Ref No:

Sri Krishna Institute of Technology, Bangalore

COURSE PLAN

Academic Year 2019-2020

Program:	B E – Information Science & Engineering
Semester :	4
Course Code:	18CS42
Course Title:	Design and Analysis of Algorthim
Credit / L-T-P:	4 / 3-2-0
Total Contact Hours:	50
Course Plan Author:	Sandhya B R

Academic Evaluation and Monitoring Cell

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A. COURSE INFORMATION

1. Course Overview

Degree:	BE	Program:	IS
Semester:	4	Academic Year:	2019-2020
Course Title:	DESIGN AND ANALYSIS OF ALGORITHMS	Course Code:	18CS42
Credit / L-T-P:	4 / 3-2-0	SEE Duration:	180 Minutes
Total Contact Hours:	50 Hours	SEE Marks:	60 Marks
CIA Marks:	40 Marks	Assignment	1 / Module
Course Plan Author:	Sandhya B R	Sign ..	Dt:
Checked By:		Sign ..	Dt:
CO Targets	CIA Target : 75 %	SEE Target:	60 %

Note: Define CIA and SEE % targets based on previous performance.

2. Course Content

Content / Syllabus of the course as prescribed by University or designed by institute.

Module	Content	Teaching Hours	Blooms Learning Levels
1	Introduction: What is an Algorithm?(T2:1.1),Algorithm Specification (T2:1.2), Analysis Framework (T1:2.1), Performance Analysis: Space complexity, Time complexity (T2:1.3). Asymptotic Notations:Big-Oh notation (O), Omega notation (Ω),Theta notation (Θ), and Little-oh notation (o), Mathematical analysis of Non-Recursive and recursive Algorithms with Examples (T1:2.2, 2.3, 2.4).Important Problem Types:Sorting, Searching, String processing, Graph Problems, Combinatorial Problems. Fundamental Data Structures: Stacks, Queues, Graphs, Trees, Sets and Dictionaries . (T1:1.3,1.4)	10	L4 Analyze
2	Divide and Conquer: General method, Binary search, Recurrence equation for divide and conquer, Finding the maximum and minimum (T2:3.1, 3.3, 3.4), Merge sort, Quick sort (T1:4.1, 4.2) , Strassen's matrix multiplication (T2:3.8) , Advantages and Disadvantages of divide and conquer. Decrease and Conquer Approach: Topological Sort. (T1:5.3)	10	L4 Analyze
3	Greedy Method: General method, Coin Change Problem, Knapsack Probl em, Job sequencing with deadlines (T2:4.1, 4.3, 4.5). Minimum cost spanning trees: Prim's Algorithm, Kruskal's Algorithm (T1:9.1, 9.2) . Single source shortest paths: Dijkstra's Algorithm (T1:9.3) . Optimal Tree problem: Huffman Trees and Codes (T1:9.4) . Transform and Conquer Approach: Heaps and Heap Sort (T1:6.4)	10	L4 Analyze
4	Dynamic Programming: General method with Examples, Multistage Graphs (T2:5.1, 5.2) . Transitive Closure: Warshall's Algorithm, All Pairs Shortest Paths: Floyd's Algorithm, Optimal Binary Search Trees, Knapsack problem ((T1:8.2, 8.3, 8.4), Bellman-Ford Algorithm (T2:5.4) , Travelling Sales Person problem (T2:5.9) , Reliability design (T2:5.8).	10	L4 Analyze
5	Backtracking: General method (T2:7.1) , N-Queens problem (T1:12.1) , Sum of subsets problem (T1:12.1) , Graph coloring (T2:7.4) , Hamiltonian cycles (T2:7.5) . Branch and Bound: Assignment Problem, Travelling Sales Person problem (T1:12.2) , 0/1 Knapsack problem (T2:8.2, T1:12.2): LC Branch and Bound solution (T2:8.2) , FIFO Branch and Bound solution (T2:8.2) . NP-Complete and NP Hard problems: Basic concepts, non deterministic algorithms, P, NP, NP-Complete, and NP-Hard classes (T2:11.1) .	10	L3 Apply
-	**Total**	**50**	**L3-L4**

3. Course Material

Books & other material as recommended by university (A, B) and additional resources used by course teacher (C).
1. Understanding: Concept simulation / video ; one per concept ; to understand the concepts ; 15 – 30 minutes
2. Design: Simulation and design tools used – software tools used ; Free / open source
3. Research: Recent developments on the concepts – publications in journals; conferences etc.

Modules	Details	Chapters in book	Availability
A	**Text books (Title, Authors, Edition, Publisher, Year.)**	**-**	**-**
1,2,3,4,5	Introduction to the Design and Analysis of Algorithms, Anany Levitin:, 2rd Edition, 2009. Pearson.	1,2,4,5,6,9,8,12	In Lib / In Dept
1,2,3,4,5	Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Press	1,3,4,5,7,8,11	In Lib/ In dept
B	**Reference books (Title, Authors, Edition, Publisher, Year.)**	**-**	**-**
1, 2,3	.Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI	1,2,3,4,5,6,7	In Lib
4,5	Design and Analysis of Algorithms , S. Sridhar, Oxford (Higher Education)	?	Not Available
C	**Concept Videos or Simulation for Understanding**	**-**	**-**
C1	Asymptotic Notations https://www.youtube.com/watch?v=OpebHLAf99Y- 10.40 secs		
C2	Data Structures https://www.youtube.com/watch?v=FNZ509S9prU-5 Mins		
C3	Recurrence stratergy https://www.youtube.com/watch?v=XNAfl2swlnY- 11 .40 Secs		
C4	Divide and Conquer technique https://www.youtube.com/watch?v=6SUmp_Cn-SU – 9 Mins		
C5	Greedy technique https://www.youtube.com/watch?v=ARvQcqJ_-NY -10 Mins		
C6	Transform and conquer approach https://www.youtube.com/watch?v=fyzQcGUsVXk -11 Mins		
C7	Dynamic Programming technique https://www.youtube.com/watch?v=WxpIHvsu1RI -9 Mins		
C8	Branch Bound Techniques https://www.youtube.com/watch?v=3RBNPc0_Q6g -10 Mins		
C9	Np-hard and Np-Complete problems https://www.youtube.com/watch?v=gq4K5hhiISE– 5 Mins		
C10	Back tracking-N Queens problem https://www.youtube.com/watch?v=3GqhzSnt2Gc -7 Mins		
D	**Software Tools for Design**	**-**	**-**
	Eclipse Juno		
E	**Recent Developments for Research**	**-**	**-**
	Formalization of Asymptotic Notations in HOL4 https://ieeexplore.ieee.org/abstract/document/8821642		
F	**Others (Web, Video, Simulation, Notes etc.)**	**-**	**-**
1	Nptel videos for Asymptototic Notations https://www.youtube.com/watch?v=EL9T1ngiCqA		
2	Nptel videos for Minimum Spanning trees https://www.youtube.com/watch?v=kgjemw3SZe0		

4. Course Prerequisites

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.
Students must have learnt the following Courses / Topics with described Content . . .

