UNIVERSITY OF CALICUT  
SCHOOL OF DISTANCE EDUCATION  
STUDY MATERIAL  
Core Course  
BA PHILOSOPHY PROGRAMME  
II Semester  

**LOGIC & SCIENTIFIC METHOD**

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<tr>
<th>Module I</th>
<th>Module II</th>
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PREFACE

The progression of human knowledge is motivated and guided by the incessant search for truth. The innate faculty of reasoning is the most reliable means to distinguish between the true and false in knowledge. Logic is the branch of philosophy that analyses and prescribes the norms, principles and rules that govern our reasoning process. Hence, it is defined as “the study of the methods and principles used to distinguish correct from incorrect reasoning”.

This study material for the Course PHL2B02 - Logic and Scientific Method of the II Semester B. A. Philosophy Programme in the SDE Stream introduces the basic features and functions of logic. It is prepared with a view to delineate the prospects of applying the concepts and canons of error free reasoning. This, we hope, will help the learners to detect the fallacies and ambiguities in any domain of knowledge and to sort out the fact. The experts while preparing the material for the modules in this course have tried, in addition to the theoretical explanations, to include the models for solving test of reasoning questions. Thus, the components of this study material will be beneficial in the Reasoning Aptitude Tests (RAT), which form a crucial part of competitive examinations.

We are living in a world of information explosion, but not every bit of information is a reliable piece of knowledge. Information becomes knowledge only if it passes the test of reasoning. Hence, the study of logic as the science and art of reasoning and argumentation will definitely help you to get your facts right. This becomes essential as we watch the developments in science or when we listen to the rival arguments in a TV debate or when we come across a political war of words.

The content of each module is prepared according to the pattern of question paper approved by the University. A model question paper is also appended for reference. We have included the Question Bank designed for conducting the Internal Evaluation. The MCQs in Part A of each module are also in the model of those in the Question Bank. With all the best wishes for your excellent performance in the examinations,

Dr. M. Ramakrishnan
Coordinator
(Chairperson, Board of Studies in Philosophy)
OBJECTIVES

Module I

➢ To learn the origin and development of logic as the basic science of sciences.
➢ To make an analysis of the important uses of learning logic.
➢ To delineate the differences between Formal Logic and Material Logic.

Module II

➢ To study the basic units of theoretical logic such as terms and propositions.
➢ To delineate the distinction between connotative and denotative meaning of propositions.
➢ To introduce the norms of the classification of propositions and their types.

Module III

➢ To introduce the different types of logical inference.
➢ To give a detailed account of immediate inference and its types.
➢ To study the relations of opposition and their truth implications with the help of the traditional Square.

Module IV

➢ To analyze the characteristics of mediate inference.
➢ To introduce the classification of syllogism.
➢ To learn the structure and rules of syllogism.
➢ To enable the learners to detect the fallacies in syllogistic reasoning.

Module V

➢ To introduce the basics of scientific method.
➢ To demonstrate how in scientific investigation we pass from inductive generalizations to deductive predictions.
➢ To make the learner aware of the significance of hypothesis in scientific investigation.
HIGHLIGHTS

Module I  Introduction: -
1.1 Definition and characteristics of the discipline
1.2 Uses of Studying Logic
1.3 Deductive Logic (Formal Logic) and Inductive Logic (Material Logic)

Module II  Proposition: -
2.1 Definition
2.2 Subject Term and Predicate Term
2.3 Connotation and denotation
2.4 Classifications of propositions
   a) Categorical propositions and conditional proposition
   b) Quality, quantity and Distribution of Terms in categorical propositions

Module III Immediate Inference
3.1 Opposition of propositions
3.2 Eduction
   a) Conversion  b) Obversion  c) Contraposition

Module – IV  Syllogism
4.1 Categorical Syllogism
   4.1.1 Standard form Categorical Syllogism
   4.1.2 Figures and Moods
   4.1.3 Rules and fallacies of Categorical Syllogism
4.2 Hypothetical Syllogism
   4.2.1 Modus Ponens
   4.2.2 Modus Tollens
4.3 Disjunctive Syllogism
4.3 Dilemma- (Four types)

Module – V Scientific Method
5.1 Material grounds of Induction – Observation and Experiment
5.2 Problem of Induction-  
   5.2.1 Inductive Leap
   5.2.2 Postulates of Induction
5.3 Stages of hypothesis- Formation, Verification and proof

Reference Books
1. T.M.P. Mahadevan - The Fundamentals of Logic
4. Irving M. Copi, Carl Cohen and Kenneth McMohan. Introduction to Logic. New Delhi: Prentice-Hall of India,
Pattern of Question Paper

