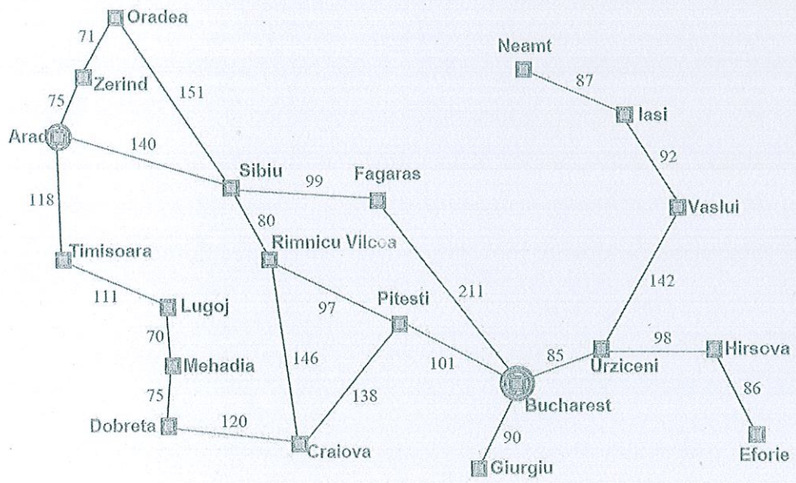

Figure: Q.2A

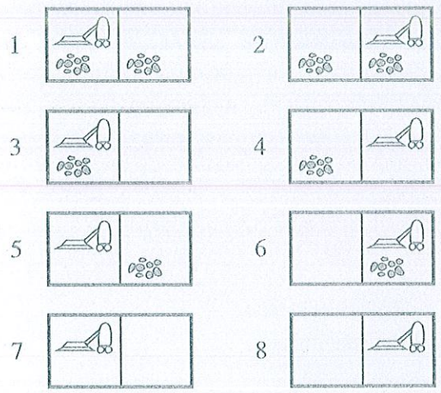

Figure: Q.3A

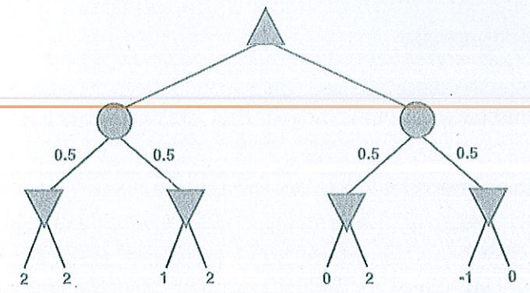

Figure: Q.3B

Reg. No.

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

SIXTH SEMESTER B.TECH (INFORMATION TECHNOLOGY / COMPUTER AND COMMUNICATION ENGINEERING) DEGREE END SEMESTER EXAMINATION-APRIL/MAY 2017

SUBJECT:PROGRAM ELECTIVE-I ARTIFICIAL INTELLIGENCE AND APPLICATIONS (ICT 328)

(REVISED CREDIT SYSTEM)

TIME: 3 HOURS 27/04/2017 MAX. MARKS: 50

Instructions to candidates

- Answer any **FIVE** full questions.
- Missing data, if any may be suitably assumed.

1A. List and describe properties of various task environments. [5]

1B. Draw a neat diagram for a model-based reflex agent, and write the pseudocode about its functioning. [3]

1C. To what extent are the following computer systems instances of artificial intelligence.

i) Supermarket bar code scanners

ii) Voice-activated telephone menus

iii) Web search engines

iv) Internet routing algorithms that respond dynamically to the state of the network. [2]

2A. Suppose two friends live in different cities on a map, such as the Romania map shown in Figure Q.2A. On every turn, we can simultaneously move each friend to a neighboring city on the map. The amount of time needed to move from city i to neighbor j is equal to the road distance $d(i, j)$ between the cities, but on each turn the friend that arrives first must wait until the other one arrives before the next turn can begin. We want the two friends to meet as quickly as possible.

i) Write a detailed formulation for this search problem.

ii) Let $D(i, j)$ be the straight-line distance between cities i and j. Which of the following heuristic functions are admissible? (a) $D(i, j)$; (b) $2D(i, j)$; (c) $D(i, j)/2$. [5]

2B. A problem can be defined by five components. List and explain those components for defining a problem. [3]

2C. For each of the following activities, give a **PEAS** description:

i) Playing soccer

ii) Shopping for used AI books on the internet. [2]

3A. Consider the sensorless version of the erratic vacuum world (see Figure Q.3A). Draw the belief-state space reachable from the initial belief state $\{1, 2, 3, 4, 5, 6, 7, 8\}$, and explain why the problem is unsolvable. [5]