Modules	Course Code	Course Name	Topic / Description	Sem	Remarks	Blooms Level
1	17pcd13/23	C Programing	1. Knowledge on Data Structures	2		L4
2	17cs33	Data Structure and Application	Knowledge of Data Structures Algorithm	3		L4
3	17cs33	Data Structure and Application	Knowledge of Data Structures Algorithm	3		L4
4	17cs36	Discrete Mathematics Structures	Knowledge of Graphs and Trees are required.	3		L4
5	17cs33	Data Structure and Application	Knowledge of Data Structures Algorithm	3		L3

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.
Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Modules	Topic / Description	Area	Remarks	Blooms Level
1	Brute Force Technique	Higher Study	Gap A seminar on Brute Force Technique	Understand L2

B. OBE PARAMETERS

1. Course Outcomes

Expected learning outcomes of the course, which will be mapped to POs.

Modules	Course Code.#	Course Outcome **At the end of the course, student should be able to . . .**	Teach. Hours	Instr Method	Assessment Method	Blooms' Level
1	18CS42.1	Analyze the computational complexity of different algorithms.	10	Black board /system	Test/ assignments	L4
2	18CS42.2	Apply and Analyze Divide and Conquer Strategy to solve problems	10	Black board /system	Test/ assignments	L4
3	18CS42.3	Apply and Analyze Optimization problems using Greedy strategy.	10	Black board /system	Test/ assignments	L4
4	18CS42.4	Apply and Analyze Optimization routes using Dynamic Programming strategy.	10	Black board /system	Test/ assignments	L4
5	18CS42.5	Classify computational problems into P, NP, NP-Hard and NP-	10	Black board /system	Test/ assignme	L3

		complete problems			nts	
-	-	**Total**	**50**	Black board /system	Test/ assignments	**L3-L4**

2. Course Applications

Write 1 or 2 applications per CO.
Students should be able to employ / apply the course learnings to . . .

Modules	Application Area Compiled from Module Applications.	CO	Level
1	Able to Analyze a given algorithm and express its time and space complexity	CO1	L4
1	Facebook to Build database,	CO1	L3
2	Able to Solve recurrence equations	CO2	L3
2	efficient use of memory cache	CO2	L4
3	In the field of artificial intelligence, automatic speech recognition.	CO3	L4
3	In the implementation of Priority queue in graph algorithms	CO3	L4
4	Computer networks	CO4	L4
4	Load-Shedding Problem in Microgrid Operation	CO4	L3
5	Machine Scheduling Problem	CO5	L4
5	Able to classify computational problems into P, NP, NP-Hard and NP-complete	CO5	L3

3. Articulation Matrix

CO – PO Mapping with mapping level for each CO-PO pair, with course average attainment.

-	-	Course Outcomes	Program Outcomes														-
Modules	CO.#	**At the end of the course student should be able to . . .**	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Level
1	18CS42.1	Analyze the computational complexity of different algorithms.	2.5	2.5	3	2.5	-	-	-	-	-	-	-	2.5	3	3		L4
2	18CS42.2	Apply and Analyze Divide and Conquer Strategy to solve problems	2.5	2.5	3	2.5	-	-	-	-	-	-	-	2.5	3	3		L4
3	18CS42.3	Apply and Analyze Optimization problems using Greedy strategy.	2.5	2.5	3	2.5	-	-	-	-	-	-	-	-	2	3		L4
4	18CS42.4	Apply and Analyze Optimization routes using Dynamic Programming strategy.	2.5	2.5	3	2.5	-	-	-	-	-	-	-	2.5	2	3		L4
5	18CS42.5	Classify computational problems into P, NP, NP-Hard and NP-complete problems	2.5	2.5	3	2.5	-	-	-	-	-	-	-	2.5	2	3		L3
-	**18CS42.**	**Average**	**2.5**	**2.5**	**3**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.5**	**2.4**	**3**		**L3-L4**
-	*PO, PSO*	*1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design*																

4. Curricular Gap and Content

Topics & contents not covered (from A.4), but essential for the course to address POs and PSOs.

Modules	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1	Brute force techniques	Presentation by students	3rd week / date	Self	List from B4 above

C. COURSE ASSESSMENT

1. Course Coverage

Assessment of learning outcomes for Internal and end semester evaluation.

Modules	Title	Teach. Hours	No. of question in Exam						CO	Levels
			CIA-1	CIA-2	CIA-3	Asg	Extra Asg	SEE		
1	Definition,specification,framework, Asymptotic notation,problem types	10	2	-	-	1	1	2	CO1	L4
2	Divide and Conquer,Decrease and conquer	10	2	-	-	1	1	2	CO2	L4
3	Greedy method ,Transform and conquer approach	10	-	2	-	1	1	2	CO3	L4
4	Dynamic Programming	10	-	2	-	1	1	2	CO4	L4
5	Backtracking,Branch and Bound,Knapsack problem,NP-Complete and NP-Hard Problem	10	-	-	4	1	1	2	CO5	L3
-	**Total**	**50**	**4**	**4**	**4**	**5**	**5**	**10**	**CO1-CO5**	**L3-L4**

2. Continuous Internal Assessment (CIA)

Assessment of learning outcomes for Internal exams. Blooms Level in last column shall match with A.2.