<table>
<thead>
<tr>
<th>Duration</th>
<th>Section</th>
<th>Pattern</th>
<th>Total number of questions</th>
<th>Questions to be answered</th>
<th>Marks for each question</th>
<th>Total marks for each section</th>
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<td>A</td>
<td>Objective Type</td>
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<td>10</td>
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<td></td>
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<td>Multiple choice questions</td>
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<td></td>
<td>B</td>
<td>Short Answer questions</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td>5 x 3 = 15</td>
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<td></td>
<td>C</td>
<td>Paragraph Answer questions</td>
<td>9</td>
<td>6</td>
<td>5</td>
<td>6 x 5 = 30</td>
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<tr>
<td></td>
<td>D</td>
<td>Essay questions</td>
<td>4</td>
<td>2</td>
<td>15</td>
<td>2 x 15 = 30</td>
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TOTAL = 80

Time: Three Hours
Maximum: 80 marks

PART - A - Multiple-choice questions
Answer all questions. Each question carries ½ marks. (10 x ½ = 5 marks)

PART - B - Short answer questions
Answer any five out of the eight questions.
Each question carries 3 marks. (5 x 3 = 15 marks)

PART - C - Paragraph answer questions
Answer any six out of the nine questions. Answer should not exceed 100 words.
Each question carries 5 marks. (6x5 = 30 marks)

PART - D - Essay questions
Answer any two out of the four questions. Answer should not exceed 1000 words.
Each question carries 15 marks. (2 x 15 = 30 marks)
PART A - Multiple-choice questions

For model questions, see the Question Bank.

PART B - Short answer questions

1. Define logic.

Logic provides us with the methods and techniques for evaluating right and wrong reasoning. According to Creighton, logic is the science, which treats of the operations of the human mind in its search for truth. In other words, it is the science of thought or the systematic inquiry into the process of thinking. Copi and Cohen define the function of logic as ‘the study of the methods and principles used to distinguish correct from incorrect reasoning’. Scientific study in any field is based on correct reasoning and hence logic is considered as the basic science of sciences.

2. Why logic is considered as a normative study?

Copi and Cohen define the function of logic as ‘the study of the methods and principles used to distinguish correct from incorrect reasoning’. Logic provides us with the methods and techniques for evaluating right and wrong reasoning. Thus, it is concerned with the norms / standards / ideals to distinguish between correct and incorrect reasoning. That is why logic is defined as the normative study of reasoning.

3. What is reasoning?

Reasoning power is inborn in human beings. It is the process of passing from certain known judgments to a new judgment. Reasoning is the act of mind that leads to inferences from certain given facts. It is the reliable means to judge what is true and what is false in knowledge. It is necessary to apply rational methods for ‘drawing new inferences from what is already known to be true’.

4. What is judgment? Or

What is inference?

Judgment is the function of mind by which we infer a certain relationship between some given facts. For example, we have the idea of ‘human being’ and the idea of ‘mortality’. By connecting these ideas, we infer the fact that ‘Humans are mortal’. Thus, we draw new knowledge from some given knowledge and this process is termed inference.
5. **What do you mean by normative science?**

A normative science is that which sets up a norm/standard/ideal to judge a given fact. There are three main areas of philosophy that deal with such norms -

Logic - the normative study of correct and incorrect reasoning.

Ethics - the normative study of right and wrong or good and evil in human conduct.

Aesthetics - the normative study of beautiful and not beautiful.

6. **Distinguish between formal and material logic.**

In a deductive argument, the form determines its validity. Hence, deductive reasoning is the basis of formal logic, which is concerned with the form of the argument rather than its content. In a deductive argument, the conclusion is already contained in the premises. Hence, in formal logic the material truth/falsity of the premises is not important. Inductive inferences are evaluated as sound or unsound by considering not only form but also the content or matter. Hence, material logic is concerned with the content of the argument and hence it is based more on inductive reasoning.

7. **How logic is related to language?**

Logic is directly concerned with thought, but language is the indispensable medium to express what we think. Logic is the science of arguments, and arguments are always expressed in language. Hence, we have to use correct language to express an argument in the correct form. The basic unit of logical analysis namely the proposition is defined as the verbal expression of judgment.

**PART - C - Paragraph answer questions**

1. **Explain why logic is treated as a normative science.**

A normative science sets up the norms/standards/ideals to judge a given fact. It explains why a thing ‘ought to be’ in order to agree with the ideal before us. For example,

Logic - the normative study of correct and incorrect reasoning.

Ethics - the normative study of right and wrong or good and evil in human conduct.

