificial Neural Networks Programming Lab	4	-	-	3	1.5	PC
07	20CS307	Database Management Systems Laboratory	1, 4, PSO1	-	-	3	1.5	PC
08	20CS308	Object Oriented Programming through C++ Lab	1, 4	-	-	3	1.5	PC
09		MOOCs	12	0	0	0	2.0	SC
10	20MCX02	Constitution of India	8	2	-	0	-	MC
		Sub-total		18	4	9	21.5	

---

* Suggested hours for tutorial
[1] By default, all courses are mapped to PO 12 as they are weakly contributing

Semester IV

No.	Course Code	Course	POs	L	T	P	C	
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	20CS302	Design and Analysis of Algorithms	1, 2, 3	3	1	0	3.0	PC
06	20CS306	Design and Analysis of Algorithms Lab	4	0	0	3	1.5	PC
07	20AI406	Python Programming for Statistics Laboratory	4, 5	0	0	3	1.5	PC
08	20CS408	Operating Systems Lab	4	0	0	3	1.5	PC
09	20AIS02	Competitive Programming Essentials	3, 4, 5	1	0	2	2.0	SC
			Sub-total	16	3	11	21.5	

Semester V

No.	Course Code	Course	POs	L	T	P	C	
01	20CS405	Theory of Computation	1, 2	3	1	0	3.0	PC
02	20AI502	Artificial Intelligence	1, 2	3	1	0	3.0	PC
03	20AI503	High Performance Computing	2, 3, 5	3	1	0	3.0	PC
04	-	Open Elective I		3	0	0	3.0	OE
05	-	Professional Elective I		3	0	0	3.0	PE
06	20AI506	Application Development Laboratory	5, PSO1, PSO2	0	0	3	1.5	PC
07	20AI507	Artificial Intelligence Laboratory	4, 5	0	0	3	1.5	PC
08		MOOCs	12	0	0	0	2.0	SC
09	20MCX03	Intellectual Property Rights and Patents		2	0	0	0	MC
10		Summer Internship #1[2]	5, 8, 9, 10, PSO1	0	0	0	1.5	TG
11		Technical Paper Writing		0	0	2	-	AC
			Sub-total	17	3	08	21.5	

Semester VI

No.	Course Code	Course	POs	L	T	P	C	
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	Machine Learning	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	Machine Learning Lab	4, 5	0	0	3	1.5	PC
09	20AIS04	Datasets & Packages for ML Engineer - 1	4, 5	0	0	4	2.0	SC
10	20MCX04	Indian Traditional Knowledge		2	0	0	-	MC
			Sub-total	17	3	13	21.5	

Semester VII

No.	Course Code	Course	POs	L	T	P	C	
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	20SAI05	Datasets & Packages for ML Engineer - 2	4, 5	0	0	4	2.0	SC
08	-	Summer Internship #2[1]	All POs	0	0	0	3.0	TG
			Sub-total	16	0	8	23	

Semester VIII

No.	Course Code	Course	POs	L	T	P	C	
01		Full Semester Internship[3]	5 – 10, PSOs				06	
02		Capstone Project[3]	5 – 10, PSOs				06	
			Sub-total				12.0	
			Total Credits				**160**	

---

[2] The work pertaining to Summer Internship #1 and #2 shall be completed at the end of Semesters IV and VI respectively.
The assessment shall be carried out during Semesters V and VII
[3] Students opting for FSI in VII semester have to take up courses of VII semester in VIII semester

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 Health	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, Environmental & Resource Management	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
	20SHO02	Design Thinking	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	Intelligent Robots and Drone Technology	3	0	0	3.0	OE
43	20DSO03	Introduction to Big Data	3	0	0	3.0	OE
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