Modules	Evaluation	Weightage in Marks	CO	Levels
1, 2	CIA Exam – 1	30	CO1, CO2	L4,L4
3, 4	CIA Exam – 2	30	CO3, CO4	L4,L4
5	CIA Exam – 3	30	CO5	L3
1, 2	Assignment - 1	10	CO1, CO2	L4,L4
3, 4	Assignment - 2	10	CO3, CO4	L4,L4
5	Assignment - 3	10	CO5	L3
1, 2	Seminar - 1		-	-
3, 4	Seminar - 2		-	-
5	Seminar - 3		-	-
1, 2	Quiz - 1		-	-
3, 4	Quiz - 2		-	-
5	Quiz - 3		-	-
1 - 5	Other Activities – Mini Project	-		
	Final CIA Marks		**-**	**-**

D1. TEACHING PLAN - 1

Module – 1

Title:	Introduction:	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Analyze the computational complexity of different algorithms.	CO1	L4
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
1	What is an Algorithm?Algorithm Specification ,Analysis Framework	CO1	L1
2	Performance Analysis: Space complexity, Time complexity	CO1	L2
3	Asymptotic Notations:Big-Oh notation (O), Omega notation (Ω),		L3
4	Theta notation (Θ), and Little-oh notation (o),	CO1	L3
5	Mathematical analysis of Non-Recursive Algorithms with Examples .		L4
6	Mathematical analysis of Non-Recursive Algorithms with Examples contd..	CO1	L4
7	Mathematical analysis of recursive Algorithms with Examples .	CO1	L4
8	Mathematical analysis of recursive Algorithms with Examples contd...	CO1	L4
9	Important Problem Types:Sorting, Searching, String processing, Graph Problems, Combinatorial Problems.	CO1	L3
10	Fundamental Data Structures: Stacks, Queues, Graphs, Trees, Sets and Dictionaries.	CO1	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Able to Analyze a given algorithm and express its time and space complexities	CO1	L4
2	Able to apply data structures to combinatorial problems	CO2	L3
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
1	Define best case, worst case and average case efficiency. Give these efficiencies for sequential search.	CO1	L4
2	Briefly explain important fundamental data structures used in algorithm design.	CO1	L3
3	Describe basic efficiency classes. (9 points)	CO1	L4
4	Briefly explain the important problem types coming under design and analysis of algorithms.	CO1	L4
5	Explain three asymptotic notations with a neat diagram. Prove $n^2 + 5n + 7 = \Theta(n^2)$	CO1	L4
e	**Experiences**	-	-
1			
2			
3			
4			
5			

Module – 2

Title:	Divide and Conquer	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Apply and Analyze Divide and Conquer Strategy to solve problems	CO2	L4
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
11	Divide and Conquer: General method,	CO2	L4

12	Binary search,	CO2	L4
13	Recurrence equation problems,	CO2	L3
14	Recurrence equation problems contd...	CO2	L3
15	Finding the maximum and minimum	CO2	L4
16	Merge sort,	CO2	L4
17	Quick sort ,	CO2	L4
18	Strassen's matrix multiplication	CO2	L4
19	Advantages and Disadvantages of divide and conquer.	CO2	L4
20	Topological Sort.	CO2	L4
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	analyze by solving recurrence equation.	CO2	L4
2	design algorithms using Divide and Conquer Strategy.	CO2	L3
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
6	Find the upper bound of recurrences given below by substitution method. i) T(n) = 2 T(n/2)+n ii) T(n) = T(n/2) + 1	CO2	L3
7	Briefly explain binary search algorithm along with efficiency analysis	CO2	L4
8	Write the algorithm for Merge Sort. .	CO2	L4
9	Sort the following elements using merge sort. Write the recursion tree. 70, 20, 30, 40, 10, 50, 60 Twisted : Use D & C method which divides problem size by considering position	CO2	L3
10	Explain quick sort with an algorithm.	CO2	L4
11	Derive worst case,best case and average case for Merge sort.	CO2	L4
12	Derive worst case,best case and average case for quick sort.	CO2	L4
13	Sort the following elements using quick sort 25,10,72,18,40,11,64,58,32,9	CO2	L3
e	**Experiences**	-	-
1			
2			
3			
4			
5			

1. CIA EXAM – 1

a. Model Question Paper – 1

Crs Code:	18CS42	Sem:	IV	Marks:	30	Time:	75 minutes		
Course:	Design and Analysis of Algorithms								
-	**-**	**Note: Answer all questions, each carry equal marks. Module : 1, 2**					**Marks**	**CO**	**Level**
1	a	Explain Algorithm Specification in detail.					6	CO1	L4
	b	Explain wit h an example how a new variable count introduced in a program can be used to find the number of steps needed by a program to solve a particular problem instance.					6	CO1	L4
	c	Derive the Time complexity for Merge sort					3	CO2	L4
		OR							
1	a	Explain the asymptotic notations with examples.					7	CO1	L4
	b	Illustrate mathematical analysis of recursive algorithm for Tower of Hanoi puzzle.					6	CO1	L4
	c	Apply Merge sort for the elements:90 30 20 90 70 10 50 40					3	CO2	L3
2	a	Compare the order of growth by using limits: n! and 2^n					2	CO1	L4
	b	Write a recursive algorithm for binary search and also bring out its efficiency.					8	CO2	L3
	c	Derive the best case and worst case time efficiency of the Quick sort Algorithm.					5	CO2	L4

		OR			
2	a	Explain the criteria that an algorithm must satisfy.	5	CO1	L4
	b	Explain the general method of divide and conquer and write an algorithm for the same.	5	CO2	L4
	c	Write a function to find the maximium and minimum elements in a given array of n elements by applying divide and conquer technique.	5	CO2	L4

b. Assignment -1

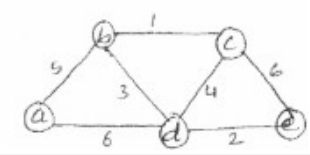
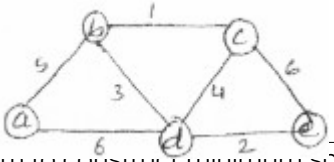
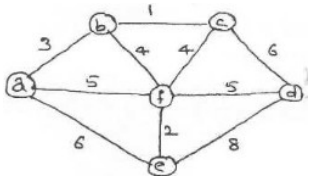
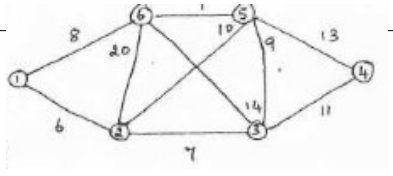
Model Assignment Questions							
Course Code:	18CS42	Sem:	IV	Marks:	10	Time:	75 minutes
Course:	Design and Analysis of Algorithms				Module : 1, 2		

