Total number of printed pages: 50 **Programme(UG)/5th/UCSE513**

2022

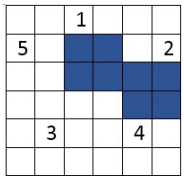
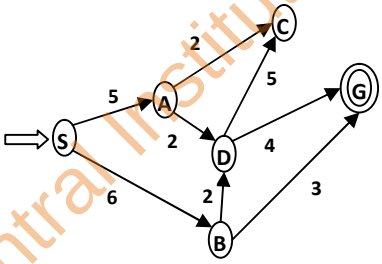
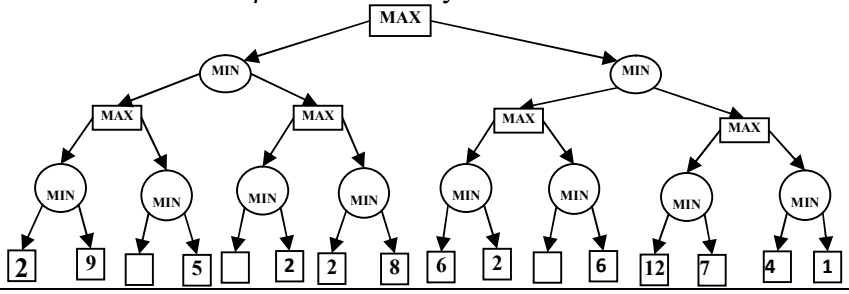
ARTIFICIAL INTELLIGENCE

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1.	**a)**	What kind of challenges was occurred after the Turing test?	4
	b)	Describe the rules of the of the production system.	6
	c)	Write down the set of agent's (1 to 5) action direction as per the rules in their first move only from the given below figure. 	10
2.	**a)**	Write down the steps of AO*algorithm which estimate the cost of goal.	6
	b)	Solve the Matrix Multiplication problem based on AND/OR node using the matrix dimensions A_1 =9*6, A_2=6*8, A_3 =8*3.	6
	c)	Apply A* algorithm for finding a goal with the path cost and heuristics values which are as follows **A=6, B=4, C=7, D=6, G=0**. 	8
3.	**a)**	Apply alpha-beta (α-β) pruning algorithm to find out the MAX (α-value) without knowing the cost of few leaf nodes in the given below figure and also mention the α-β values at every levels. 	6

	b)	Decide whether each of the following sentences is 'VALID' or 'SATISFIABLE'. Verify your decisions using truth tables or the equivalence rules. ***(i)*** *Light ⇒ Light* ***(ii)*** *Light ⇒ Electricity* **(iii)***(Light ⇒ Electricity) ⇒ (¬ Light ⇒ ¬ Electricity)* ***(iv)*** *Light ∨ Electricity ∨ ¬ Electricity* ***(v)*** *((Light ∧ Fan)⇒ Electricity) ⇔ ((Light ⇒ Electricity)∨ (Fan⇒ Electricity))* ***(vi)*** *(Light ⇒ Electricity) ⇒ ((Light ∧ Fan) ⇒ Electricity))* ***(Hint:*** *Given Truth Table (*Standard logical equivalences) Standard logical equivalences: $(\alpha \wedge \beta) \equiv (\beta \wedge \alpha)$ (commutativity of ∧) $(\alpha \vee \beta) \equiv (\beta \vee \alpha)$ (commutativity of ∨) $((\alpha \wedge \beta) \wedge \gamma) \equiv (\alpha \wedge (\beta \wedge \gamma))$ (associativity of ∧) $((\alpha \vee \beta) \vee \gamma) \equiv (\alpha \vee (\beta \vee \gamma))$ (associativity of ∨) $\neg(\neg\alpha) \equiv \alpha$ (double negation elimination) $(\alpha \Rightarrow \beta) \equiv (\neg\beta \Rightarrow \neg\alpha)$ (contrposition) $(\alpha \Rightarrow \beta) \equiv (\neg\alpha \vee \beta)$ (implication elimination) $(\alpha \Leftrightarrow \beta) \equiv ((\alpha \Rightarrow \beta) \wedge (\beta \Rightarrow \alpha))$ (biconditional elimination) $\neg(\alpha \wedge \beta) \equiv (\neg\alpha \vee \neg\beta)$ (De Morgan's Law) $\neg(\alpha \vee \beta) \equiv (\neg\alpha \wedge \neg\beta)$ (De Morgan's Law) $(\alpha \wedge (\beta \vee \gamma)) \equiv ((\alpha \wedge \beta) \vee (\alpha \wedge \gamma))$ (distributivity of ∧ over ∨) $(\alpha \vee (\beta \wedge \gamma)) \equiv ((\alpha \vee \beta) \wedge (\alpha \vee \gamma))$ (distributivity of ∨ over ∧)	6
	c)	Maximize the function f(x) = (x^2 + x + 1) over the range of integers from 0...7. Apply a genetic algorithm to solve this problem. Show at least the possible solution (i.e. near to termination criteria). *(Note: x represent five-digit unsigned binary integers, f(x) value itself a fitness solution, Coding in binary form having 4-bit string length (represent 10 numbers, Four chromosomes (1100, 1001, 1010, 1011) as initial populations, Decode individual for further evaluation (like fitness i.e. (x^2+x +1) (1001=9; 9^2+9+1=91), probability, random number, crossover and mutation).*	8
4.	**a)**	Explain the types of network structures (learning) with diagrams.	12
	b)	What is STRIPS representation?	4
	c)	Define planning operator, precondition and effects.	4
5.	Write short notes on the following (***any four***):		4x5=20
	a)	Hill climbing search	
	b)	Rules of Inference (Propositional logic)	
	c)	Generalized Modus Ponens	
	d)	Self-organizing Maps	
	e)	Backpropagation NN	

6.	Differentiate between the following (***any four***):		4x5=20
	a)	OPEN and CLOSED lists	
	b)	IDA* and Best first search	
	c)	Crossover and Mutation	
	d)	Existential and Universal quantifier	
	e)	Lazy and Eager learning	