Q. What is Symbolic logic? How does it differ from Aristollian logic?

Ans.:

Introduction

Logic is the study of valid reasoning and correct inference. Two milestones dominate its history: Aristollian logic, developed in the 4th century BC as the first systematic study of deduction, and Symbolic logic developed in the 19th-20th centuries, which revolutionized reasoning by introducing symbols, truth-values, and quantifiers. Both aim at the same goal, distinguishing valid from invalid reasoning but differ greatly in method, scope and application.

Date:_____

Aristotlian Logic

Background :

- Aristotelian logic or Syllogistic logic was founded by Aristotle in works such as Prior Analytics.

- It is concerned with the relationship of terms.

- It focuses on categorical propositions and syllogisms.

Categorical Syllogism

A syllogism contain two premises and a conclusion. Three terms appears each exactly twice.

Major Term (P.) - predicate of conclusion.

Minor Term (S) - Subject of conclusion

Middle Term (M) - Appears in both, not in conclusion.

Standard Form :

Major Premises $M - P$
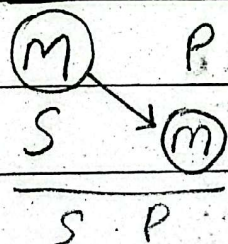
Minor Premise : $S - M$

Conclusion : $S - P$

Example :

1)
- All mammals are animals (All M are P)
- All dogs are mammals (All S are m)

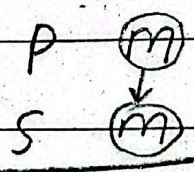— Therefore, All dogs are animals.
  (All S are P)

2) All men are mortal (All m are P)

Socrates is a man (All S are M)

Therefore, Socrates is mortal. (All S are P)

Figures of Syllogism

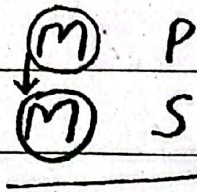The position of middle term decides the figure of syllogism.

① **1st Figure :**

M	P
S	m
S	P

All men are mortal

Socrates is a man.

∴ Socrates is mortal

② **2nd Figure**

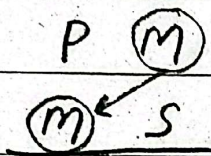| P	m
S	m

No politicians are professors

Some doctors are professors

∴ Some doctors are politicians.

③ **3ʳᵈ Figure**

Ⓜ P   All (poets) are creative
Ⓜ S   Some (poets) are philosophers

∴ Some philosophers are creative

④ **4ᵗʰ Figure**

All trees are (plants)
P Ⓜ   All (plants) are alive
Ⓜ S   ∴ all trees are alive.

Categorical Propositions (AEIO)

A - Universal Affirmative

All men are mortal - All S are P.

E - Universal Negative

No birds are mammals - No S are P.

I - Particular Affirmative

Some students are intelligent -
Some S are P.

O - Particular Negative

Some animals are not carnivores - Some S are not P

Symbolic Logic

Background

The symbolic logic emerged in the 19th century with George Boole and Gottlob Frege.

It is shifted from terms to symbols and formal rules.

It became the foundation of mathematics, computer science, and philosophy of language.

Features

- Symbolic logic uses symbols to eliminate ambiguity of natural language.
- It deals with propositions, connectives, and quantifiers.

Structure of Symbolic Logic

1) Propositional Logic

It deals with whole propositions without analyzing their internal

structure. Each proposition is treated as a single unit and is either true or false.

- Capital letters like P, Q, R used as symbols to denote propositions.
- Logical connectives ($\neg$, $\wedge$, $\vee$, $\rightarrow$) to form compound propositions.

Example

P = It is raining

Q = The ground is wet

$P \rightarrow Q$ — If it rains, then the ground is wet.

2) Predicate Logic

It goes beyond whole statements by examining their internal structures using predicates and variable.

Example

$\forall x \, (\text{human}(x) \rightarrow \text{Mortal}(x)) \rightarrow$ for all x, if x is human, then x is mortal.

Human (Socrates) → Socrates is a human

∴ Mortal (Socrates) → Therefore, socrates

is mortal.

3) **Quantifiers**

1) • Universal Quantifiers (∀) :

means for all x or Every x

Example

$\forall x (Bird(x) \rightarrow Can fly(x))$ →

All birds can fly.

2) Existential Quantifier (∃) :

means " There exists at least one x ".

Example

$\exists x (Prime(x) \wedge Even(x))$ →

There exists an x such that x is a

prime and even.

Key Differences

Aristotelian   **Symbolic**

Ⓞ **Founder**

Aristotle   Boole, frege

② Basic Unit

| Term & Syllogism | Proposition/Predicate |

③ Language

| Natural language | Abstract symbols |

④ Scope

| Limited to syllogism | Handle all reasoning |

⑤ Precision

| Ambiguities possible | Unambigious |

⑥ Application

| Philosophy, basic reasoning | Math, AI, formal sciences |

⑦ Example

| All men are mortal → Socrates is mortal | $\forall x (Men(x) \rightarrow Mortal(x))$: Man (socraties) → Mortal (socrates) |

Critical Evaluation

Aristotelian logic has historical significance : it trained minds in th systemic thinking. Its simplicity makes it accessible, however, it is narrow in scope. Symbolic logic, on the

other hand, revolutionised reasoning by creating a precise, formal system that can represent complex arguments, mathematical proofs. It is the logic of modern age.

Conclusion

In conclusion, Aristotelian logic laid the foundation of logical reasoning through syllogism and categorical propositions. Symbolic logic expanded this into a universal, precise system capable of handling modern science and technology.