Exam Code: 407

NOVEMBER 2022 EXAMINATION
III B.E. (4YDC) INFORMATION TECHNOLOGY
IT38001/IT3801 COMPUTER NETWORKS

TIME: 3 HRS

Max Marks: 70
Min Pass Marks: 22

TOTAL NO OF QUESTIONS IN THIS PAPER: 5

Note: Attempt all five questions. Each Question has 5 subparts. Parts A, B, C are compulsory and attempt any one from D or E.

		Marks	CO	BL	PI
Q.1					
(a)	Assume 6 devices are arranged in a mesh topology. How many cables are needed? How many ports are needed for each device?	2	1	3	1.3.1
(b)	DNS uses UDP instead of TCP. If a DNS packet is lost, there is no automatic recovery. Does this cause a problem, and if so, how it is solved?	2	1	1	1.4.1
(c)	Describe the functionality of network layer and transport layer in OSI model.	3	1	1	1.3.1
(d)	Two hosts are connected via a packet switch with 10^7 bits per second links. Each link has a propagation delay of 20 micro-seconds. The switch begins forwarding a packet 35 microseconds after it receives the same. If 10000 bits of data are to be transmitted between the two hosts using a packet size of 5000 bits, the time elapsed between the transmission of the first bit of data and the reception of the last bit of the data in micro seconds is..?	7	1	3	1.4.1
	OR				
(e)	Explain TCP/IP model with each layer protocol in details.	7	1	2	1.3.1
Q.2					
(a)	What is the need of Error Detection and Correction in Data Link Layer?	2	2	2	1.4.1
(b)	Describe the sliding window protocol for data link layer.	2	2	2	1.3.1
(c)	Station B needs to send a message consisting of 9 packets to Station C using a sliding window (window size 3) and go-back-n error control strategy. All packets are ready and immediately available for transmission. If every 5th packet that B transmits gets lost (but no acks from C ever get lost), then what is the number of packets that B will transmit for sending the message to C?	3	2	3	1.3.1
(d)	Consider a network connected two systems located 8000 kilometers apart. The bandwidth of the network is 500×10^6 bits per second. The propagation speed of the media is 4×10^6 meters per second. It is needed to design a Go-Back-N sliding window protocol for this network. The average packet size is 10^7 bits. The network is to be used to its full capacity. Assume that processing delays at nodes are negligible. Then the minimum size in bits of the sequence number field has to be?	7	2	3	1.4.1
	OR				
(e)	Explain different error detection and correction mechanisms with examples	7	2	2	1.3.1
Q.3					
(a)	Describe CSMA/CD protocol.	2	2	1	1.3.1

	(b)	What is meant by congestion? List the ways of avoiding congestion.	2	2	1	1.4.1
	(c)	Consider five wireless stations, A, B, C, D, and E. Station A can communicate with all other stations. B can communicate with A, C and E. C can communicate with A, B and D. D can communicate with A, C and E. E can communicate A, D and B. (a) When A is sending to B, what other communications are possible? (b) When B is sending to A, what other communications are possible? (c) When B is sending to C, what other communications are possible?	3	5	4	1.3.1
	(d)	Explain different multiple access protocol mechanisms in brief.	7	2	2	1.3.1
		OR				
	(e)	If a CSMA/CD network that transmits data at a rate of 100 Mbps (10^8 bits second) over a 1 km(kilometer) cable with no repeaters and the minimum frame size required for this network is 1250 bytes, what is the signal speed (km/sec) in the cable?	7	2	3	1.4.1
	Q.4					
	(a)	Explain IPV4 header format.	2	3	2	1.3.1
	(b)	Explain ARP packet frame format.	2	3	2	1.3.1
	(c)	What is the maximum number of subnets and the maximum number of hosts in each subnet, if the address of a class B host is to be split into subnets with a 6-bit subnet number?	3	3	3	1.4.1
	(d)	What is IP? Discuss the different classes of IP addressing? Explain classful and classless addressing.	7	3	2	1.3.1
		OR				
	(e)	Divide the network 220.125.5.192/26 into 8 sub networks. How many hosts can be connected in each network? Show their IP range, network address and broadcast address.	7	3	3	1.4.1
	Q.5					
	(a)	Differentiate between TCP and UDP	2	4	4	1.4.1
	(b)	Explain the format of TCP header.	2	4	2	1.3.1
	(c)	What is meant by piggybacking? What are its advantages and disadvantages?	3	4	1	1.3.1
	(d)	How transport layer connection is established in TCP? Explain 3 way handshake process of TCP with example.	7	4	2	1.4.1
		OR				
	(e)	What is socket? Which are various primitives used in client server communication.	7	6	2	1.3.1