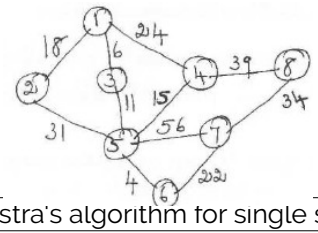
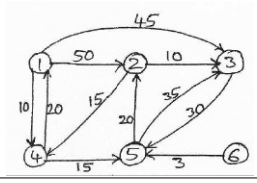
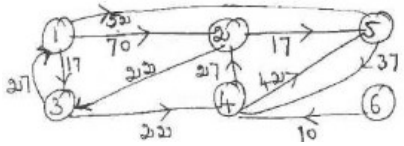
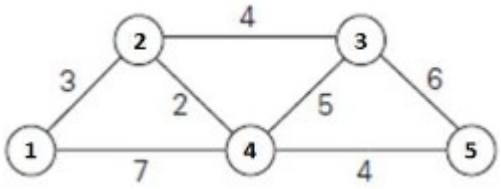
SNo	Assignment Description	Marks	CO	Level
1	Describe basic efficiency classes. (9 points)	5	CO1	L4
2	Briefly explain the important problem types coming under design and analysis of algorithms.	6	CO1	L3
3	Consider Tower of Hanoi puzzle. Derive the recurrence relation for the total movement of disk. Solve the recurrence relation using substitution method	10	CO1	L4
4	Write the algorithm for Quick Sort. Derive the best case, worst case, average case time efficiency of the algorithm	10	CO2	L4
5	What is an algorithm? Explain the notion of algorithm with an example.	10	CO1	L4
6	Compare the order of growth of ½ n(n-1) and n^2.	4	CO1	L4
7	Find the upper bound of recurrences given below by substituation method. a)2T(n/2)+n b)T(n/2)+1	4	CO2	L3
8	write an algorithm for merge sort. Analyze its efficiency.	7	CO2	L4
9	Apply quick sort on following list and draw recursive call tree : 5, 3, 1,9, 8,2, 4,7	10	CO2	L4
10	Write the algorithm for Quick sort. Derive the worst case time efficiency of the algorithm.	10	CO2	L4
11	Compare the order of growth by using limits: n! and 2^n	4	CO1	L4
12	Write a function to find the maximium and minimum elements in a given array of n elements by applying divide and conquer technique.	5	CO2	L4
13	Explain the general method of divide and conquer and write an algorithm for the same.	5	CO2	L4

D2. TEACHING PLAN - 2

Module – 3

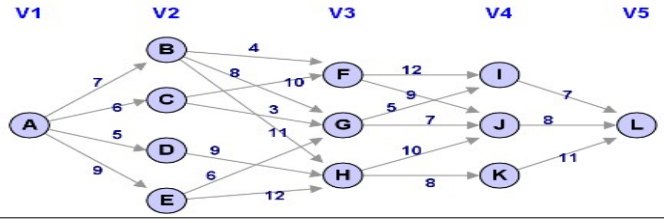
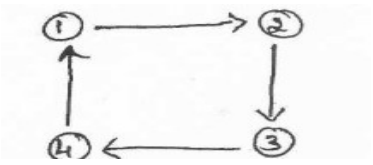
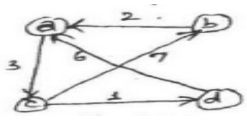
Title:	Greedy Method	Appr Time:	12 Hrs
a	***Course Outcomes***	**CO**	**Blooms**

-	At the end of the topic the student should be able to . . .	-	**Level**
1	Apply and Analyze Optimization problems using Greedy strategy.	CO3	L4
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
21	General method, Coin Change Problem,	CO3	L4
22	Knapsack Problem,	CO3	L4
23	Knapsack Problem contd..	CO3	L4
24	Job sequencing with deadlines	CO3	L4
25	Minimum cost spanning trees:Prim's Algorithm,	CO3	L4
26	Kruskal's Algorithm	CO3	L4
27	Single source shortest paths:Dijkstra's Algorithm	CO3	L4
28	Single source shortest paths:Dijkstra's Algorithm contd...	CO3	L4
29	Optimal Tree problem:Huffman Trees and Codes	CO3	L4
30	Transform and Conquer Approach:Heaps and Heap Sort	CO3	L4
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	solve Optimization problems using Greedy strategy.	CO3	L4
2	constuct Optimal Tree usingTransform and Conquer Approach	CO3	L4
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
14	Define Optimal solution and feasible solution.	CO3	L4
15	Define Coin Change Problem. State the greedy method to solve the coin change problem. For 49 rupees, find the denominations with least no. of coins. The available denominations in rupees are { 1, 2, 5, 10}	CO3	L4
16	What is the solution generated by the function job scheduling (JS) when n=5, [p1,p2,p3,p4,p5]=[20,15,10,5,1] and [d1,d2,d3,d4,d5]=[2,2,1,3,3]	CO3	L4
17	What is a knapsack problem?Obtain solution for the knapsack problem using greedy method for n=3,capacity m=20 values 25,24,15 and weights 18,15,10 respectively.	CO3	L4
18	Write a Kruskal algorithm to find minimum cost spanning tree and obtain spanning tree of the graph shown below. 	CO3	L4
19	Apply PRIMS algorithm for the following graph to find minimum spanning tree. 	CO3	L4
20	Write Krushkal 's algorithm to construct minimum spanning tree and show that the time efficiency isO(|€|log|€|)	CO3	L4
21	Apply Krushkal 's algorithm for the following graph to find minimum spanning tree. 	CO3	L4
22	Apply PRIMS algorithm for the following graph to find minimum spanning tree. 	CO3	L4