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	Speech and 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	Audio-Video 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
Category II							
8	20CEM02	Climate Change Mitigation and Adaptation	3	0	0	3.0	MI
9	20CSM02	Knowledge Discovery and Databases	3	0	0	3.0	MI
10	20MEM02	Micro Electromechanical Systems	3	0	0	3.0	MI
11	20EEM02	Design of Photovoltaic Systems	3	0	0	3.0	MI
12	20ECM02	Digital Electronics	3	0	0	3.0	MI
13	20AIM02	Machine Learning with Python	3	0	0	3.0	MI
14	20DSM02	Data Management and Analysis	3	0	0	3.0	MI
Category III							
15	20CEM03	Sustainability and Pollution Prevention Practices	3	0	0	3.0	MI
16	20CSM03	Database Security	3	0	0	3.0	MI
17	20MEM03	Surface Engineering	3	0	0	3.0	MI
18	20EEM03	Electrical Engineering Material Science	3	0	0	3.0	MI
19	20ECM03	Analog Electronic Circuits	3	0	0	3.0	MI
20	20AIM03	Interpretable Deep Learning	3	0	0	3.0	MI
21	20DSM03	Data Governance	3	0	0	3.0	MI

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

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

CONTROL COPY ATTESTED

NSRIT
Chairman
Board of Studies CSE (AI&ML)

PC 20AI502 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		
20AI502.1	Describe the foundational principles of artificial intelligence	3	2	1	L1, L2
20AI502.2	Formalise the given problem using different AI methods	3	2	1	L1, L2
20AI502.3	Explain different concepts of logic	3	2	1	L1, L2
20AI502.4	Describe the different methods of knowledge representation	3	2	1	L1, L2
20AI502.5	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

CONTROL COPY ATTESTED
Chairman
Board of Studies CSE (AI&ML)

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

CONTROL COPY ATTESTED

Chairman
Board of Studies CSE (AI&ML)

PC **20AI506 Application Development Lab**   0   0   3   1.5

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

Code	Course Outcomes	Mapping with POs		
		PO5	PSO1	PSO2
20AI506.1	Demonstrate android application hierarchy, UI components and their purpose	3	2	2
20AI506.2	Demonstrate the use of Android software development tools	3	2	2
20AI506.3	Develop applications using services and publishing android applications	3	2	2
20AI506.4	Configure and implement context menu and option menu as a part of android app	3	2	2
20AI506.5	Deploy application to mobiles	3	2	2

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

List of Experiments
1. Install the Android Studio and Setup the Development Environment
2. Create "Hello World" Application
    Create a new Android Project
    Run "Hello World" on the Emulator, on a physical device greeting the user
3. Develop mobile applications using GUI components, fonts and colors
4. Working with forms
5. Develop a native calculator application
6. Demonstrate list view
7. Create application by using building blocks for Android application design
    Design the application by using
        (a) Linear Layout
        (b) Relative Layout
        (c) Absolute Layout
7. Implement an application that implements multithreading.
8. Create an Android app that does a currency converter operation using an options menu
9. Develop a simple application with context menu and option menu
10. Implement an application that creates an alert upon receiving a message

Reference
1. Lab Manual for Application Development Lab Department of Computer Science and Engineering, NSRIT

CONTROL COPY ATTESTED

Chairman
Board of Studies CSE (AI&ML)

PC **20AI507 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
20AI507.1	Implement simple PEAS for the given AI tasks	3	3
20AI507.2	Implement the simulated annealing techniques for simple problems	3	3
20AI507.3	Implement the Genetic algorithm for simple problems	3	3
20AI507.4	Demonstrate the use of backtracking algorithms to solve problems	3	3
20AI507.5	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

CONTROL COPY ATTESTED
Chairman
Board of Studies CSE (AI&ML)

| | 20MCX03 Intellectual Property Rights and Patents | | 2 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	Acquireknowledgeonintellectualpropertyrights	-	-	L1,L2
20MCX03.2	Knowaboutheacquisition oftrademarks.	-	-	L1,L2
20MCX03.3	Identifytheimportanceofcopyrights,patentsand transferofOwnership.	-	--	L1, L2
20MCX03.4	Reciprocatetonewdevelopmentsofintellectualpropertyrights	-	-	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

UnitI: 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. Infringementof 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, and intern; development in trade secrets law.