Code No.: 409

Aug -Dec 2022

III B. E. (4YDC) EXAMINATION

IT38003/IT3803 : OPERATING SYSTEM Time: 3 Hrs.]

[Max. Marks: 70

[Min. Marks: 22

TOTAL NO. OF QUESTION IN THIS PAPER: 5

NOTE: 1)Attempt all questions. Attempt all parts of the same question at one place.

2) Attempt any one part from 'd' or 'e'.

S.No.		Questions	Marks	CO	BL	PI
Q.1	(a)	With a neat diagram, explain various states of a process.	2	CO1	BL1	1.4.1
	(b)	What is the purpose of system programs/system calls?	2	CO1	BL1	1.4.1
	(C)	What are the advantages of inter-process communication and also compare various implementations of inter-process communication?	3	CO1	BL1 ·3	1.4.2
	(d)	Assume the following workload in a system: Process Arrival Time Burst Time P1 5 5 P2 4 6 P3 3 7 P4 1 9 P5 2 2 P6 6 3 Draw a Gantt chart illustrating the execution of these jobs using Round robin scheduling algorithm and also Calculate the average waiting time and average turnaround time.	7	CO2	BL4	2.3.1
		OR				
	(e)	Show how wait() and signal() semaphore operations could be implemented in multiprocessor environments using the test and set instruction. The solution should exhibit minimal busy waiting. Develop pseudo code for implementing the operations.	7	CO2	BL4	2.3.1
Q.2	(a)	Illustrate the use of fork and exec system calls.	2	CO2	BL2	1.4.2
	(b)	Some computer systems do not provide a privileged mode of operation in hardware. Is it possible to construct a secure operating system for these computer systems?	2	CO2	BL4	1.4.1
	(C)	Explain swap() operations in process synchronization.	3	CO2	BL2	1.4.1
	(d)	Consider the following system snapshot using data structures in the banker's	7	CO3	BL4	2.3.1

algorithm, with resources A, B, C and D and process P0 to P4.

	Max	Allocation	Available
	A B C D	A B C D	A B C D
P0	6 0 1 2	4 0 0 1	3 2 1 1
P1	1 7 5 0	1 1 0 0	
P2	2 3 5 6	1 2 5 4	
P3	1 6 5 3	0 6 3 3	
P4	1 6 5 6	0 2 1 2	

Using banker's algorithm, Answer the following questions:
a) How many resources of type A, B, C and D are there?
b) What are the contents of the need matrix?
c) Is the system in a safe state? Why?
d) If a request from process P4 arrives for additional resources of (1,2,0,0), can the banker's algorithm grant the request immediately? Show the new system state and other criteria.

OR

(e) For the following snapshot. Find the safe sequence using Banker's algorithm. — 7 — CO3 — BL4 — 2.3.1

	Max	Allocation	Available
	A B C	A B C	A B C
P0	0 0 2	0 0 4	1 0 2
P1	1 0 0	2 0 1	
P2	1 3 5	1 3 7	
P3	6 3 2	8 4 2	
P4	1 3 2	1 5 7	

i) Is the system in safe state?
ii) If a request from process P2 arrives for (002), can the request be granted immediately?

Q.3	(a)	Under what circumstances user level threads are better than the kernel level threads?	2	CO3	BL1	1.4.1
	(b)	Can a multithreaded solution using multiple user-level threads achieve better performance on a multiprocessor system than on a single processor system?(	2	CO3	BL4	1.4.1
	(C)	Given the memory partitions of 100K, 500K, 200K, 300K, and 600K apply First fir	3	CO4	BL2	2.3.1

		and last fit algorithm to place 212K, 417K, 112K, 426K.				
	(d)	Consider the reference string { 7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1} with frame size 3, explain the LRU Page Replacement algorithms.	7	CO4	BL3	2.3.1
		OR				
	(e)	Consider the following reference string {7,0,1,2,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1} for a memory with three (03) frames. How many page Faults occur for LRU and FIFO page replacement algorithms? Which is efficient among both?	7	CO4	BL3	2.3.1
Q.4	(a)	What do you mean by compaction? In which situation is it applied?	2	CO5	BL2	1.4.1
	(b)	Priority inversion is a condition that occurs in real time systems – Analyzing this statement.	2	CO5	BL3	1.4.1
	(C)	If the average page faults service time of 25 ms and a memory access time of 100ns.Calculate the effective access time.	3	CO5	BL5	2.3.1
	(d)	A disk drive has 200 cylinders, numbered 0 to 199. The drive is currently serving a request at cylinder 53. The queue of pending requests, in FIFO order, is 98, 183, 37, 122, 14, 124, 65, 67. Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms? *i) FCFS ii) SSTF iii) SCAN iv) LOOK v) C-SCAN vi) C-LOOK.*	7	CO5	BL4	2.3.1
		OR				
	(e)	Let a disk drive have 5000 cylinders from 0 to 4999. Currently the drive is at 143rd cylinder, and the previous request was at cylinder 125. Queue of pending requests in FIFO order is 186, 1470, 913, 1774, 948, 1509, 1022, 130. What is the total distance the disk arm moves to satisfy all the pending requests for each of the following disk scheduling algorithms from current position i) FCFS ii) SCAN iii)LOOK Vi) SSTF v) C-SCAN vi) C-LOOK	7	CO5	BL4	2.3.1
Q.5	(a)	Differentiate between low-level and high level formatting?	2	CO6	BL3	1.4.1
	(b)	Explain how protection is provided for the hardware resources by the operating system.	2	CO6	BL5	1.4.1
	(C)	Write short notes on different categories of files.	3	CO6	BL1	1.4.1
	(d)	*What is protection? Distinguish between mechanisms and policies. Explain briefly Access matrix with domains as objects.*	7	CO6	BL2	1.4.1
		OR				
	(e)	Explain how protection is provided for the hardware resources by the operating system.	7	CO6	BL3	1.4.1

Q5 (b) Explain in Brief Access control list ?

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NOVEMBER 2022 EXAMINATION

III B.Tech./B.E. (4YDC) INFORMATION TECHNOLOGY

IT 38007 : Design and Analysis of Algorithms

Time : 3 Hrs.] **[Max. Marks : 70**
[Min Pass Marks : 22

TOTAL NO. OF QUESTIONS IN THIS PAPER : 05

Note : Each question has three parts a, b, and c. Part a of each question is compulsory, and attempt any one part from b or c from each question.

			Marks	CO	BL	PI

Q.1	a	**State true/false for the following, also give reason to support your answer:-**
		i) The worst case and best case of divide & conquer based quick sort is $O(n^2)$ and $O(n)$, respectively.
		ii) For an undirected connected graph 'G', if 'w' be the minimum weight among all the edge weights and 'e' is a specific edge of weight 'w', than edge 'e' will be present in all minimum spanning tree's of the graph 'G'.
		iii) Given some problem P_1 & P_2. If problem P_1 is NP-complete and P_1 reduces to P_2 in polynomial time than P_2 is NP-hard.
		iv) Look at the following function
		Test (int n) {
		int summation = 0; a=1;
		for (int i=0; i<=n; i++) {
		for (int j=1; j<=a; j++)
		summation++; }
		a = a*2;
		} The best running time complexity of the above code is $O(n^a)$.
		Give one word for the following:-
		i) The tightest lower bound on the number of comparisons, in the worst case, for comparison-based sorting is of the order of _____ ?
		ii) To implement Dijkstra's shortest path algorithm on unweighted graphs so that it runs in linear time, the data structure to be used is ____?
		iii) Consider a decision problem *'Q'* such that 3-CNF-SAT reduces in polynomial time to Q, than Q belongs to ____ class of problems.
			4+3	CO1, CO6	BL1	1.4.1

