

Course Title: Introduction to Cognitive Science

Course no: CSC-255

Credit hours: 3

Full Marks: 60+20+20

Pass Marks: 24+8+8

Nature of course: Theory (3 Hrs.) + Lab (3 Hrs.)

Course Synopsis: An introduction to cognitive science and its relation with other sciences. It covers briefly the area of Artificial Intelligence, Computational models and connectionist approach.

Goal:

- The student will gain an introductory understanding of what it means to say that intelligence is computational The student will:
 - Acquire a good understanding of what an algorithm is and learn how to implement algorithms in the programming language LISP /PROLOG.
 - Develop an introductory understanding of formal models for computation, the limits of computation, the Chomsky hierarchy, and the Turing-Church hypothesis

The student will study some of the modern attempts to demonstrate a computational model for intelligence through an introduction to the discipline of artificial intelligence, including introductions to knowledge representation, search, and artificial neural networks.

Finally, the student will explore some of the positions taken in the ongoing discussion of this issue. In Philosophy and Linguistics, we will begin with Descartes, and look (and discuss) Turing, Gelernter, Newell and Simon, Penrose, Searle, and others, finishing with a partial response to Descartes given to us by Chomsky and others.

Course Contents:

Unit 1. Introduction to the Problem

6 Hrs.

Cognitive Science and other Science:

Psychology, Philosophy, Sociology, Computer Science (AI), Biology (Neuroscience), Linguistics and mathematics

Descartes Mind Body Problem

Marr's three level view of information processing:

Computational, Algorithmic & Implementation

Turing's response to Descartes

Application related system in the Cognitive Science:

NLP, Neural N/W, AI,

Unit 2. Brief Introduction to Artificial Intelligence

13 Hrs.

History and background of Artificial Intelligence :

Introduction and history

Think rationally, act rationally and Think humanly, act humanly

Knowledge representation:

Rule based: *If then*

Object based: *Frames, Semantic n/w, O-A-V*

Simple examples of predicate logic, overview of FOPL

Human information processing and problem solving:

If then rule

Example: Water Leakage Problem

Search:

Informed (Heuristic) Search: *Hill-climbing search, A* search*

Uninformed (Blind) Search: *Depth-first search, Breadth -first search*

Expert system:

Block diagram

Introduction of Neural Networks :

Synapse, neuron

Mathematical model

Unit 3. Computation

11 Hrs.

Introduction: *Computation and Cognition*

Basic Model for Computation,

The Turing Machine,

Computational and Language : the Chomsky hierarchy: *Type 0, Type 1, Type 2, Type3*

The Physical Symbols Systems Hypothesis,

Illustration of practical examples.

Unit 4. Approaches

15 Hrs.

The connectionist approach, Different models and tool:

Hebbian Learning, Perceptron, Back propagation

Gelernter, Penrose, Pinker, Searle; Response to Descartes :

Natural Language Processing:

Natural Language Understanding and Generating

Lexicon, Morphology

Syntactic Analysis: Parse tree

Parameters in the Natural Language Processing:

Auditory Inputs, Segmentation, Syntax, Semantics, Pragmatics

Text / Reference books :

1. Thinking about consciousness / David Papineau, Oxford : Clarendon Press New York : Oxford University Press, 2002.
2. Copeland, Jack : *Artificial Intelligence : A Philosophical Introduction*. Blackwell Publishers.
3. Cognition in a digital world / edited by Herre van Oostendorp, Mahwah, N.J. : L. Erlbaum Associates, 2003
4. The evolution and function of cognition / Felix Goodson, Mahwah, N.J. : Lawrence Erlbaum Associates, Publishers, 2003.

Model Question: Introduction to Cognitive Science

Semester: IV

Time: 3 hrs

Full Marks: 100

- **Candidates are required to give their answers in their own words as far as practicable .**
- **Attempt all questions . All questions carry equal marks**

- 1. What do you mean by cognitive science ? Compare it with other sciences with examples.**
- 2. Explain the importance of artificial intelligence . How can you represent knowledge ? Draw the block diagram and explain it with suitable example .**
- 3. What do you mean by syntax and semantics for propositional logic? Explain with suitable example .**
- 4. Why searching is required? Explain in detail about any two blind search techniques with suitable example .**

or

Is it possible that artificial intelligence can exist without searching? Justify it. Explain in detail about any two informed search techniques with suitable example

- 5. Why neural network is important? Explain any type of neural network system along with its algorithm.**
- 6. What do you understand by Turing machine ? Design a Turing machine with finite set of states as q_0 and q_1 , alphabets are 'a' and blank, initial state is q_0 and assume suitable transitions .**
- 7. What do you mean by Chomsky hierarchy? Explain it with suitable practical examples.**
- 8. Why connectionist approach is required? Explain it with any two models with real time examples .**
- 9. What are the approaches of Descartes for human machine interaction? How can you implement it with turing machine ?**
- 10. What is natural language processing? Explain the issues in syntax and semantics in the natural language processing.**

or

Differentiate between natural language understanding and natural language generating. Explain different parameters used in the natural language processing.