23	Apply PRIMS algorithm for the following graph to find minimum spanning tree. 	CO3	L4
24	Write the Dijkstra's algorithm for single source shortest path	CO3	L4
25	Write the Dijkstra's algorithm for single source shortest path. Apply Dijkstra's algorithm 	CO3	L4
26	In the weighted digrapg given below.Determine the shortest paths from vertex 1 to all other vertices. 	CO3	L4
27	Apply Dijkstra's algorithm to find the shortest path,considering source vertex as 1. 	CO3	L4
28	Construct the Huff man code for the following data. Symbol | A | B | C | D | - frequency | 0.35 | 0.1 | 0.2 | 0.2 | 0.15 Also i)encode DAD ii)10011011011101	CO3	L4
29	Construct a heap for the list 1, 8, 6, 5, 3, 7, 4 by the bottom-up algorithm.	CO3	L4
30	Sort the array 2, 9, 7, 6, 5, 8 by heapsort.	CO3	L4
e	**Experiences**	-	-
1			
2			
3			
4			
5			

Module – 4

Title:	Dynamic Programming Technique	Appr Time:	10Hrs

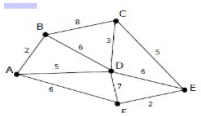
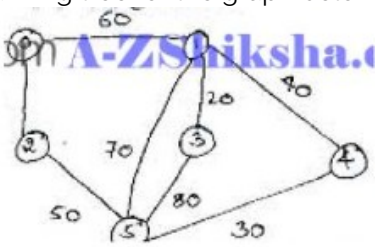
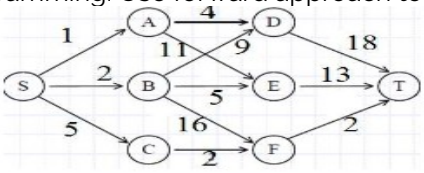
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Apply and Analyze Optimization routes using Dynamic Programming strategy.	CO4	L4
b	***Course Schedule***		
Class No	**Portion covered per hour**	**-**	**-**
31	Dynamic Programming: General method with Examples,	CO4	L4
32	Multistage Graphs	CO4	L4
33	Transitive Closure: Warshall's Algorithm,	CO4	L4
34	All Pairs Shortest Paths:Floyd's Algorithm,	CO4	L4
35	Bellman-Ford Algorithm	CO4	L4
36	Bellman-Ford Algorithm contd...	CO4	L4
37	Travelling Sales Person problem	CO4	L4
38	Optimal Binary Search Trees,	CO4	L3
39	Knapsack problem	CO4	L3
40	Reliability design	CO4	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Apply and Analyze Optimization routes using Dynamic Programming strategy.	CO4	L4
2	Solve Optimization problems	CO4	L3
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
32	Briefly explain how dynamic programming works.	CO4	L4
34	Find the shortest path from A to L , in the following multistage graph, using dynamic programming. Use forward approach to solve the prob lem. 	CO4	L4
36	Generate Transitive Closure for the given graph 	CO4	L4
37	ExplainWarshalls AlgorithmGenerate Transitive Closure for the given graph.Apply this algorithm to the given graph below. 	CO4	L4
38			
39			
40			
41			

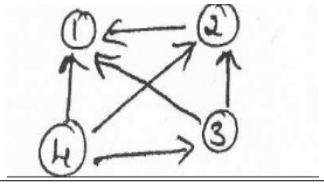
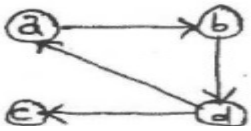
e	**Experiences**	-	-
1			
2			
3			
4			
5			

E2. CIA EXAM – 2

a. Model Question Paper – 2

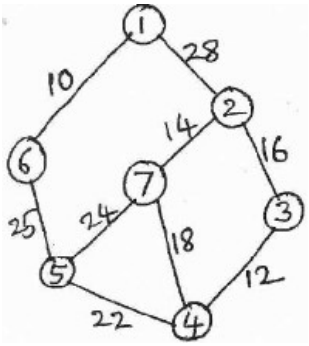
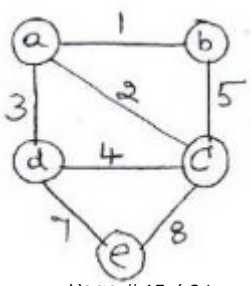
Course Code:	18CS42	Sem:	IV	Marks:	30	Time:	75 minutes
Course:	Design and Analysis of Algorithms						

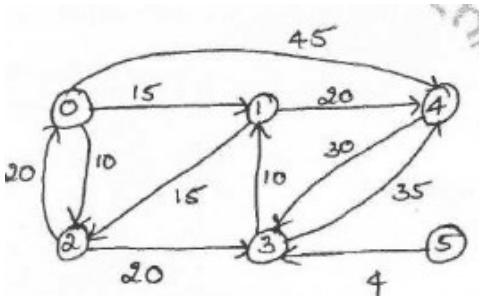
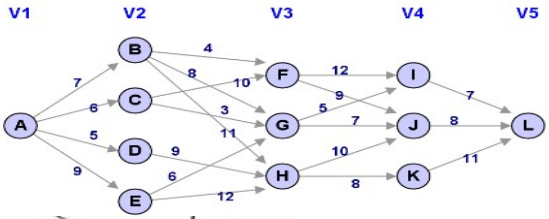
-	-	**Note: Answer all questions, each carry equal marks. Module : 3, 4**	**Marks**	**CO**	**Level**
1	a	Obtain the optimal solution for the job sequencing problem with deadline.where n=4 profit (p1,p2,p3,p4)=(100,10,15,27) and deadlines. (d1,d2,d3,d4)=(2,1,2,1)	4	CO3	L4
	b	Define MST. Apply PRIMS and KRUSKAL algorithm for the following graph to get MST. Show the intermediate steps. 	11	CO3	L4
2	a	Explain the concept of greedy techniques for prim's algorithm. Obtain minimum cost spanning tree for the graph below. $\begin{bmatrix} 0 & 3 & \infty & 7 & \infty \\ 3 & 0 & 4 & 2 & \infty \\ \infty & 4 & 0 & 5 & 6 \\ 7 & 2 & 5 & 0 & 4 \\ \infty & \infty & 6 & 4 & 0 \end{bmatrix}$	7	CO3	L4
	b	Explain the concept of greedy techniques for prim's algorithm. Obtain minimum cost spanning tree for the graph below. 	8	CO3	L4
3	a	Find the shortest path from S to T inthe following multistage graph using dynamic programming. Use forward approach to solve the prob lem 	8	CO4	L4
	b	Generate Transitive Closure for the given graph	7	CO4	L4