	b	Solve the following recurrence equations:- **(i)** $T(n)=T(n/2)+T(n/2)+cn$ **(ii)** $T(n)=T(n/3)+cn$ **(iii)** $T(n)=T(n/2)+n^2$. Mention the time complexity of heap sort algorithm in worst case.	7	CO1	BL3	1.4.1
		OR				
	c	Give the step by step analysis of Build-max-heap and Max-heapify procedure of Heap-sort algorithm. Mention the time complexity of heap sort algorithm in best, average and worst case.	7	CO1	BL6	3.2.1
Q.2	a	Compare (I) Divide & Conquer, Dynamic Programming and Greedy technique (II) Prim's and Kruskal's Algorithm (III) Deterministic and non-deterministic algorithms.	3+2+2	CO2	BL5	1.4.1
	b	Write an efficient algorithm using divide and conquer technique to find k^{th} largest and k^{th} smallest element from a list of numbers arranged randomly. Mention time and space complexity of the algorithm.	7	CO4	BL6	3.2.1
		OR				
	c	Let us consider that you rank a set of 'n' movies and then a collaborative filtering system consults its database to look for other people who had similar	7	CO4	BL6	3.3.1

PTO

		rankings of same set of movies. To compare two different ranking of movies, filtering system randomly picks the movie ranking from the data-base. If stranger's ranking of movies are from 1 to n than write an θ (n lg n) algorithm to find difference in the ranking of movies specified by you relative to stranger's movie preference available in the database.				
Q.3	a	Given three types of items in three different boxes respectively i.e. each box contains items of same types, with the following respective weights and values $B = (B_1, B_2, B_3)$ $w_i = (2, 3, 5)$ $v_i = (3, 7, 11)$ and the knapsack with capacity W = 49. Give a dynamic programming based solution to obtain the optimal solution.	7	CO5	BL3	2.2.3
	b	Define transitive closure of a graph. Write an $O(n^3)$ algorithm to find All-Pair Shortest Path (APSP) of a directed graph.	7	CO3, CO4	BL6	3.2.1
		OR				
	c	Mathematically define left turn & right turn with respect to three points in a two dimensional plane. By taking a suitable example, explain how convex hull of set of points in two dimensional plane can be obtained? Also explain what data structure you will use to determine convex hull and if a new point is to be added into existing convex hull, how above data structure will be used to define new convex hull?	7	CO3, CO4	BL2	1.4.1
Q.4	a	Consider following chain of matrices to be multiply: $A_{(3,9)} \times B_{(9,15)} \times C_{(15,20)} \times D_{(20,5)}$. Give the most optimal solution in terms of minimum number of multiplications required and order of matrix chain multiplication. Also show the contents of 'M' array used for storing minimum multiplications and '*K*' arrays used for storing value of k.	7	CO5	BL3	2.2.3
	b	With respect to Depth First Search (DFS) algorithm for the graph, define: (i) Forward edge (ii) Back edge (iii) Cross edge, by taking suitable example. Write a modified DFS algorithm to determine whether a given directed graph is a DAG or not.	7	CO3	BL1	2.2.3
		OR				
	c	What is union-find data-structure? Give implementation of union and find operations using (i) Arrays data-structure (ii) Linked list data-structure. Mention time complexity of union and find operations, in both the cases.	7	CO3	BL1	1.4.1
Q.5	a	What is reduction technique? Define mathematically. By using reduction technique how a problem of finding longest path for a graph with all edge weights negative can be solved?	7	CO6	BL1	1.4.1
	b	Prove that (i) SAT $\leq_p$ 3-CNF-SAT (ii) Clique $\leq_p$ Independent Set Problem (ISP).	7	CO6	BL4	1.4.1
		OR				
	c	Formally define (i) P Class (ii) NP-class (iii) NP-complete class (iv) NP-hard class (v) Decision Problem (vi) Verification (vii) Backtracking.	7	CO6	BL1	1.4.1

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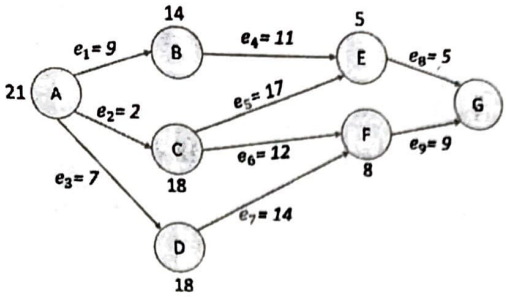
NOV-DEC-2022 EXAMINATION
III B. TECH. (4YDC) INFORMATION TECHNOLOGY
IT 38005: ARTIFICIAL INTELLIGENCE

[Time: 3 Hrs.] 0801I72010 [Max. Marks: 70]
[Min. Pass Marks:22]

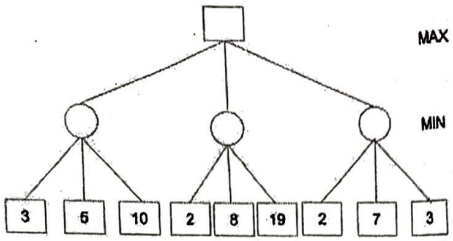
TOTAL NO. OF QUESTIONS IN THIS PAPER: 5

Note: Attempt all the questions. Each question has five subparts A, B, C, D and E. Attempt any one part from D and E. Answers should be brief and to the point. Make suitable assumptions wherever necessary and clearly state the same.

S. No.	Questions	Marks	CO	BL	PI
Q1 (a)	Define cognition, and briefly discuss the cognitive science approach of Artificial Intelligence.	2	1	BL1	1.4.1
(b)	Discuss in brief, the differences between Artificial Intelligence and Machine Learning.	2	1	BL1	1.4.1
(c)	What do you understand by observability of agent environment? What are fully observable and partially observable environments? Provide explanation along with suitable examples.	3	1	BL2	1.4.1
(d)	Discuss in brief i. State-based agents ii. Goal-based agents iii. Utility-based agents Clearly mention the factor that can be used to differentiate whether the given agent is state-based, goal-based or utility-based agent.	7	6	BL3	1.4.1
	OR				
(e)	Write the difference between uninformed and informed search strategies, with examples. Given a *k*-ary tree with depth *d* state the following for Breadth First Search (BFS) and Depth First Search (DFS). i. Is the search method complete? ii. Is the search method optimal? iii. Time complexity of the search method.	7	6	BL4	1.4.1
Q2 (a)	What are heuristics in the context of search space? Provide two possible heuristic metrics for the 8-puzzle problem.	2	2	BL1	1.4.1
(b)	What are AND-OR graphs? Provide one example.	2	2	BL1	1.4.1
(c)	What are the metrics to evaluate a given search strategy?	3	2	BL2	1.4.1
(d)	Solve the following constrained cryptarithmetic problem. Provide proper justification for each step. Problem: P O I N T + Z E R O E N E R G Y Following are the constraints for cryptarithmetic problems: i. Every character/letter must have a unique and distinct value ii. The values of a character/letter cannot be changed and should remain the same throughout. iii. Starting digit of a number cannot be a zero example – 0341 should be simply 341. iv. Once all the characters/letters are replaced with numbers, arithmetic operations must be correct.	7	2	BL3	1.4.1
	OR				
(e)	Apply A* algorithm on the given graph. Show each step clearly. Calculate the length of optimal path. Draw a clean diagram of the obtained tree.	7	2	BL4	1.4.1