Text Books

1. Intellectualpropertyright,Deborah,E. Bouchoux, Cengage learning.

2. Intellectual property right - Unleashing the knowledge economy, Prabuddha Ganguli,TataMcGraw Hill Publishing Company Ltd.

3. Cornish, William Rodolph & Llewelyn, David. Intellectual property:patents, copyright, trademarks and allied rights. Sweet& Maxwell,8/e,2013.

Reference Books

1. Cornish,WilliamRodolph.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.

CONTROL COPY ATTESTED

Chairman
Board of Studies (MBA)

IN   Summer Internship #1   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

CONTROL COPY ATTESTED
Chairman
Board of Studies CSE (AI&ML)

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

CONTROL COPY ATTESTED
Chairman
Board of Studies (CSE)

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

CONTROL COPY ATTESTED

Chairman ·
Board of Studies CSE(AI&ML)

PG 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: Introduction   9 +3 hours
Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

Terminologies of machine learning
            9 + 3 hours
Unit II: Deep Networks
History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization - Batch normalization- VC Nets-Deep Vs Shallow Networks - Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning

Design parameters of deep networks
            9+3 hours
Unit III: Dimensionality Reduction
Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization

Need for dimension reduction
            9+3 hours
Unit IV: Optimization and Generalization
Optimization in deep learning– non-convex optimization for deep networks- Stochastic Optimization - Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning

Computational Artificial Neuroscience

Unit V: Case Study and Applications   9+3 hours
Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint Detection - BioInformatics- Face Recognition-Scene Understanding- Gathering Image Captions

Face detection

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. 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

CONTROL COPY ATTESTED

_____Chairman
Board of Studies CSE(AI&ML)

PC **20AI603 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			
20AI603.1	Describe the essential elements of machine learning	3	2	1	1	L1, L2
20AI603.2	Explain the learning algorithms for tree-based models and rule-based models	3	2	1	1	L1, L2
20AI603.3	Describe the algorithms for linear models and distance-based models	3	2	1	1	L1, L2
20AI603.4	Describe various probabilistic models	3	2	1	1	L1, L2
20AI603.5	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 LearningII, 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

CONTROL COPY ATTESTED
Chairman
Board of Studies CSE(AI&ML)

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.

CONTROL COPY ATTESTED

Chairman
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

CONTROL COPY ATTESTED

Chairman
Board of Studies CSE(AI&ML)

PC 20AI608 Machine Learning Lab - 1   0   0   3   1.5

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

Code	Course Outcomes	Mapping with POs PO4
20AI608.1	Demonstrate the use of python packages for developing machine learning models	3
20AI608.2	Implement different classification algorithms	3
20AI608.3	Implement different clustering algorithms	3
20AI608.4	Develop machine learning models for performing prediction task	3
20AI608.5	Demonstrate handling of different types of data sets	3

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

CONTROL COPY ATTESTED
Chairman
Board of Studies CSE(AI&ML)

PC **20AIS04 Datasets and Packages for ML Engineer - 1**   **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	
20AIS04.1	Interpret and use different types of data sets for classification tasks	2	2	L1, L2, L3
20AIS04.2	Interpret and use different types of data sets for clustering tasks	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

Classification tasks: Binary classification (spam mail detection) – Multiclass classification (plant species classification) – Clustering tasks: document analysis – Prediction: House-price prediction, time-series data

Resources
1. https://data.mendeley.com/
2. https://deepmind.com/
3. https://www.kaggle.com
4. https://machinelearningmastery.com/

CONTROL COPY ATTESTED

Chairman
Board of Studies CSE(AI&ML)

20MCX04 Indian Traditional Knowledge   2   0   0   2

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   6 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 2: Protection of traditional knowledge   6 hours
The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT 3: Legal framework and TK   6 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 4: Traditional knowledge and intellectual property   6 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 5: Traditional Knowledge in Different Sectors   6 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. Amit Jha, "Traditional Knowledge System in India", 2009.

