Logic and Principles of Reasoning

S.Y.B.A.

G-2: Formal Logic

[**Objective** : To acquaint the student with the principles and techniques of Axiomatics, Predicate Calculus, Relational Logic and Set theory
The approximate duration of teaching of each unit is 12 lectures]

Part I

Unit 1 :

1.1 Nature of systematization and its limits, Degrees of systematization : Axiomatic system, Logistic system, Distinction between syntax and semantics and significance of Logical Syntax

1.2 Elements of deductive system and their role.

1.3 Evaluation of a deductive system in terms of Consistency, Completeness and Independence.

1.4 Russell and Whitehead's P.M. System and its first 15 theorems.

Unit 2 :

2.1 Need for the study of predicate structure of propositions. Difference between Propositional logic and Predicate logic. Difference in approach between Traditional logic and Predicate logic.

2.2 Definition of singular and general propositions, individual constants and predicate constants; Propositional functions and Substitution instances; Defining a propositional function in terms of variable components; Instantiation and Quantification.

2.3 Universal and existential quantifiers; Four –fold scheme for symbolizing general propositions; Universally general and existentially general proposition; Comparison with AEIO structure; Evaluation of the square of opposition of traditional logic; Exercises in symbolizing general propositions.

Unit 3 :

3.1 Explaining the need for quantification rules (enabling the continued use of the 19 rules of inference in arguments that are not truth functionally compound but which are made up of non-compound general propositions.)

3.2 Explaining the nature, form and use of each of the four Quantification rules UI, UG, EI, EG (Preliminary version), Rule of quantificational negation (Q.N.)

3.3) Proving the validity of arguments involving quantification rule (preliminary version).

Unit 4 :

4.1) The basis for demonstration of invalidity of arguments (Isomorphism and correspondence between valid argument forms and tautologies).

4.2) Method of demonstrating invalidity of arguments in Predicate logic (through assumptions of increasing universe of discourse).

4.3) Exercises in demonstrating invalidity of arguments in Predicate logic

Part II

Unit 5 :

1.1 The nature and definition of multiply general propositions: two varieties : (1) Truth functionally compound, (2) One general proposition containing another general proposition within it.

1.2 Exercises in symbolizing both kinds of multiply general propositions.

Unit 6 :

2.1 Need for revising the preliminary quantification rules (To ensure the correct inferences by the preliminary qualification rules in a more complex situation).

Explaining the revised form of and the restrictions on each quantification rule,

2.2 Exercises in detecting mistakes arising out of not adhering to the revised quantification rules.

2.3 Exercises in proving the validity of arguments involving the use of revised quantification rules, proof of logical truths involving quantifiers using the strengthened rule of conditional proof where necessary.

Unit 7 :

3.1 Predicates and relations : Need for recognizing relations as a distinct category of predicates. Relational Logic as an extension of Predicates logic.

3.2 The logical structure of a relational proposition in terms of referent/relation/relatum and domain/ field/ converse domain, singular and general relational propositions, kinds of relational propositions according to the number of relata.

3.3 Symbolizing relational propositions and translating symbolized relational propositions into ordinary language. Difference between relations expressed in active/ passive voice and the problem of ordering of quantifiers.

3.4 Proving validity of arguments involving relational propositions by direct and conditional method of formal proof, using the strengthened rule of conditional proof where necessary.

3.5 Properties of dyadic relations : Symmetry/Asymmetry/ Non-Symmetry, Transitivity/ Intransitivity/ Non-transitivity. Reflexivity/ Irreflexivity/Non-reflexivity. Characterizing given relations in terms of the above properties. Enthymeme. Proving validity of relational enthymemic arguments.

3.6 Study of identity as a relation, symbolizations of exceptive, comparative and numerical propositions, propositions involving descriptive phrases.

Exercises in proving validity of arguments involving identity (above)

Unit 8: Elements of set theory :

4.1 Definitions : Sets, elements of sets, sub-set, proper sub-set, null-set, universal sets, compliment of set, identity of sets, modes of specifying sets : listing, defining. Basic operation on sets : union, intersection, complementation.

4.2 Interpreting A, E, I and O, propositional forms in terms of set theory and Venn diagrams.

4.3 Problems involving basic operations (above).

Books for Reading

1. Copi I. M. : *Symbolic Logic* (Relevant Chapters only).
2. Copi I. M. : *Introduction to Logic*, relevant chapters only.
3. Suppes : *Introduction to Logic* (Chapters on set theory)
4. Ehlers : *Logic by Way of Set Theory*.
5. Quine W.V.O. : *Methods of Logic* (Relevant Chapters)

6. Pospesel H. *Predicate Logic*, Prenice Hall, New Jersy, 1976
7. Korde Asok *Symbolic Logic*, Korde Prakashan, Mumbai 1972

Books for Reference

1) Hughes and Londey : *Elements of Formal Logic*,
Relevant chapters only.
2) Quine W.V.O. : *Methods of Logic*, relevant chapters
3) Basson and O'Connor: Inoduction to Symbolic Logic
4) S.S. Barlingay & M.P.Marathe, '*Tarkarekha'* Part II, Continental Prakashan Pune
5) S.R. Kawle & Leela Gole – "*Sugam Aakarik Tarkashastra"*
6) M.P.Rege : *Aakarik Tarkashastra*
7) Joshi, B.*R.*, Kulkarni, S. V. and Mathwale E. R.: *Tarka-Vidya,* Part II, Swati Prakashan, Parbhani, 2002