					
4	a	Explain\Warshalls Algorithm Generate Transitive Closure for the given graph.Apply this algorithm to the given graph below. 	8	CO4	L4
	b	Write Warshall's-Floyd Algorithm	7	CO4	L4

b. Assignment – 2

Model Assignment Questions							
Course Code:	18CS42	Sem:	IV	Marks:	10	Time:	75 minutes
Course:	Design and Analysis of Algorithms				Module : 3, 4		

SNo	Assignment Description	Marks	CO	Level
1	Define coin change problem. Write the greedy strategy for getting the optimal solution. If coins available are of values { 2, 5, 3, 6 }, find the least denominations for a) 55 b)77	10	CO3	L4
2	What is job sequencing with deadlines?find solution generated by job sequencing with deadlines for 7 jobs ,given profits 3,5,2018,1,6,30 and deadlines 1,3,4,3,2,1,2 respectively.	6	CO3	L4
3	What is minimum cost spanning tree?Apply prim's and kruskal's algorithm for the given graph below. 	10	CO3	L4
4	Define minimum cost spanning tree.Give high level description of Prim's algorithm to find minimum spanning tree and find minimum spanning tree for graph shown below. 	8	CO3	L4

<table>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>5</td><td>Solve the following single source shortest path problem.Assume vertex 5 as source vertex.
 
</td><td>9</td><td>CO3</td><td>L4</td></tr>
<tr><td>6</td><td>Construct the Huff man code for the following data.
<table>
<tr><td>Symbol</td><td>A</td><td>B</td><td>C</td><td>D</td><td>-</td></tr>
<tr><td>frequency</td><td>0..4</td><td>0.1</td><td>0.2</td><td>0.15</td><td>0.15</td></tr>
</table>
Also i)encode ABACABAD ii)100010111001010</td><td>10</td><td>CO3</td><td>L3</td></tr>
<tr><td>7</td><td>Sort the following lists by heapsort by using the array representation of heaps. 5, 2, 4, 1, 3 (in increasing order)</td><td>8</td><td>CO3</td><td>L3</td></tr>
<tr><td>8</td><td>Find the shortest path from A to L , in the following multistage graph, using dynamic programming. Use forward approach to solve the problem
 
</td><td>10</td><td>CO4</td><td>L4</td></tr>
<tr><td>9</td><td></td><td>6</td><td>CO4</td><td>L4</td></tr>
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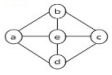
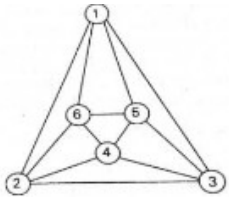
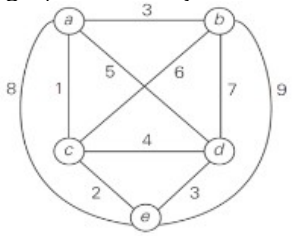
</table>

D3. TEACHING PLAN - 3

Module – 5

Title:	Backtracking	Appr Time:	10 Hrs
a	***Course Outcomes***	**CO**	**Blooms**
-	At the end of the topic the student should be able to . . .	-	**Level**
1	Classify computational problems into P, NP, NP-Hard and NP-complete problems	CO5	L3

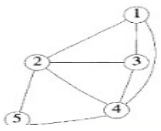
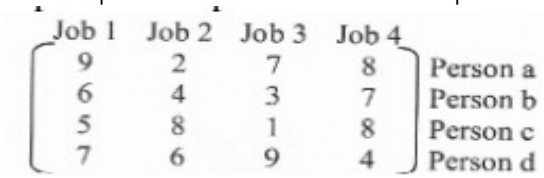
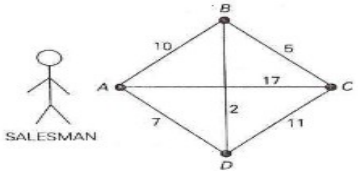
b	***Course Schedule***	-	-
Class No	**Portion covered per hour**	**-**	**-**
41	Backtracking: General method , N-Queens problem.	CO5	L3
42	Sum of subsets problem , Graph coloring Hamiltonian cycles.	CO5	L3
43	Branch and Bound: Assignment Problem,	CO5	L3
44	Travelling Sales Person problem	CO5	L3
45	0/1 Knapsack problem LC Branch and Bound solution ,	CO5	L3
46	FIFO Branch and Bound solution	CO5	L3
47	NP- Complete and NP-Hard problems: Basic concepts,	CO5	L3
48	non-deterministic algorithms, P, NP,	CO5	L3
49	non-deterministic algorithms, P, NP contd...	CO5	L3
50	NP-Complete, and NP-Hard classes	CO5	L3
c	**Application Areas**	**-**	**-**
-	Students should be able employ / apply the Module learnings to . . .	-	-
1	Able to design efficient algorithms using Back Tracking and Branch Bound Techniques	CO5	L3
2	Able to classify computational problems into P, NP, NP-Hard and NP-complete	CO5	L3
d	**Review Questions**	-	-
-	The attainment of the module learning assessed through following questions	-	-
34	What is backtracking. Give the general Procedure.	CO5	L2
35	Apply backtracking to solve the 3-cloring problem for the graph given below. 	CO5	L4
36	Apply the backtracking to the problem of finding Hamiltonian cycle in the following graphs 	CO5	L4
37	What branch and bound method. How it is different from backtracking.	CO5	L3
38	Apply the branch – and -bound algorithm to solve the travelling sales man problem for the following graph. Start city is a. Give the states pace tree 	CO5	L3
39	Apply FIFO Branch and Bound method for the following instance of 0/1 Knapsack problem to get the optimal solution. Knapsack Capacity W = 15	CO5	L3

Item No.	1	2	3	4
Weight	2	4	6	9
Value	10	10	12	18

e	**Experiences**	-	-
1		CO10	L2
2		CO9	
3			
4		CO9	L3
5			

E3. CIA EXAM – 3

a. Model Question Paper – 3

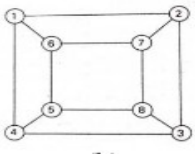
Crs Code:	18CS42	Sem:	IV	Marks:	30	Time:	75 minutes		
Course:	Design and Analysis of Algorithms								
-	**-**	**Note: Answer all questions, each carry equal marks. Module : 5**					**Marks**	**CO**	**Level**
1	a	Give the problem statement of n-queens problem. Explain the solution for 4-queens problem using state space tree.					6	CO5	L2
	b	Apply backtracking to solve the following instance of the subset-sum problem : S={1,3,4,5} and d=11. Draw the state space tree.					9	CO5	L4
		OR						CO5	L4
1	a	Apply backtracking based graph coloring algorithm for the graph given below with m=4. Give state space tree showing first 3 valid assignments. 					10	CO5	L4
	b	Give the backtracking based algorithm to the problem of finding Hamiltonian cycle in the graph					5	CO5	L4
								CO5	
2	a	Apply branch and bound method for the following instance of assignment problem to find the optimal solution. Give the complete state space tree 					9	CO5	L3
	b	Apply the branch -and- bound algorithm to solve the travelling sales man problem for the following graph. Consider start city is A. Give the state space tree. 					6	CO5	L3
		OR							
2	a	With the help of a state space tree, solve the following instance of Knapsack problem by the branch and bound algorithm. Knapsack Capacity W = 15					10	CO5	L4

Item No.	1	2	3	4	5	6
Weight	5	7	2	4	5	1
Value	40	35	18	4	10	2

	b	Explain the following with examples a. Class P Problems b. Class NP Problems c. NP complete problem d.NP hard problem.	5	CO5	L3

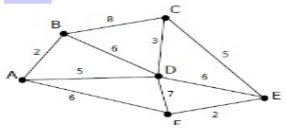
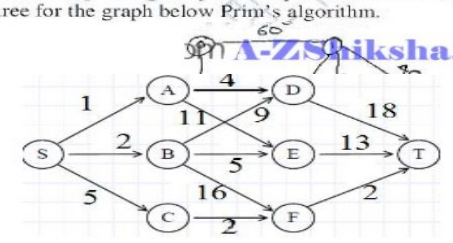
b. Assignment – 3

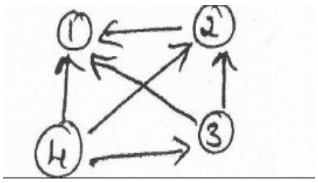
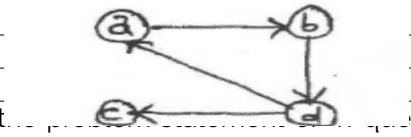
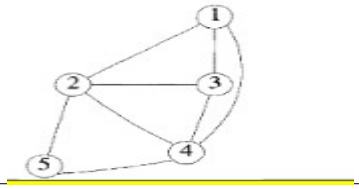
Model Assignment Questions							
Course Code:	18CS42	Sem:	IV	Marks:	5	Time:	75 minutes
Course:	Design and Analysis of Algorithms			Module : 5			
Note: Each student to answer 2-3 assignments. Each assignment carries equal mark.							

SNo	Assignment Description	Marks	CO	Level
1	Explain backtracking concept and apply it solve subset sum problem for S = {6,5,3,7} and d=15. Draw the state space tree.	10	CO5	L3
2	Apply the backtracking to the problem of finding Hamiltonian cycle in the following graphs 	6	CO5	L3
3	How branch and bound algorithm is different from backtracking	5	CO5	L3
4	With the help of a state space tree, solve the following instance of Knapsack problem by the branch and bound algorithm. Knapsack Capacit y W = 10 Item and bound algorithm. Knapsack Item No. 1 2 3 4 Weight 4 7 5 3 Value 40 42 25 12	10	CO5	L3
5	Draw the portion of a state space tree generated by FIFOBB, LCBB and LIFOBB for the job sequencing with deadlines instance n=5, (p1,p2, …,p5)=(6,3,4,8,5), (t1,t2,….,t5)=(2,1,2,1,1) and (d1,d2,…,d5)=(3,1,4,2,4). What is the penalty corresponding to an optimal solution? Use a variable tuple size formulation and ĉ (.) and u (.).	10	CO5	L3
6	Present a program schema for a FIFO Branch and Bound search for a Least-Cost answer node.	6	CO5	L3

F. EXAM PREPARATION

1. University Model Question Paper

Course:	Design and Analysis of Algorithms					Month / Year	May /2020	
Crs Code:	18CS42	Sem:	IV	Marks:	100	Time:	180 minutes	
Module	**Note**	Answer all FIVE full questions. All questions carry equal marks.				**Marks**	**CO**	**Level**
1	a	Compare the orders of growth of following functions i) (½) n (n-1) and n ii) 3n+2 and n				8	CO1	L4
	b	Write the non recursive algorithm for finding the Fibonacci sequence and derive the complexity				12	CO1	L4
		OR						
1	a	Explain the asymptotic notations with examples.				10	CO1	L4
	b	Write an algorithm for selection sort. Analyze its efficiency				10	CO1	L4
2	a	Sort the following elements using merge sort. Write the recursion tree. 70, 20, 30, 40, 10, 50, 60 Twisted : Use D & C method which divides problem size by considering position				10	CO2	L4
	b	Solve the recurrence relation for the time complexity: T(n) = 2 If n=2 T(n) = 2T (n/2) + 3 ∗ n If n2				10	CO2	L3
		OR						
2	a	Write an algorithm for Binary Search,obtain the time complexity of this algorithm for successful and unsuccessful search.				10	CO2	L4
	b	Write an algorithm for Quick Sort and sort the following numbers:10,8,5,15,25,75,12.Obtain its Complexity				10	CO2	L4
3	a	Obtain the optimal solution for the job sequencing problem with dead line,where n=4,profit (P1,P2,P3,P4)=(100,10,15,27) and deadlines (d1.d2.d3.d4)=(2,1,2,1)				6	CO3	L4
	b	Define MST. Apply PRIMS and KRUSKAL algorithm for the following graph to get MST. Show the intermediate steps. 				14	CO3	L4
		OR						
3	a	Explain the concepts of greedy technique for prim's algorithm. Obtain minimum cost spanning tree for the graph whose weight matrix is given below				10	CO3	L4
	b	Explain the concept of greedy technique for Prim's algorithm. Obtain minimum cost spanning tree for the graph below Prim's algorithm. (09 Marks) 				10	CO3	L4
4	a	F c				10	CO3	L4

	b	Generate transitive closoure for given graph. 	10	CO4	L4
		OR			
3	a	Explain Warshall algorithm to find the transitive closure of a directed graph. Apply this algorithm to the graph given below. (08 Marks) 	12	CO4	L4
	b	Write	8	CO4	L4
5	a	Give t… …ens problem. Explain the solution for 4-queens problem using state space tree.	10	CO5	L3
	b	Apply backtracking to solve the following instance of the subset-sum problem : S={1,3,4,5} and d=11. Draw the state space tree.	10	CO5	L3
		OR			
5	a	Apply backtracking based graph coloring algorithm for the graph given below with m=4. Give state space tree showing first 3 valid assignments. 	10	CO5	L3
	b	Give the backtracking based algorithm to the problem of finding Hamiltonian cycle in the graph	10	CO5	L3

2. SEE Important Questions

Course:		Design and Analysis of Algorithms						Month / Year	May /2020	
Crs Code:		18CS42	Sem:	4	Marks:	100		Time:	180 minutes	
	Note	Answer all FIVE full questions. All questions carry equal marks.						-	-	
Module	Qno.	Important Question						**Marks**	**CO**	**Year**
1	a	Explain all the mathematical notations used for the analysis of an algorithm						06	CO1	2016
	b	Explain the method of comparing the order of the growth of two functions using limits. Compare order of growth of following functions i) log n and sqrt(n) ii) (log2 n)2 and log2 n square						06	CO1	2015
	c	Explain in brief the basic asymptotic efficiency classes.						10	CO1	2017
2	a	Solve the following recurrence relations x(n) =3x(n-1) for n>1,x 1)=4 and x(n)=x(n/2)+n for n>1,x(1)=1,n=2k						06	CO2	2015
	b	Explain and Analyze the merge sort algorithm.						10	CO2	2016
	c	How quick sort can be improved?						04	CO2	2015

3	a	Explain Kruskal's Algorithm With an example	10	CO3	2016
	b	Construct a Huffman code for the following data: Character : A B C D - Probability: 0.4 0.1 0.2 0.15 0.15	10	CO3	2015
4	a	Write Warshall's algorithm and apply it to compute transitive closure for the directed graph with the adjacency matrix shown below: A B C D A 0 1 0 0 B 0 0 0 1 C 0 0 0 0 D 1 0 1 0	10	CO4	2014
	b	Explain the dynamic programming with Floyd's algorithm in detail. Apply Floyd's all pairs shortest problem. For the digraph given below	10	CO4	2013
	c	What is the Optimal Binary Search Tree problem? Explain how principal of optimality holds for this problem. Also explain how it is solved using dynamic programming.	8	CO4	2012
	d	What is the difference between Greedy approach and Dynamic Programming? Explain with example	5	CO4	2013
5	a	Write an algorithm for sum of subset problem using backtracking. Also solve the following instance of sum of subset problem : S ={1,5,2,7} with d = 8.	10	CO5	2016
	b	Apply Branch and Bound algorithm to solve the travelling salesman problem for the graph with a cost adjacency matrix is as follows. A B C D E A 0 3 1 5 8 B 3 0 6 7 9 C 1 6 0 4 2 D 5 7 4 0 3 E 8 9 2 3 0	10	CO5	2014
	c	Show that Hamilton cycle problem is NP-Complete.	5	CO5	2014
	d	Explain the terms P, NP, NP-Hard and NP-Complete with suitable example. Also give relationship between them.	6	CO5	2014

Course Outcome Computation

Academic Year:

Odd / Even semester

INTERNAL TEST					**T1**						**T2**	
Course Outcome	**CO1**		**CO2**		**CO3**		**CO4**		**CO5**		**CO6**	
QUESTION NO	**Q1**	**LV**	**Q2**	**LV**	**Q3**	**LV**	**Q1**	**LV**	**Q2**	**LV**	**Q3**	**LV**
MAX MARKS	10	-	10	-	10	-	10	-	10	-	10	-
USN-1	5	2	10				10	3	9	3	4	1
USN-2	5	2	8	3								
USN-3	7	3	7	3	10	3	8	3	8	3	5	2
USN-4					4	1	10	3	8	3	6	2
USN-5	8	3	6	2	9	3	10	3	8	3		
USN-6							10	3	9	3	4	1
Average CO Attainment		2.5		2.75		2.33		3		3		1.5

LV Threshold : 3:>60%, 2:>=50% and <=60%, 1: <=49%
CO1 Computation :(2+2+2+3)/4 = 10/4=2.5

PO Computation

Program Outcome	PO1		PO3		PO3		PO1		PO12		PO12	
Weight of CO - PO	3		1		3		2		2		3	
Course Outcome	CO1		CO2		CO3		CO4		CO5		CO6	
Test/Quiz/Lab	T1						T2					
QUESTION NO	Q1	LV	Q2	LV	Q3	LV	Q1	LV	Q2	LV	Q3	LV
MAX MARKS	10	-	10	-	10	-	10	-	10	-	10	-
USN-1	5	2	10	3			10	3	9	3	4	1
USN-2	5	2	8	3								
USN-3	7	3	7	3	10	3	8	3	8	3	5	2
USN-4					4	1	10	3	8	3	6	2
USN-5	8	3	6	2	9	3	10	3	8	3		
USN-6							10	3	9	3	4	1
Average CO Attainment		2.5		2.75		2.33		3		3		1.5