Reference Books:
1. Amit Jha, "Traditional Knowledge System in India", 2002
2. Kapil Kapoor, Michel Danino, "Knowledge Traditions and Practices of India", CBSE, 2012

Web Links:
1. https://www.youtube.com/watch?v=LZP1S...
2. http://nptel.ac.in/courses/121106003/

CONTROL COPY ATTESTED
Chairman
Board of Studies CSE(AI&ML)

| 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. William 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

CONTROL COPY ATTESTED

Chairman
Board of Studies CSE(AI&ML)

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.

CONTROL COPY ATTESTED

Chairman
Board of Studies CSE(AI&ML)

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 Security‖, 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.

CONTROL COPY ATTESTED

Chairman
Board of Studies CSE(AI&ML)

▓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

CONTROL COPY ATTESTED

Chairman
Board of Studies CSE(AI&ML)

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
20AI005.1	Understand the components of cyber security		L1, L2
20AI005.2	Describe the need of security for operating systems and networks		L1, L2
20AI005.3	Explain the countermeasures of security attacks	-	L1, L2
20AI005.4	Understand the importance of privacy		L1, L2
20AI005.5	Explain the implementation of organizational security		L1, L2

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 -Harm - Vulnerabilities - Controls - Authentication - Access Control and Cryptography - Web—User Side - Browser Attacks - Web Attacks Targeting Users - Obtaining User or Website Data

Email attacks

Unit II: Security in Operating Systems and Networks   **9 hours**
Security in Operating Systems - Security in the Design of Operating Systems -Rootkit - Network security attack- Threats to Network Communications - Wireless Network Security - Denial of Service

Distributed Denial-of-Service

Unit III: Security Countermeasures   **9 hours**
Firewalls - Intrusion Detection and Prevention Systems - Network Management - Databases - Security Requirements of Databases - Reliability and Integrity

Database disclosure

Unit IV: Privacy in Cyberspace   **9 hours**
Privacy Concepts -Privacy Principles and Policies -Authentication and Privacy - Data Mining -Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies

Advantages of privacy

Unit V: Organizational Security   **9 hours**
Policies, Procedures, Standards, and Guidelines - Security Awareness and Training - Interoperability Agreements - The Security Perimeter - Physical Security - Environmental Issues - Wireless - Electromagnetic Eavesdropping

Issues and challenges in organizational security

Text Books
1. Charles P. Pfleeger, Shari Lawrence and Pfleeger Jonathan Margulies, "Security in Computing", Fifth Edition, Pearson Education, 2015
2. George K. Kostopoulous, "Cyber Space and Cyber Security", CRC Press, 2013
3. Martti Lehto, Pekka Neittaanmäki, "Cyber Security: Analytics, Technology and Automation", Springer International Publishing Switzerland 2015

Reference Books
1. W.A.Coklin W. A. and White G., "Principles of Computer Security", Fourth Edition, McGrawHill, 2016
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. https://www.newhorizons.com/promotions/cybersecurity-ebooks

Internal Assessment Pattern

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

CONTROL COPY ATTESTED

Chairman
Board of Studies CSE(AI&ML)

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

CONTROL COPY ATTESTED

Chairman

Board of Studies CSE(AI&ML)

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?

CONTROL COPY ATTESTED

'Chairman

Board of Studies (CE)

| **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

CONTROL COPY ATTESTED

Chairman Board of Studies (CSE)

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

CONTROL COPY ATTESTED
Chairman
Board of Studies (CSE)

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,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 properties

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, branchld, branch_nm, br_city)
3. Construct a transaction state diagram and describe each state that a transaction goes through during its execution?
4. Demonstrate serializability concept

CONTROL COPY ATTESTED

Chairman
Board of Studies(CSE)

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

CONTROL COPY ATTESTED

- Chairman
Board of Studies (ECE)

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.

CONTROL COPY ATTESTED

Chairman
Board of Studies (EEE)

▨ 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.

CONTROLCOPYATTESTED

Chairman
Board of Studies (ME)

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

CONTROL COPY ATTESTED

Chairman
Board of Studies

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

CONTROL COPY ATTESTED

Chairman
Board of Studies (CSE)

⬛ 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

CONTROL COPY ATTESTED
Chairman
Board of Studies (CSE)

▉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?