3B. Consider pruning in games with chance nodes. Figure Q.3B shows the complete game tree for a trivial game. Assume that the leaf nodes are to be evaluated in left-to-right order, and that before a leaf-node is evaluated, we know nothing about its value. The range of possible value is $-\infty$ to ∞.

i) Copy the figure, mark the value of all internal nodes, and indicate the best move at the root with an arrow.

ii) Given the value of first six leaves, do we need to evaluate the seventh and eighth leaves?

iii) Suppose the leaf node values are known to lie between -2 and 2 inclusive. After the first two leaves are evaluated, what is the value range for the left-hand chance node? [3]

3C. Explain why it is a good heuristic to choose the variable that is most constrained but the value that is least constraining in a CSP search. [2]

4A. Decide whether each of the following sentence is valid, unsatisfiable, or neither. Verify your decisions using truth tables or the equivalence rules.

i) $(Smoke \rightarrow Fire) \rightarrow (\neg Smoke \rightarrow \neg Fire)$

ii) $Smoke \vee Fire \vee \neg Fire$

iii) $((Smoke \wedge Heat) \rightarrow Fire) \leftrightarrow ((Smoke \rightarrow Fire) \vee (Heat \rightarrow Fire))$

iv) $(Smoke \rightarrow Fire) \rightarrow ((Smoke \wedge Heat) \rightarrow Fire)$

v) $Big \vee Dump \vee (Big \rightarrow Dump)$ [5]

4B. Convert the following set of sentences to clausal form.

S1: $A \leftrightarrow (B \vee E)$

S2: $E \rightarrow D$

S3: $C \wedge F \rightarrow \neg B$

S4: $E \rightarrow B$

S5: $B \rightarrow F$

S6: $B \rightarrow C$ [3]

4C. Let $\mathcal{F}$ be $\{d, f, g\}$, where d is a constant, f is a function symbol with arity two, and g a function symbol with arity three respectively. Which of the following strings are terms over $\mathcal{F}$?

i) $g(d, d)$

ii) $g(x, f(y, z), d)$

iii) $g(x, h(y, z), d)$

iv) $f(x, g(y, z), d)$. [2]

5A. Knowledge engineering projects vary widely in content, scope, and difficulty, but all such projects have common steps. Describe those generic steps of knowledge engineering independent of any project. [5]

5B. Consider a vocabulary with the following symbols:

$Occupation(p, o)$: Person p has occupation o

$Customer(p_1, p_2)$: Person p_1 is a customer of person p_2

$Boss(p_1, p_2)$: Person p_1 is a boss of person p_2

$Doctor, Surgeon, Lawyer, Actor$: Constant denoting occupations

$Emily, Joe$: Constants denoting people

Use these symbols to write the following assertions in first-order logic:

i) Emily is either a surgeon or a lawyer

ii) Joe is an instructor, but he also holds another job

iii) There exists a lawyer all of whose customers are doctors. [3]

5C. For each pair of atomic sentences, give the most general unifier if it exists:

i) $P(A, B, B), P(x, y, z)$

ii) $Q(y, G(A, B)), Q(G(x, x), y)$. [2]

6A The monkey-and-bananas problem is faced by a monkey in a laboratory with some bananas hanging out of reach from the ceiling. A box is available that will enable the monkey to reach the bananas if he climbs on it. Initially, the monkey is at A, the bananas at B, and the box at C. The monkey and box have height Low, but if the monkey climbs onto the box he will have height $High$, the same as the bananas. The actions available to monkey include Go from one place to another, $Push$ an object from one place to another, $ClimbUp$ onto or $ClimbDown$ from an object, and $Grasp$ or $Ungrasp$ an object. The result of a $Grasp$ is that the monkey holds the object if the monkey and object are in the same place at the same height.

i) Write down the initial state description.

ii) Write the six action schemas.

iii) Suppose the monkey wants to fool the scientists, who are off to tea, by grabbing the bananas, but leaving the box in its original place. Write this as a general goal in the language of situational calculus. [5]

6B Let $\mathcal{L}$ be the first-order language with a single predicate $S(p, q)$, meaning "p shaves q". Assume domain of people.

i) Consider the sentence "There exist a person P who shaves everyone who does not shave themselves, and only people that do not shave themselves". Express this in $\mathcal{L}$.

ii) Convert the sentence in (i) to clausal form.

iii) Construct a resolution proof to show that the clauses in (ii) are inherently inconsistent. [3]

6C How can resolution be used to show that a sentence is valid or unsatisfiable? [2]