Q3 **(a)**	What are frames in knowledge representation? Provide a frame system for a cricket player.	2	2	**BL1**	1.4.1
(b)	You can graduate only if you have completed the requirements of your program and you do not owe money to the university and you do not have an overdue library book. Express your answer in terms of g: "You can graduate," m: "You owe money to the university," r: "You have completed the requirements of your program," and b: "You have an overdue library book."	2	2	**BL1**	1.4.1
(c)	Use De Morgan's laws to find the negation of each of the following statements. a) Ashutosh is rich and happy. b) Trishna will bicycle or run tomorrow. c) Kohli walks or takes the bus to class.	3	2	**BL2**	1.4.1
(d)	For each of these arguments, explain which rules of inference are used for each step. i. "Doug, a student in this class, knows how to write programs in JAVA. Everyone who knows how to write programs in JAVA can get a high-paying job. Therefore, someone in this class can get a high-paying job." ii. "Somebody in this class enjoys whale watching. Every person who enjoys whale watching cares about ocean pollution. Therefore, there is a person in this class who cares about ocean pollution."	7	2	**BL3**	1.4.1
	OR				
(e)	Use quantifiers and predicates with more than one variable to express these statements. i. Every computer science student needs a course in discrete mathematics. ii. There is a student in this class who owns a personal computer. iii. Every student in this class has taken at least one computer science course. iv. There is a student in this class who has taken at least one course in computer science. v. Every student in this class has been in every building on campus.	7	2	**BL4**	1.4.1
Q4 **(a)**	What is Cut off refinement in Artificial Intelligence?	2	2	**BL1**	1.4.1
(b)	What is the Minimax algorithm explain it with suitable examples?	2	2	**BL1**	1.4.1
(c)	Explain in brief about Planning in Artificial Intelligence?	3	2	**BL2**	1.4.1
(d)	Solve following using Alpha Beta Pruning Algorithm:	7	2	**BL3**	1.4.1



OR

(e)	Write a PseudoCode for Blocks World example in an Artificial Intelligence based system?	7	2	**BL4**	1.4.1
Q5	Calculate union between A and complement of B.	2	2	**BL1**	1.4.1
(a)					

The sets A and B are given below. Kindly show calculations at each step of your solution.

$$A = 1,1,2,1,3,0.9,4,0.6,5,0.4,6,0.3,7,0.2,8,0.1,9,0$$

$$B = \{1,0\},\{2,0\},\{3,0\},\{4,0.2\},\{5,0.5\},\{6,0.8\},\{7,1\},\{8,1\},\{9,0.7\}$$

(b)	What is Crossover? What are different kinds of crossover operators?	2	2	**BL1**	1.4.1
(c)	What is optimization? Explain briefly the three factors governing optimization problems. Provide at least one example for each factor.	3	2	**BL2**	1.4.1
(d)	Explain in detail the max-min composition of fuzzy relations. Compute max-min composition R1R2 with R1 and R2 given as;	7	2	**BL3**	1.4.1

x \ y	y1	y2	y3
x1	0.2	0.5	0.7
x2	0.3	0.6	0.7
x3	0.4	0.8	0.9

R1≙

y \ z	z1	z2
y1	1.0	0.8
y2	0.5	0.6
y3	0.4	0.3

R2≙

OR

(e)	Draw a detailed and well-labelled flow chart of genetic programming.	7	2	**BL4**	1.4.1

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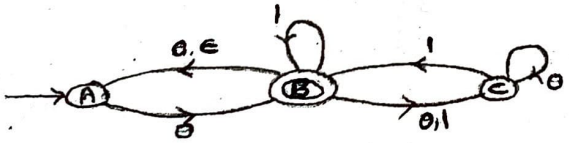
NOV-DEC 2022 EXAMINATION
III BE (4YDC) INFORMATION TECHNOLOGY
IT38002: THEORY OF COMPUTATION

Time: 3 Hrs.] [Max. Marks : 70
[Min. Pass Marks : 22

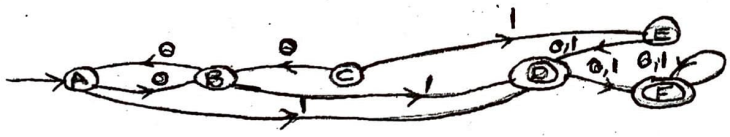
TOTAL NO. OF QUESTIONS IN THIS PAPER: 5

Note: Attempt all the questions. Each question has five subparts A, B, C, D, and E. Part A, B, and C are compulsory. Attempt any one part from D and E. Answers should be brief and to the point. Make suitable assumptions wherever necessary and clearly state the same.