CONTROL COPY ATTESTED

Chairman
Board of Studies (CSE)

▓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

CONTROL COPY ATTESTED

Chairman
Board of Studies (ECE)

▓▓ 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.

CONTROL COPY ATTESTED

Chairman
Board of Studies (EEE)

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.,/Pearso neducationinc.
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
L1: 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?

L2: 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?

L3: Classify
1. .Name the different cooling methods with neat sketches.
2. Describe with P-V diagrams the two used cycles for internal combustion engines.

L4: Interpret
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

CONTROLCOPYATTESTED

Chairman
Board of Studies (ME)

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
Naïve 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

CONTROL COPY ATTESTED
Chairman
Board of Studies CSE(AI&ML)

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

CONTROL COPY ATTESTED
Chairman
Board of Studies CSE (AI&ML)

20CEM01 Air Pollution   3   0   0   3

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

Code	Course Outcomes	Mapping withPOs	DoK
20CEM01.1	Identify different types of pollution and their sources		L1,L2
20CEM01.2	Identify the meteorological components		L1,L2
20CEM01.3	Outline the impact on local and global effects of air pollution on human, materials, properties and vegetation	-	L1,L2
20CEM01.4	Explain various types of air pollution control equipment and their working principles		L1,L2
20CEM01.5	Understand sampling methods and monitoring of air pollution		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
Definition of air pollution, Sources and causes of air pollution, Types and classification of air pollution - Natural contaminants,Particulate, Gases and Vapors, Primary and secondary air pollutants

Unit II: Meteorology   9 Hours
General atmospheric circulation, Atmospheric stability, Effect of meteorology on Plume dispersion, Inversion, Wind profiles andstack plume patterns

Unit III: Effects of Air Pollution   9 Hours
Effects of air pollution on human beings, plants and animals and properties. Global effects-Green house effect, Ozone depletion,heat island, dust storms, Automobile pollution sources and control, Photochemical smog

Unit IV: Air Pollution Control   9 Hours
Particulate matter and gaseous pollutants - Settling chambers, Cyclone separators, Scrubbers, Filters & Electrostatic precipitator

Unit V: Air Quality Sampling and Monitoring   9 Hours
Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants

Text Books

1. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, "Environmental Engineering", Mc Graw Hill, International Edition, 2017
2. Rao M. N., Rao H. V. N., "Air Pollution", 1st Edition, Mc Graw Hill, 2004

Reference Books

1. Martin, Crawford, "Air Pollution Control Theory", Tata McGraw Hill, New Delhi, 1986
2. Bulkeley, H., "Cities and Climate Change", Routledge, London, 2013
3. Rao C. S., "Environmental Pollution Control Engineering," Wiley Eastern Limited, New Delhi, 1992
4. Gurjar, B. R., Molina, L., Ojha, C. S. P., "Air Pollution: Health and Environmental Impacts", CRC Press, 2010

Web References

1. http://www.epa.gov
2. http://www.indiaenvironmentportal.org.in
3. http://nptel.iitm.ac.in
4. http://www.filtersource.com
5. https://dgserver.dgsnd.gov

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. Mention various sources of air pollution.
2. Define Atmospheric stability
3. Write a note on Ozone depletion
4. What are Filters & Electrostatic precipitators?

L2: Understand
1. What are Primary and secondary air pollutants?
2. Write the effect of effect of meteorology on Plume dispersion
3. Explain briefly about effects of air pollution on human beings, plants and animals and properties

CONTROL COPY ATTESTED

Chairman
Board of Studies

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

CONTROL COPY ATTESTED

Chairman
Board of Studies (CSE)

| | 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 replacementimplant: 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

CONTROLCOPYATTESTED

Chairman
Board of Studies(ME)

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.

CONTROL COPY ATTESTED

Chairman
Board of Studies (EEE)

| 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

CONTROL COPY ATTESTED

Chairman
Board of Studies (ECE)

▓▓ 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

CONTROL COPY ATTESTED
Chairman
Board of Studies (CSE)

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

CONTROL COPY ATTESTED

Chairman
Board of Studies (CSE)