Aesthetics - the normative study of beautiful and not beautiful.

Logic by definition is the normative study of human reasoning as it prescribes the norms to distinguish between correct and incorrect reasoning. The study of logic helps us to evaluate judgments according to the ideal of truth. Hence, we can say that logic is the normative science that provides the standards of truth to evaluate the judgments of human thinking.

2. **Analyze the view that logic is both a science and an art.**
Logic is defined as the normative study of human reasoning that provides the norms/standards/ideals of correct thinking. It is a regulative science as its main concern is to fix the precise rules and norms of evaluating correct judgments and arguments. Thus, it is crucial to scientific investigation and testing of hypotheses. There has been much dispute on the question - Is logic a science or an art? Critics differ in their opinion as to whether logic is a science or an art. Logicians like Mansel and Thompson accept logic only as a science while Aldrich and others consider logic only as an art. Mill and Whitely recognize logic as both a science and an art. We have already seen that it is basically the science of reasoning. It is also true that a proper study of logic will improve our reasoning skill and the ability to detect the errors and lapses in judgments and arguments. Hence, learning logic certainly involves practical training in making and analyzing arguments. It is therefore an art also. Logic is an art because it is a practical science that guides us in the ‘search for truth’. The phrase, ‘search for truth,’ in Creighton’s definition of logic brings out the practical aspect of logic. Thus, logic is primarily a science and only secondarily, it is an art.

3. Distinguish between positive and normative sciences.

Sciences, according to their function, are of two types: Positive sciences and normative sciences. The main differences between them are the following:

i) Positive sciences study ‘what is’ while normative sciences study ‘what ought to be’. Positive sciences are concerned with facts while normative sciences study ideals and values.

ii) Positive sciences take up factual study whereas normative sciences focus on axiological study. Hence, the former is descriptive, but the latter is prescriptive. Normative sciences prescribe what ought to be the case, for example, logic provides the specific norms to distinguish between the true and false in our judgments.

iii) The conclusions of the natural sciences find application only in a limited field. They are, therefore, relative. The scope of the normative sciences is far more extensive and comprehensive. They cover many different aspects and spheres of human life. Positive sciences are mainly physical/natural sciences like physics and biology and social sciences like sociology. There are mainly three normative disciplines-

Logic - the normative study of correct and incorrect reasoning.

Ethics - the normative study of right and wrong or good and evil in human conduct.

Aesthetics - the normative study of beautiful and not beautiful.

4. Bring out the relationship and differences between logic and psychology.

Both logic and psychology deal with the process of human thinking. Hence, they share the common field of study. In spite of this agreement, there are some important differences between them. In the first place, logic and psychology differ in their scope of enquiry. Logic deals with the reasoning part of human mind while psychology studies the whole of human mind. Psychology is concerned with
the three basic operations of mind namely knowing, feeling and willing. Moreover, as the science of behavior, psychology studies all aspects of mind in all types of humans, i.e., adult or children, normal or abnormal people. Nevertheless, logic focuses on the reasoning process in a normal adult mind only. A more important point of difference between the two sciences is in their method of approach. Logic is a normative science while psychology is a positive science. Psychology is the study of the structure and functions of mind, whereas logic has to prescribe the norms to distinguish between correct and incorrect reasoning. Anyway, logic and psychology are interdependent and complementary disciplines.

5. Distinguish between deduction and induction.

Based on the method and type of inference, logic is divided into two - deductive logic or deduction and inductive logic or induction. In a deduction, the form determines the validity of inference. Hence, deductive reasoning is the basis of formal logic, which is concerned with the form of the argument rather than its content. Inductive inferences are evaluated as sound or unsound by considering not only form but also the content or matter.

In deductive argument, the conclusion cannot be wider than the premises, but in induction, the conclusion is equal to or wider than the premises.

In deduction, the conclusion necessarily follows from the given premises. Hence, their relationship is of implication or entailment. See for example,

- All humans are mortal.
- Socrates is a human being.
- Therefore, Socrates is mortal.

Induction is the process of drawing conclusion from observed instances that give specific evidence to support the inference. See for example,

- Aristotle is human and mortal.
- Bacon is human and mortal.
- Descartes is human and mortal.

Therefore, all humans are mortal.

In deduction, the premises form the necessary ground for the conclusion. In induction, the conclusion is always probable. Hence, an inductive argument is neither true nor false, but only sound or unsound.

Anyway, logicians do not consider deduction and induction as opposites, but as complementary processes of reasoning. They together form the basis of scientific investigation by hypothetico-deductive method.
6. Distinguish between formal and material logic.

In a deductive argument, the form determines its validity. Hence, deductive reasoning is the basis of formal logic, which is concerned with the form of the argument rather than its content. In a deductive argument, the conclusion is already contained in the premises. Hence, in formal logic the material truth or falsity of the premises is not important. The following deductive argument is invalid because although the premises are true the conclusion is false.

   All cows are four-legged animals.
   All horses are four-legged animals.
   Therefore, all horses are cows.

Inductive inferences are evaluated as sound or unsound by considering not only form but also the content or matter. Hence, material logic is concerned with the content of the argument and it is based more on inductive reasoning. For example, from all the reported instances - ‘Crows are black’, we infer the conclusion - All crows are black. Yet, this inductive inference is only probable because as soon as we come across the material evidence for a non-black crow it turns invalid.

7. Examine the relationship between truth and validity.

The terms truth and validity refer to the logical status of propositions and arguments. Truth and falsehood apply only to propositions, but never to arguments. Validity and invalidity, on the other hand, are the logical properties of deductive arguments, but never of propositions. There is a relationship between the validity or invalidity of an argument and the truth or falsehood of its premises and conclusion, which are propositions. An argument may be valid even when one or more of its premises are false. Some valid arguments contain only true premises.

   All mammals have lungs.
   All whales are mammals.
   Therefore, all whales have lungs.

However, a valid argument may contain exclusively false propositions as in this following example,

   All mammals have wings.
   All reptiles are mammals.
   Therefore, all reptiles have wings.

From the above examples, it is clear that the truth or falsity of the conclusion in an argument does not by itself determine the validity or invalidity of that argument. Moreover, the fact that an argument is valid does not guarantee the truth of its conclusion. Nevertheless, if all the premises of a valid deductive argument are true, its conclusion must also be true. A valid deductive argument with true premises and conclusion is called a sound argument.

8. Describe the features of an argument.

Reasoning provides the evidences to support an inference. Thus, a conclusion is to be drawn from strong premises that form the ground of the conclusion. The premises and conclusion are to be
presented in a manner that shows their relationship and coherence. Thus, it is expressed in the form of an argument. An argument is a set of propositions arranged in terms of their relationship as premises and conclusion. The propositions of an argument are either the premises or the conclusion. Hence, an argument is defined as ‘a relational arrangement of premises and conclusion’. The conclusion of an argument is always the one proposition that is derived from one or more supporting propositions called premises. In other words, the propositions, which substantiate the conclusion, are the premises. The proposition which is drawn on the basis of the premises is a conclusion. See for example,

   Premise 1 - All men are mortal.
   Premise 2 - Socrates is a man.
   Conclusion - Therefore, Socrates is mortal.

9. Describe the most important uses of the study of logic.

Scientific study in any field should be based on correct reasoning and hence logic is considered as the basic science of sciences. Logic is therefore crucial to the methodology of science. It is both the normative and regulative science of thinking. There is no doubt about the value of logic in the fields of law and crime investigation. Judges and lawyers are always keen on the logical coherence of arguments in law courts. Detectives and police officers apply the tools of logic to discover the loopholes in crime investigation.

A careful study of logic guards us against the common errors in reasoning such as hasty generalization and ambiguity. Thus, the study of logic guarantees training in detecting fallacies in judgments and arguments. That is why we consider logic not only as the science of reasoning but also as the art of argumentation.

It is true that a person who had not studied logic can do well in making and analyzing arguments. This is possible because reasoning power is an inborn skill of human mind. Anyway, a proper training of this natural skill will definitely improve it. This is true as in the case of a ‘born athlete’ who can win medals if trained properly by an athletic coach.

   PART – D - Essay questions

1. Define Logic and explain its nature and scope.

The word ‘logic’ is derived from the Greek word ‘logos’ which means thought. Hence, etymologically logic is the science of thought or the science that investigates the process of thinking. Thinking is the mental act by means of which we acquire knowledge. Logic is a science because it is the systematic study of all reasoning processes. It is therefore the systematic study of the operations of human mind in its search for truth.

In spite of the differences in the definitions given by different logicians, there is clear agreement about its subject matter namely the relationship between reasoning and truth. Let us examine the definition given by Creighton for a comprehensive understanding of the nature and subject matter of logic. According to him, Logic is the science, which deals with the operations of human mind in its
search for truth. This definition states three facts about logic. It is (i) a science, (ii) concerned with the operations of the human mind and (iii) concerned with the search for truth.

(i) Logic is a science as it is a systematic and organized body of knowledge about a particular part of the universe namely human thought.

(ii) Logic is concerned with a specific power of human mind namely thinking/reasoning. