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

No.	Course Code	Course	POs	Contact Hours				
				L	T*	P	C	
Semester I								
01	20HSX01	Communicative English	10	3	0	0	3.0	HS
02	20BSX11	Linear Algebra and Differential Equations	1, 12[1]	3	1	0	3.0	BS
03	20BSX33	Applied Physics	1	3	1	0	3.0	BS
04	20ESX02	Programming for Problem Solving using 'C'	1	1	0	4	3.0	ES
05	20CS101	Fundamentals of Computer Science	1	3	0	0	3.0	ES
06	20HSX02	Communicative English Laboratory	1, 10	-	-	3	1.5	BS
07	20BSX34	Applied Physics Laboratory	1, 4	-	-	3	1.5	HS
08	20ESX07	Programming for Problem Solving using 'C' Lab	1, 4	-	-	3	1.5	ES
			Sub-total	13	02	13	**19.5**	
Semester II								
01	20BSX12	Partial Differential Equations and Vector Calculus	1	3	1	0	3.0	BS
02	20BSX23	Applied Chemistry	1	3	1	0	3.0	BS
03	20ESX05	Basic Electrical and Electronics Engineering	1	3	1	0	3.0	ES
04	20CS201	Data Structures using 'C'	1	3	1	0	3.0	ES
05	20EC203	Digital Logic Design	1	3	1	0	3.0	ES
06	20BSX24	Applied Chemistry Laboratory	1, 4	0	0	3	1.5	BS
07	20CS202	Data Structures using 'C' Laboratory	1, 4	0	0	3	1.5	ES
08	20ESX08	Basic Electrical & Electronics Engineering Lab	1, 4	0	0	3	1.5	ES
09	20MCX01	Environmental Science	1	2	0	0	-	MC
			Sub-total	17	05	09	**19.5**	
Semester III								
01	20BSX16	Mathematical Foundations for Computer Science	1	3	1	0	3.0	BS
02	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

No.	Course Code	Course	POs	Contact Hours				
				L	T	P	C	
Semester IV								
01	20HSX03	Managerial Economics & Financial Analysis	11	3	0	0	3.0	HS
02	20BSX15	Probability and Statistics	2, 5	3	1	0	3.0	BS
03	20CS502	Computer Networks	1, 2	3	0	0	3.0	PC
04	20CS404	Operating Systems	1	3	1	0	3.0	PC
05	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								
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	Machine Learning	1, 2, 3	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	Machine Learning Laboratory - 1	4	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								
01	20CS603	Modern Software Engineering	1, 2, 3	3	0	0	3.0	PC
02	20AI602	High Performance Computing	2, 3, 5	3	1	0	3.0	PC
03	20AI603	Deep Learning Principles and Practices	2, 3, 5	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	20AI606	High Performance Computing Laboratory	4, 5	0	0	3	1.5	PC
07	20AI607	Machine Learning Laboratory - 2	4, 5	0	0	3	1.5	PC
08	20AI608	Application Development Laboratory	5, PSO1, PSO2	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								
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								
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	Video Analytics		3	0	0	3.0	PE
3	20AI003	Fundamentals of Natural Language Processing		3	0	0	3.0	PE
4	20AI004	Cyber Security		3	0	0	3.0	PE
5	20AI005	Social Network Analysis		3	0	0	3.0	PE
6	20AI006	Fundamentals of Business Intelligence		3	0	0	3.0	PE
Professional Elective #2								
7	20AI007	Computer Vision in Healthcare Applications		3	1	0	3.0	PE
8	20AI008	Perception and Algorithms		3	0	0	3.0	PE
9	20AI009	Speech and Language Processing for Text		3	1	0	3.0	PE
10	20AI010	Blockchain Technology		3	0	0	3.0	PE
11	20AI011	Sentiment Analysis		3	0	0	3.0	PE
12	20AI012	Intelligent Multiagent and Expert Systems		3	0	0	3.0	PE
Professional Elective #3								
13	20AI013	Bioinformatics		3	0	0	3.0	PE
14	20AI014	Audio/Video Forensics		3	0	0	3.0	PE
15	20AI015	Speech and Language Processing for Audio		3	1	0	3.0	PE
16	20AI016	Cyber Threat Intelligence		3	1	0	3.0	PE
17	20AI017	Fundamentals of Digital Marketing		3	1	0	3.0	PE
18	20AI018	Fundamentals of Robot and Drone Technology		3	0	0	3.0	PE
Professional Elective #4								
19	20AI019	Soft Computing in Medical Diagnostics		3	0	0	3.0	PE
20	20AI020	Evolutionary Computation for Video Processing		3	0	0	3.0	PE
21	20AI021	Design of Virtual/Voice Assistants		3	0	0	3.0	PE
22	20AI022	Malware Analysis in Data Science		3	0	0	3.0	PE
23	20AI023	AI & ML for Digital Marketing		3	0	0	3.0	PE
24	20AI024	Reinforcement and Ensemble Learning		3	0	0	3.0	PE
Professional Elective #5								
The curriculum provides academic flexibility to choose any of the domain specific courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration (4-credits) and the assessment shall be as per the academic regulation 2020.								PE
Open Elective #1								
25	20CEO01	Urban Environmental Service		3	0	0	3.0	OE
26	20CSO01	Data Structures and Algorithms		3	0	0	3.0	OE
27	20AIO01	Machine Learning for Engineers		3	0	0	3.0	OE
28	20DSO01	Introduction to Database Management Systems		3	0	0	3.0	OE
29	20ECO01	Architecture and Algorithms of IoT		3	0	0	3.0	OE
30	20EEO01	Introduction to Renewable Energy Sources		3	0	0	3.0	OE
31	20MEO01	Nano Technology		3	0	0	3.0	OE
32	20SHO01	Women and Society		3	0	0	3.0	OE
Open Elective #2								
33	20CEO02	Ecology, Environment and Resources		3	0	0	3.0	OE
34	20CS004	Internet of Things		3	0	0	3.0	OE
35	20AIO02	Fundamentals of Deep Learning		3	0	0	3.0	OE
36	20DSO02	Introduction to Data Science		3	0	0	3.0	OE
37	20ECO02	IoT for Smart Grids		3	0	0	3.0	OE
38	20EEO02	Electrical Safety and Management		3	0	0	3.0	OE
39	20MEO02	Fundamentals of Automobile Engineering		3	0	0	3.0	OE
Open Elective #3								
39	20CEO03	Disaster, Risk mitigation and Management		3	0	0	3.0	OE
40	20CS302	Operating Systems		3	0	0	3.0	OE
41	20AIO03	Intelligent Robots and Drone Technology		3	0	0	3.0	OE
42	20DSO03	Introduction to Big Data		3	0	0	3.0	OE
43	20ECO03	Privacy and Security in IoT		3	0	0	3.0	OE
44	20EEO03	Low-cost Automation		3	0	0	3.0	OE
45	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	20AIH01	Advanced Data Structures		4	0	0	4.0	HO
2	20AIH02	Advanced Database Management Systems		4	0	0	4.0	HO
3	20AIH03	Advanced Computer Architecture		4	0	0	4.0	HO
Category II								
4	20AIH04	Distributed Systems		4	0	0	4.0	HO
5	20AIH05	Design Patterns		4	0	0	4.0	HO
6	20AIH06	Information Retrieval Systems		4	0	0	4.0	HO
Category III								
7	20AIH07	Cryptography and Information Security		4	0	0	4.0	HO
8	20AIH08	Web Development Frameworks		4	0	0	4.0	HO
9	20AIH09	Exploratory Data Analytics		4	0	0	4.0	HO
Category IV								
10	20AIH10	Big Data Analytics		4	0	0	4.0	HO
11	20AIH11	Human Computer Interaction		4	0	0	4.0	HO
12	20AIH12	Qualitative Data Analytics		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 IIII								
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. Advanced Architecture
2. Web development
3. Data Analytics

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

1. Machine Learning and Deep Learning

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

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

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

Unit I: Mathematical logic. **11+1 Hours**

Propositional Calculus: Statements and Notations -Connectives - Well-formed Formulas - Truth Tables - Tautology – Equivalence Implication- principal disjunctive and conjunctive normal forms, Rules of Inference for Statement Logic - Proof Techniques - Proof by Contradiction.

Predicate Calculus: Predicative logic, free & bound variables, quantifiers, rules of inference.

Disjunctive and Conjunctive normal forms

Unit II: Binary Relations, Functions and Algebraic Structures. **11+1 Hours**

Binary Relations - Properties and Operations - Relational Graphs - Relation Matrices – Equivalence Relations - Partial Ordering Relations - Hasse Diagram.

Functions – Types of functions - Composition of Functions-Permutation and Recursive Functions.

Algebraic Structures(Definitions and simple illustrations) - Semi Groups – Monoids – Groups - Abelian Groups – Subgroups.

Algebraic Structures(Definitions and simple illustrations), Inverse functions

Unit III: Number Theory. **11+1 Hours**

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

Chinese Remainder theorem

Unit IV: Recurrence Relations. **11+1 Hours**

Generating Functions - Function of Sequences -Calculating Coefficient of Generating Functions.

Recurrence Relations - Solving Recurrence Relation by Substitution- solving homogeneous linear recurrence relations by characteristic roots method- non homogeneous linear recurrence relations

Applications: Algorithm Analysis - Time and Space Complexity

Unit V: Graph Theory(All theorems without proof). **11+1 Hours**

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

Operations on Graphs

Textbooks:

1.Kenneth H. Rosen, "Discrete Mathematics and Applications", 7th Edition, Tata McGraw Hill, 2015.
2. Mott J. L, Kandel A & Baker T. P, Discrete Mathematics for Computer Scientists & Mathematicians, 2nd Edition, Prentice Hall ,India, 2010.
3. Santha. S, Prasad. E.V," Mathematical Foundation for computer Science" 1st Edition, Cengage, 2017.

Reference Books:

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

Web References:

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

Internal Assessment Pattern

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

L1: Remember

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

L2: Understand

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

L3: Apply

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

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Chairman
Board of Studies
(Mathematics)

PC 20AI302 Artificial Neural Networks 3 1 0 3

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

Code	Course Outcomes	Mapping with POs		PO12	DoK
		PO1	PO3		
20AI302.1	Explain the building blocks and operations of artificial neural networks	3	2	1	L1, L2
20AI302.2	Explain architecture, taxonomy and functions of several neural networks	3	2	1	L1, L2
20AI302.3	Describe the structure, function, and applications of single layered feed forward networks	3	2	1	L1, L2
20AI302.4	Describe the structure, function, and applications of multi layered feed forward networks	3	2	1	L1, L2
20AI302.5	Describe the principles and implementations of associative memories	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 Neural Networks **9 + 2 Hours**

Introduction, Artificial Neural Networks, Historical Development of Neural Networks, Model of a Neuron, Biological Neural Networks, Comparison Between Biological and Neural Network, Basic Building Blocks of Artificial Neural Networks, Artificial Neural Network (ANN) Terminologies, Basic Learning Laws (Hebb's Law, Perceptron Learning Law, Delta Learning Law, Widrow and Hoff LMS, Correlation Learning Law), Knowledge Representation.

ANS data structures

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

Introduction, McCulloch-Pitts Neuron Model Architecture, Learning Rules, Hebb Net Architecture.

Supervised Learning & Unsupervised Learning

Unit III: Single Layered Feed Forward Networks **9 + 3 Hours**

Introduction, Adaptive Filtering Problem, Linear Least-Square Filters, Least-Mean-Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron, Perceptron Convergence Theorem, Relation Between the Perceptron and Bayes Classifier for a Gaussian Environment.

Types of Feed Forward Networks

Unit IV: Multi-Layered Feed Forward Networks **9 + 4 Hours**

Introduction, Preliminaries, Back-Propagation Algorithm, Summary of the Back-Propagation Algorithm, XOR Problem, Heuristics for Making the Back-Propagation Algorithm Perform Better, Output Representation and Decision Rule, Feature Detection, Back-Propagation and Differentiation, Generalization, Approximations of Functions, Cross-Validation, Virtues and Limitations of Back-Propagation Learning, Convolution Networks.

Recurrent Neural Networks

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

Introduction, Algorithms for Pattern Association, Hetero Associative Memory Neural Networks, Auto Associative Memory Network, Bi-directional Associative memory.

Short term Memory& Long-Term Memory

Text Books

1. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Networks Using MATLAB 6.0", Tata McGraw-Hill Companies, 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", PHI
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.htm
2. https://nptel.ac.in/courses/117/105/117105084/
3. http://cs231n.stanford.edu/slides/2017/cs231n_2017_lecture4.pdf
4. https://freebiesglobal.com/artificial-neural-networks-ann-with-keras-in-python-and-r-6
5. http://www.nptelvideos.in/2012/12/neural-networks-and-applications.html

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

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

L2: Understand

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

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PC 20CS303 Database Management Systems 3 1 0 3.0

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

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

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

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

History of DBMS

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

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

Expressive Power of Algebra and Calculus

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

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

Compare all Database Languages, Importance of Null values

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

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

Compare all Normal Forms

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

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

Concurrency Control without Locking

Text Books

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

Reference Books

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

Web References

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

Internal Assessment Pattern

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

L1: Remember

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

L2: Understand

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

L3: Apply

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

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PC 20CS304 Object Oriented Programming through C++ 3 1 0 3.0

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20CS304.1	Articulate the principles of object-oriented problem solving and programming	3	1	L1, L2
20CS304.2	Explain dynamic memory management techniques	3	1	L1, L2
20CS304.3	Illustrate the concept of function overloading, operator overloading	3	1	L1, L2, L3
20CS304.4	Demonstrate the use of virtual functions and exception handling	3	1	L1, L2, L3
20CS304.5	Demonstrate generic programming and templates	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 Object Oriented Programming **9 +3 hours**

The Object Oriented Technology, difference between Procedural Oriented Programming and object oriented programming, advantage of OOP, Principles of object oriented programming. Introduction to C++: Evolution of C++, I/O stream classes in C++, Unformatted and Formatted Console I/O Operations, Manipulators, Data Types, Reference Variables, Namespace. Functions: Introduction, types of arguments, Return statement, Recursion.

Variables, branching and looping statements

Unit II: Classes and Objects **8 + 2 hours**

Classes and Objects : classes In C++, declaring objects, dynamic Memory allocation and deallocation, Access specifiers and scope, Member functions, static member variables, Types of member functions, Friend functions, Inline functions, Overloading member functions, Anonymous objects,.

Nested Classes, static member functions

Unit III: Constructors, Operator Overloading and Inheritance **9 +3 hours**

Constructors and Destructors: Introduction, characteristic Of constructors and destructors, applications With Constructors, Types of Constructors, overloading constructors, Array of objects Using Constructors. Operator overloading: The keyword operator, rules for overloading operators, overloading unary operator, assignment operator (=), Operator return Type. Inheritance: Introduction, advantages and disadvantages of inheritance, Types of inheritance, Virtual base classes- object as a class member

Constructor and destructor with static members, Overloading binary operator

Unit IV: Polymorphism & Exception Handling **11 +3 hours**

Pointers**:** Pointer, features of pointers, pointer to class, pointer object, this Pointer. Polymorphism**:** Binding In C++, Static (Early) Binding, Dynamic (Late) binding, Pointer to derived classes and base Class, Virtual Function, Rules for virtual function, Binding polymorphisms and virtual functions, virtual destructor, pure virtual functions, abstract classes. Exception handling: Introduction, Principles of Exception Handling, Exception Handling Mechanism, The keywords try, throw and catch, Multiple catch statements.

Virtual functions in derived classes, Re-throwing exception

Unit V: Generic Programming with Templates **9 +3 hours**

Generic programming with templates: Need of Templates, definition of class templates, normal function templates, Sorting using Function Templates, difference between Templates and Macros. Overview of standard template library, STL Programming Model, Containers - Sequence containers, Iterators, Vectors, Lists.

Templates and Inheritance, Associative Containers

Text Books

1. Gary Bronson, “A First Book of C++”, Fourth Edition, Cengage Learning, 2012.
2. Herbert Schildt, “The Complete Reference C++”, Fifth Edition, TMH, 2012.
3. Ashok N Kamthane,“Programming in C++”, Second Edition, Pearson, 2013.

Reference Books

1. Joyce Farrell,"Object Oriented Programming C++", Fourth Edition,Cengage, 2008.
2. DS Malik ,"C++ Programming: from problem analysis to program design", Sixth Edition, Cengage Learning,2016

Web References

1. https://www.javatpoint.com/cpp
2. https://www.learncpp.com/cpp-tutorial
3. https://www.tutorialspoint.com/cplusplus

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. Write any 4 benefits of OOP
2. List all the access specifiers
3. What is overloading?
4. Define the term virtual base class and its implementation.
5. Define function template & Class template
6. What is a Container?
7. List out all types of containers
8. List out member functions from vectors & lists class in STL

L2: Understand

1. Compare all access modes with their scope.
2. Explain types of constructor
3. Explain types of inheritance
4. Demonstrate friend function with example
5. Explain unary and relational operator overloading
6. Explain pure virtual function with example
7. Illustrate Exception Handling Mechanism with using try, throw & catch.