		Marks	CO	BL	PI
Q1A	Let L be any language on a non-empty alphabet. Argue that L and $\overline{L}$ cannot both be finite.	(02)	CO1	2	1.2.1
B	Find grammar for $\Sigma = \{a, b\}$ that generates the set of all strings with exactly one a.	(02)	CO2	4	2.4.1
C	The reverse of string can be defined precisely by the recursive rules: $a^R = a$, $(wa)^R = aw^R$, for all $a \in \Sigma$, $w \in \Sigma^+$. Use this to prove using mathematical induction that $(uv)^R = v^R u^R$, for all u, v $\in \Sigma^+$.	(03)	CO4	3	1.2.1
D	(i) Construct DFA equivalent to the given NFA:	(03)	CO5	3	1.4.1



(ii) Minimize the states in the DFA given below: (04)



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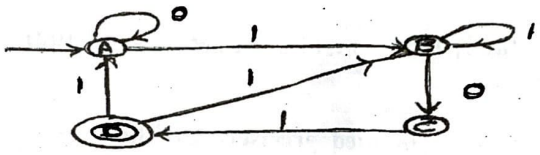
E	Construct the Deterministic finite automata that accept all strings of length three or more such that the second letter of the string is same as the second last letter of the string over $\Sigma = \{a, b\}$.	(07)	CO2	4	2.4.1

Q2A	Give a formal definition for the regular expression.	(02)	CO1		
B	Define the following terms: (i) Homomorphism (ii) Right quotient	(02)	CO1	1	
C	Using pumping lemma show that the following language is not regular: $L = \{ww^R: w \in \Sigma^*\}$	(03)	CO3	4	1.4.1
D	(i) Construct finite automata equivalent to the given regular expression: $(0+11)^*(00+1)01$	(03)	CO5	3	1.4.1
	(ii) Construct regular expression equivalent to given finite automata using Arden's theorem:	(04)			



OR

E	Construct a Moore machine for input from (0+1+2+3+4)* that print the residue modulo 3 of the input treated as a quinary (base 5 with digits 0, 1, 2, 3, 4) number.	(07)	CO2	4	2.4.1
Q3A	Give formal definition of Push Down Automata (PDA).	(02)	CO1	1	1.4.1
B	Construct a PDA equivalent to the given CFG: $S \rightarrow aSA/a, A \rightarrow bB, B \rightarrow b$	(02)	CO5	3	1.4.1
C	Define the following terms: (i) Sentential Form (ii) Partial derivation tree (iii) Subtree of a derivation tree	(03)	CO1	1	1.4.1
D	Construct PDA for Given language: $L = \{a^n b^m: m > n \geq 1\}$	(07)	CO2	4	2.4.1

OR

E	Convert the given grammar into Greibach Normal Form (GNF): $S \rightarrow AA/a, A \rightarrow SS/b$	(07)	CO5	3	1.4.1

A	Give transition (Next move) functions for the Turing machine and Nondeterministic Turing machine. Also, write the Turing thesis.	(02)	CO1	1	1.4.1
B	Give the formal definition of Linear Bounded Automata (LBA).	(02)	CO1	1	1.4.1
C	Briefly explain Chomsky's hierarchy of languages, and give the associated grammar and automata for each language.	(03)	CO1	1	1.4.1
D	Construct a Turing machine that copies strings of 1's over $\Sigma = \{0, 1\}$. $q_0w \vdash q_fww$ where $w \in \{1\}^+$	(07)	CO2	4	2.4.1
	OR				
E	Design a Turing machine to compute the following function: $f(x) = \begin{cases} \frac{x}{2}, & if\ x\ is\ even \\ \frac{x+1}{2}, & if\ x\ is\ odd \end{cases}$	(07)	CO2	4	2.4.1
Q5A	Differentiate between Recursive languages and recursively enumerable languages.	(02)	CO6	2	1.4.1
B	Define the term computable function and decidable problem.	(02)	CO6	1	1.4.1
C	Explain Post Correspondence Problem (PCP). If $\Sigma = \{0, 1\}$ and A and B are: A: $w_1 = 1, w_2 = 1110, w_3 = 10$ B: $v_1 = 111, v_2 = 101, v_3 = 0$ Does there exist a PC-solution for this? If yes, write that PC-solution.	(03)	CO6	1	1.4.1
D	Define P, NP and NP-complete classes of problems with examples. What do you mean by polynomial time reducibility?	(07)	CO6	2	1.4.1
	OR				
E	State "Turing machine halting problem". Prove that "The Turing machine halting problem is undecidable".	(07)	CO6	2	1.4.1

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