THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. DEGREE PROGRAMME: LEVEL 05
**FINAL EXAMINATION: SEMESTER 1: 2024/2025**
**CSU5308/CSU5317: ARTIFICIAL INTELLIGENCE**
DURATION: **TWO HOURS (2 HOURS)**

Date: **12.12.2024** Time: **9.30 am – 11.30 am**

**Answer FOUR Questions ONLY.**

**Q1.**

(a) Define the following terms in your own words.

(i) Acting humanly

(ii) Thinking rationally

(iii) Intelligent agent

(iv) Rationality [04 Marks]

(b) Briefly explain the **Turing Test** in your own words. computer would have some capabilities to pass the Turing Test. Briefly explain three of them.

[06 Marks]

(c) *"Reasoning is the process of arriving at a conclusion from a given set of premises."* Explain the terms **Reasoning** and **Premises** with the help of an example.

[06 Marks]

(d) Write the most suitable type of reasoning technique to solve each of the following problems. Briefly explain why you select the particular reasoning technique.

(i) All employees in the IT department have access to a company laptop. Sarah is an IT department employee. Therefore, Sarah has access to a company laptop.

(ii) I have noticed that every time I eat late at night, I have trouble sleeping. It seems likely that eating late causes sleep disturbances.

(iii) Managing a team is like coaching a sports team; just as a coach motivates players and adjusts strategies to win; a manager motivates employees and adapts plans to achieve goals.

[09 Marks]

**Q2.**

(a) Check the validity and consistency of the following propositional formulas using truth tables.

(i) $(P \wedge \neg Q) \leftrightarrow (\neg P \vee \neg Q)$

(ii) $((P \rightarrow Q) \wedge (\neg Q \rightarrow \neg P)) \vee (\neg P \vee Q)$

[05 Marks]

(b) Define **Conjunctive Normal Form** and **Disjunctive Normal Form** of a propositional formula.

[04 Marks]

(c) Using the laws of propositional logic, translate the following formulas into **Conjunctive Normal Form**.

(i) $\neg(P \wedge (Q \rightarrow R))$

(ii) $(P \wedge (Q \rightarrow R)) \vee (S \rightarrow T)$

[08 Marks]

(d) Transform the following formulas into **Prenex Normal Form.**

(i) $\forall x \exists y (P(x) \vee \neg Q(y)) \rightarrow \exists z R(z)$

(ii) $\forall x (P(x) \wedge \exists y (Q(y) \vee \forall z R(z, x)))$

[08 Marks]

**Q3.**

(a) Briefly explain the terms; **Percept** and **Percept Sequence.**

[04 Marks]

(b) Differentiate between the following properties related to a **Task Environment.**

(i) Static vs Semi Dynamic

(ii) Deterministic vs Stochastic

(iii) Episodic vs Sequential

[06 Marks]

(c) *"Assume that an automated taxi comes into a road junction. Then it can turn left, turn right or go forward. How does it come to a decision where is it going on next?"* Explain this statement with the help of both **Goal-based Agents** and **Utility-based Agents.**

[06 Marks]

(d) Definition of a problem can be done by four components. Define the following problems according to that.

(i) 8-queens

(ii) 8-puzzle

[09 Marks]

**Q4.**

(a) Define the concept of **problem-solving agents** and explain how they address the limitations of simple reflex agents in complex environments.

[05 Marks]

(b) Explain the components **Fringe** and **Leaf Node** in a Search Tree.

[06 Marks]

(c) Briefly explain the following uninformed search strategies.

(i) Breadth-first Search

(ii) Uniform-cost Search

(iii) Iterative Deepening Depth-first Search

[06 Marks]

(d) Which uninformed search strategy mentioned in the above question (c) holds the statement "*It is complete and optimal if every step cost is positive*".

[04 Marks]

(e) List four ways to measure the performance of a problem-solving algorithm.

[04 Marks]

**Q5.**

(a) *For some problems repeated states can be avoidable and for some it cannot be avoidable.* State two (02) benefits that we can gain if we avoid expanding nodes that have already been expanded.

[04 Marks]

(b) Which search strategy is more efficient among **Uninformed** and **Informed** search strategies when we need to find a solution for a certain problem? Mention those three (03) search strategies.

[06 Marks]

(c) "*Local search algorithms are useful to find solutions for optimization problems, which are a class of problems with the objective of maximizing or minimizing their objective functions.*" Draw the one-dimensional state space landscape graph and describe the following terms.

(i) Global Maximum

(ii) Global Minimum

[06 Marks]

(d) Explain the following disadvantages in your own words related to Hill Climbing Search.

(i) Local maxima

(ii) Ridges

(iii) Plateaus

[09 Marks]

**Q6.**

(a) Provide the output for the following PROLOG codes.

(i)
```
?- X is mod(9,3).
```

(ii)
```
?-  X is 10,Y is -X-2.
```

(iii)
```
?- 88+15-3=:=110-5*2.
```

(iv)
```
checkodd(N):-M is N mod 2, M=:=1.

?-checkodd(5).
```

(v)
```
?-  X is 10,pred1(X) == pred1(10).
```

[05 Marks]

(b) Differentiate between the predicates `assertz/1` and `asserta/1`.

[02 Marks]

(c) Consider the following PROLOG predicates to answer the following questions (i) and (ii).

```
bird(sparrow).
bird(eagle).
bird(duck).
bird(crow).
bird(ostrich).
bird(puffin).
bird(swan).
bird(albatross).
bird(starling).
bird(owl).
bird(kingfisher).
bird(thrush).
can_fly(X):-bird(X).
```

(i) What will be the output for the rule **`?- can_fly(owl).`**

[02 Marks]

(ii) *"Ostriches are one of the few exceptions, as they are not able to fly."* According to that the desired output is as follows;

```
?- can_fly(ostrich).
false.
```

Modify the code given in question (c) to fulfill the need.

[03 Marks]

(d) According to the predicates given below, answer the queries given in questions (i) to (ii).

```
manages(john, alice).
manages(john, bob).
manages(jane, charles).
manages(jane, diana).
manages(mike, emily).
manages(mike, frank).
manages(alex, george).

employee(alice).
employee(bob).
employee(charles).
employee(diana).
employee(emily).
employee(frank).
employee(george).

manager(john).
manager(jane).
manager(mike).
manager(alex).
```

(i) Create the following PROLOG rules;

`works_for/2, colleague/2, and supervisor/2`

(Assume that all these rules have standard meanings.)

[03 Marks]

(ii) Explain how prolog answer the following queries.

(a) `?- supervisor(X, Y).`

(b) `?- colleague(alice, Y).`

(c) `?- colleague(jane, mike).`

(d) `?- supervisor(john, diana).`

(e) `?- supervisor(alex, george).` [10 Marks]