2021
COMPUTER SCIENCE
[HONOURS]
Paper : VII

Full Marks : 80 Time : 4 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer any **seven** questions: 1×7=7

   a) Differentiate, with example, a simple graph and a multigraph.

   b) Explain the unbalanced transportation problem with suitable example.

   c) Define Cook's theorem.

   d) Explain pigeon hole principle with suitable example.

   e) Explain Components with suitable example.

   f) Define Upper bound of function.

   g) Find the regular expression for the following languages

   L={ ab, aab}

   h) Give the English description of the following languages

   (0+1)*11(0+1)

   i) Define a bipartite graph with suitable example.

2. Answer any **six** questions: 2×6=12

   a) Define adjacency list for complete graph using suitable example.

   b) Define pigeon hole principle using suitable example.

   c) Define tautology using suitable example.

   d) Define Exclusion and inclusion principle with suitable example.

   e) Prove that if L1 and L2 is regular then L1 U L2 is also regular.

   f) Draw the state diagram of languages– "all string starting and ending with 101".

   g) Prove that: $\lambda + R.R^* = \lambda + R^*.R$.

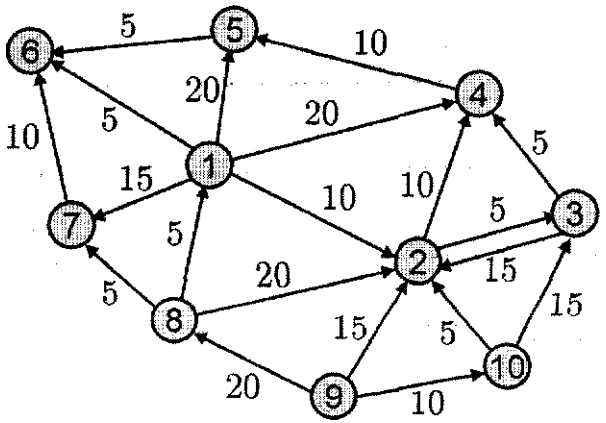
   h) Explain the advantages of curve fitting algorithm.

3. Answer any **three** questions: 7×3=21

a) i) Define Universal Turing Machine with suitable example.

ii) Chomsky Classification of Grammar with suitable example.

b) Solve the minimum spanning tree problem for the following graph using Prim's Algorithm:



c) Solve the recurrence relation

i) $a_n = 5a_{n-1} - 6a_{n-2}$

ii) Check that $a_n=2^n+1$ is a solution to the recurrence relation $a_n=2a_n-1$ with $a_1=3$.

d) Construct the minimum automaton for the following finite automaton:

	a	**b**
→q0	q1	q0
q1	q0	q2
q2	q3	q1
*q3	q3	q0
q4	q3	q5
q5	q6	q4
q6	q5	q6
q7	q6	q3

e) Construct a DFA for the following finite automaton:

	a	**b**
→q0	{q0, q1}	q0
q1	q2	q1
q2	q3	q3
*q3	-	$\{q_1, q_2\}$

4. Answer any **four**: 10×4=40

a) There are five machines and five jobs are to be assigned and the associated cost matrix is as follows. Find the proper assignment.

		Machines				
		I	*II*	*III*	*IV*	*V*
	A	6	12	3	11	15
	B	4	2	7	1	10
Jobs	*C*	8	11	10	7	11
	D	16	19	12	23	21
	E	9	5	7	6	10

b) Obtain an initial basic feasible solution to the following transportation problem North-West Corner Method:

	I	**II**	**III**	**IV**	
A	5	1	3	3	34
B	3	3	5	4	15
C	6	4	4	3	12
D	4	–1	4	2	19
	21	25	17	17	

c) Find y in [0, 3] by solving the initial value problem $y' = (x - y)/2$, y(0)=1 using RK method of order four with h=1/2 and 1/4.

d) Solve the linear system by Gauss elimination method:

$$x + y + z = 3$$

$$x + 2y + 2z = 5$$

$$3x + 4y + 4z = 11$$

e) A carpenter makes tables and chairs. Each table can be sold for a profit of £30 and each chair for a profit of £10. The carpenter can afford to spend up to 40 hours per week working and takes six hours to make a table and three hours to make a chair. Customer demand requires that he makes at least three times as many chairs as tables. Tables take up four times as much storage space as chairs and there is room for at most four tables each week. Formulate this problem as a linear programming problem and solve it graphically.

f) Construct a precedence network based on the same activity descriptions below. Show all your work. Label activities in the network by their activity letters and node numbers. Remove all redundant dependencies and arrange activities in proper sequence steps.

• Activities H, R2, Tl start the project.

• Activity T2 can start when Activities H, El and S are completed.

• Activity El also depends on Activity R2.

• Activity X follows Activity H and precedes Activity L.

• Activity E is preceded by Activities T2 and PI.

• The predecessors to Activity G are Activities L, T2 and P1.

• The successors to Activity Tl are Activities El, S, W and D2.

• Activity PI cannot begin until Activity W is finished.

• Activity P2 and F follow Activities W and D2, and precede Activities E and Rl.

• Activity 02 depends on T2 and PI, and precedes Activity L.

g) Consider a single-server queue with infinite buffer space

i) Consider the situation

• The inter-arrval time is a constant and is given by 1 sec

• The service time required by each customer

is always 0.5 sec

What is the mean waiting time per customer?

ii) Consider the situation

• The inter-arrival time is exponentially distributed with mean 1 sec

• The service time required by each customer is exponentially distributed with mean 0.5 sec

What is the mean waiting time per customer?

iii) Compare the answers of (i) and (ii), what conclusions can you draw?

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