L3: Apply

1. Implement student class to get and print details.
2. Apply the concept of multiple inheritance to read and print employee information
3. Solve to find the area of different shapes using abstract class.
4. Implement any sorting algorithm using templates

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PC 20CS305 Computer Organization 3 0 0 3

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

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

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

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

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

Digital components: Integrated Circuits, Decoders, Multiplexers, Registers, Shift Registers, Binary Counters, Memory Unit.
Data Representation: Data types, Complements, Fixed Point Representation, Floating – Point Representation, Other Binary Codes, Error Detection codes.

Computer Types, Generation of Computers.

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

Register Transfer Language And Micro operations: Register Transfer language, Register Transfer Bus and memory transfers, Arithmetic Micro operations, logic micro operations, shift micro operations, Arithmetic logic shift unit.
Basic Computer Organization And Design: Instruction codes, Computer Register Computer instructions, Timing and control, Instruction cycle, Memory – Reference Instructions, Input – Output and Interrupt.

Assembly Language, Design of basic computer.

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

Central Processing Unit: Stack organization, Instruction formats, Addressing modes, Data Transfer and manipulation, Program control, Reduced Instruction set computer.
Micro Programmed Control: Control memory, Address sequencing, Micro program example, Design of control unit.

General Register Organization, RISC Vs CISC Architecture.

Unit IV :Computer Arithmetic **12 Hours**

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

BCD Adder-BCD Subtraction

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

The Memory System: Main memory, Auxiliary memory, Associative Memory, Cache Memory, Virtual Memory.
Input-Output Organization : Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupts, Direct memory Access.

Synchronous data transfer, Memory Hierarchy

Text Books

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

Reference Books

1. Carl Hamacher,Zvonko Vranesic, SafwatZaky, "Computer Organization", Fifth Edition ,McGraw Hill.
2. William Stallings,"Computer Organization and Architecture", Sixth Edition, Pearson.
.

Web Resources

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

Internal Assessment Pattern

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

L1: Remember

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

L2: Understand

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

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PC 20AI306 Artificial Neural Networks Programming Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs
		PO4
20AI306.1	Implement different activation functions and analyse their impact	3
20AI306.2	Demonstrate the working of simple perceptron for logic gates	3
20AI306.3	Implement classification with a perceptron on linearly and non-linear data	3
20AI306.4	Implement backpropagation learning	3
20AI306.5	Implement associative memory for simple applications	3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos		

List of Experiments

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

Reference

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

PC 20CS307 Database Management Systems Lab 0 0 3 1.5

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

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

List of Experiments

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

References

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

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PC 20CS308 Object Oriented Programming through C++ Lab 0 0 3 1.5

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

Code	Course Outcomes	Mapping with POs	
		PO1	PO4
20CS308.1	Demonstrate the usage of I/O Functions	3	1
20CS308.2	Implement the concepts of class, objects	3	1
20CS308.3	Implement the concepts of Overloading	3	1
20CS308.4	Demonstrate the use of virtual functions & error handling mechanisms	3	1
20CS308.5	Implement generic programming and templates	3	1
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create.			

List of Experiments

1. Demonstrate input & output operations using streams in C++
2. Write Programs to illustrating Control statements.
3. Write Programs to demonstrate the usage of Arrays & Functions.
4. Write Demonstrate the usage of Classes & Objects
5. Write Programs illustrate Access Specifiers Public, Private, Protected
6. Write Programs to illustrate new and delete Keywords for dynamic memory allocation.
7. Write Programs to illustrate the usage of following: Default Constructor, Parameterized Constructor, Copy Constructor and Destructor.
8. Write Programs that illustrates the following:
   i. Friend Function ii. Inline function
9. Write Programs to illustrate Overloading Unary (++) & Assignment Operator (=).
10. Write Programs that illustrate the following forms of inheritance:
    i. Single Inheritance ii. Multiple Inheritances iii. Hierarchical Inheritance
11. Write Programs to calculate the percentage of a student using multi-level inheritance. Accept the marks of three subjects in base class. A class will derived from the above mentioned class which includes a function to find the total marks obtained and another class derived from this class which calculates and displays the percentage of student.
12. Write Programs to illustrate this pointer
13. Write Programs to show an Example of Pointers to base class
14. Write Programs to illustrates pure virtual function and calculate the area of different shapes by using abstract class.
15. Write Programs to illustrate the usage of an exception Handling Mechanism.
16. Write Programs to demonstrate the usage of Templates.

References

1. Lab Manual for Object Oriented Programming through C++, Department of Computer Science and Engineering, NSRIT.

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

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

Code	Course Outcomes	Mapping with POs		DoK
		PO11	PO12	
20HSX03.1	Understand the theoretical concepts of managerial economics to make decisions for business problems	3	1	L1, L2
20HSX03.2	Gain adequate theoretical knowledge on microeconomics concepts to perform successful business operations	3	1	L1, L2
20HSX03.3	Understand the basic accounting principles to prepare final Accounts	3	1	L1, L2
20HSX03.4	Apply Financial planning techniques to make successful longterm investment decisions.	3	1	L3, L4
20HSX03.5	Apply accounting concepts to analyze financial strength of business	3	1	L1, L2

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

Unit I: Introduction to Managerial Economics and Demand Analysis 9 Hours

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

Role of Managerial Economist, Law of Supply

Unit II: Production and Cost Analysis 9 Hours

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

Economies of Scale and Diseconomies of Scale

Unit III: Introduction to Final Accounts 9 Hours

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

Unit IV: Introduction to Capital Planning 9 Hours

Cocept of Capital – Types of Capital - Capital Budgeting -: Meaning of Capita l - Capitalization - Meaning of Capital Budgeting - Time Value of Money - Methods of Appraising Project Profitability - Traditional Methods and Modern Methods.

Concept of Working Capital

Unit V: Financial Analysis through ratios 9 Hours

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

Cash Flow Statement and Funds Flow Statement (Theory Only)

Text Books

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

Reference Books

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

Web References

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

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

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

L2: Understand

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

L3: Apply

1. Journalise the following transactions
   2013 Jan 1st ABC Firm commenced business with Rs.40000
   Jan 2nd Deposited into bank Rs.30000
   Jan 3rd Bought goods worth Rs.48000 from Kamala
   Jan 4th Sold goods worth Rs.60000
2. Calculate Net Profit Ration from the following data
   Sales returns Rs.100000 Administration expences Rs.10000
   Gross Profit Rs.40000 Selling expences Rs.10000
   Income from investment Rs.5000 Loss on account of fire Rs.3000
3. From the following particulars findout
   Selling price Rs.200 per unit
   Variable cost Rs.100 per unit
   Total fixed cost Rs.96000
   i) Break even units and values
   ii) Sales to earn a profit Rs.20000

4. The following are the Ratios related to XYZ Limited company.
   Inventory holding period 2 months
   Gross profit ration 25 %
   Gross profit for the current year announced Rs.200000
   Closing stock is excess of Rs 40000 over opening stock. Findout
   A) Sales
   B) Cost of goods sold
   C) Closing stock
   D) Opening stock

L4: Analyze

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

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

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

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

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Board of Studies (MBA)

BS 20BSX15 Probability and Statistics 3 1 0 3

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

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

Unit I: Descriptive statistics methods. **11+1 Hours**

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

Measures of Dispersion – Range – Quartile Deviation

Unit II: Curve fitting and Correlation. **11+1 Hours**

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

Curve Fitting by Orthogonal Polynomials

Unit III: Probability and Probability Distributions. **11+1 Hours**

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

Geometric Probability, Gamma distribution function

Unit IV: Sampling Theory. **11+1 Hours**

Introduction – Population and samples – Sampling distribution of Means and variances – Central limit theorem (without proof) - Point and Interval Estimations Maximum error of estimate.

Introduction to Sampling, parameters, statistics, Introduction to student t test,

Unit V: Tests of Hypothesis. **11+1 Hours**

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Large samples: Tests concerning one mean and two means - Small samples:
Student t-distribution (test for single mean, two means and paired t-test), $\chi 2$ - test for Single variance, $\chi 2$ - test for goodness of fit
Test for single proportion, difference of proportions (large samples), testing of equality of variances (F-test),(small samples)

Textbooks:

1. Miller and Freund J. E, "Probability & Statistics for Engineers", 9th Edition, Prentice Hall of India, 2011.

2. Iyenger.T.K.V, Prasad.M.V.S.S.N, Ranganatham.S, KrishnaGandhi.B "Probability & Statistics", 2nd Edition, S. Chand publications, 2019.

Reference Books:

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

Web References:

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

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

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

L2: Understand

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

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

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

L3: Apply

1. The mean voltage of a battery is 15 and SD is 0.2. Compute the probability that four such batteries connected in series will have a combined voltage of 60.8 0r more volts. 2. A company claims that the mean life time of tube lights is 500 hours. Is the claim of the company tenable if a random sample of 25 tube lights produced by the company has mean 518 hours and SD 40 hours Company is satisfied if t falls between 0.01 and 0.03. It is observed that 174 out of a random sample of 200 truck drivers on highway during night are drunk. Is it valid to state that at least 90% of the truck drivers are drunk Use 0.05 LOS

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

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Board of Studies (Mathematics)

PC 20CS502 Computer Networks 3 0 0 3.0

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

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

Unit I: Introduction to Networks **12 hours**

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

Network Devices; The Mobile Telephone System

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

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

Bluetooth, Data Link layer switching

Unit III: Network Layer **12 hours**

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

Routing for mobile hosts, Routing in Ad Hoc Networks.

Unit IV: Transport Layer **12 hours**

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

Delay-Tolerant Networking: DTN Architecture, The Bundle protocols

Unit V: Application Layer **12 hours**

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

World Wide Web; Streaming Audio & Video

Text Books

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

Reference Books

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

Web Resources

1. https://nptel.ac.in/courses/106/105/106105183/
2. https://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network_pdf_version.htm
3. https://www.javatpoint.com/computer-network-tutorial

Internal Assessment Pattern

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

L1: Remember

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

L2: Understand

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

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PC 20CS404 Operating Systems 3 1 0 3

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

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

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

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

The Shell, Mobile Operating System, Choice of Interface

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

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

Process Termination, Multiprocess Architecture

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

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

Transactional Memory, Two Phase Locking

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

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

Buddy System, Prepaging

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

File concept, Access methods, Directory and disk structure, File system mounting, File sharing, Protection.
Implementing file systems: File system structure, File system implementation, Directory implementation, allocation methods, free-space management.

Consistency Checking, Malware, Denial of service

Text Books

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

Reference Books

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

Web Resources

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

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

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

L2: Understand

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

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

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

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

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

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

Depth First Search, Breadth First Search

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

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

Balanced search trees

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

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

Optimal Binary Search trees

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

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

Simplified NP – hard problems

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

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

0/1 knapsack problem

Text Books

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

Reference Books

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

Web Resources

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

Internal Assessment Pattern

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

L1: Remembering

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

L2: Understanding

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

L3: Applying

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

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Board of Studies (CSE)

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

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

Code	Course Outcomes	Mapping with POs
		PO4
20CS306.1	Calculate the time and space complexities of simple algorithms	3
20CS306.2	Implement divide and conquer strategy for computing problems and analyse their performance complexity	3
20CS306.3	Implement greedy strategy for computing problems and analyse their performance complexity	3
20CS306.4	Implement dynamic programming strategy for computing problems and analyse their performance complexity	3
20CS306.5	Implement backtracking and branch & bound strategies for computing problems and analyse their performance complexity	3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos		
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge		

List of Experiments

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

Reference

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

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

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

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

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

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

Reference

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

PC 20CS408 Operating Systems Lab 0 0 3 1.5

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

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

List of Experiments

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

References

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

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PC 20AIS02 Competitive Programming Skills 1 0 2 2.0

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

Code	Course Outcomes	Mapping with POs			DoK
		PO3	PO4	PO5	
20AIS02.1	Diagnose the time and space complexity of program structure	3	2	2	L1, L2
20AIS02.2	Analyse the problem statement, select appropriate design strategy, implement it in a time bounded environment	3	2	2	L1, L2, L3, L4
20AIS02.3	Take part in competitive programming contests	3	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

Introduction to competitive programming platforms – GCC complier – Description of problem statements in competitive programming – Constraints of the problems – Handling large inputs – Examples for Dynamic Programming - Examples for Greedy algorithms – Examples on string algorithms – Calculating the performance of algorithms – Reducing the time complexity of algorithms – Programming standards – Exposure to time bounded programming – Tips and Tricks for competitive programming and related resources

Resources

1. www.sanfoundary.com
2. www.geeksforgeeks.com
3. www.codechef.com
4. www.topcoder.com
5. www.codingninja.com
6. www.hackerearth.com
7. www.hackerrank.com

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PC 20CS502 Computer Networks 3 0 0 3.0

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

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

Unit I: Introduction to Networks **12 hours**

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

Network Devices; The Mobile Telephone System

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

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

Bluetooth, Data Link layer switching

Unit III: Network Layer **12 hours**

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

Routing for mobile hosts, Routing in Ad Hoc Networks.

Unit IV: Transport Layer **12 hours**

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

Delay-Tolerant Networking: DTN Architecture, The Bundle protocols

Unit V: Application Layer **12 hours**

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

World Wide Web; Streaming Audio & Video

Text Books

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

Reference Books

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

Web Resources

1. https://nptel.ac.in/courses/106/105/106105183/
2. https://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network_pdf_version.htm
3. https://www.javatpoint.com/computer-network-tutorial

Internal Assessment Pattern

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

L1: Remember

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

L2: Understand

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

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PC 20CS404 Operating Systems 3 1 0 3

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

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

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

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

The Shell, Mobile Operating System, Choice of Interface

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

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

Process Termination, Multiprocess Architecture

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

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

Transactional Memory, Two Phase Locking

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

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

Buddy System, Prepaging

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

File concept, Access methods, Directory and disk structure, File system mounting, File sharing, Protection.
Implementing file systems: File system structure, File system implementation, Directory implementation, allocation methods, free-space management.

Consistency Checking, Malware, Denial of service

Text Books

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

Reference Books

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

Web Resources

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

Internal Assessment Pattern

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

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

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

L2: Understand

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

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

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

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

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

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

Depth First Search, Breadth First Search

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

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

Balanced search trees

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

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

Optimal Binary Search trees

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

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

Simplified NP – hard problems

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

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

0/1 knapsack problem

Text Books

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

Reference Books

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

Web Resources

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

Internal Assessment Pattern

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

L1: Remembering

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

L2: Understanding

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

L3: Applying

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

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

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

Code	Course Outcomes	Mapping with POs
		PO4
20CS306.1	Calculate the time and space complexities of simple algorithms	3
20CS306.2	Implement divide and conquer strategy for computing problems and analyse their performance complexity	3
20CS306.3	Implement greedy strategy for computing problems and analyse their performance complexity	3
20CS306.4	Implement dynamic programming strategy for computing problems and analyse their performance complexity	3
20CS306.5	Implement backtracking and branch & bound strategies for computing problems and analyse their performance complexity	3
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos		
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge		

List of Experiments

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

Reference

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

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

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

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

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

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

Reference

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

PC 20CS408 Operating Systems Lab 0 0 3 1.5

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

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

List of Experiments

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

References

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

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PC 20AIS02 Competitive Programming Skills 1 0 2 2.0

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

Code	Course Outcomes	Mapping with POs			DoK
		PO3	PO4	PO5	
20AIS02.1	Diagnose the time and space complexity of program structure	3	2	2	L1, L2
20AIS02.2	Analyse the problem statement, select appropriate design strategy, implement it in a time bounded environment	3	2	2	L1, L2, L3, L4
20AIS02.3	Take part in competitive programming contests	3	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

Introduction to competitive programming platforms – GCC complier – Description of problem statements in competitive programming – Constraints of the problems – Handling large inputs – Examples for Dynamic Programming - Examples for Greedy algorithms – Examples on string algorithms – Calculating the performance of algorithms – Reducing the time complexity of algorithms – Programming standards – Exposure to time bounded programming – Tips and Tricks for competitive programming and related resources

Resources

1. www.sanfoundary.com
2. www.geeksforgeeks.com
3. www.codechef.com
4. www.topcoder.com
5. www.codingninja.com
6. www.hackerearth.com
7. www.hackerrank.com

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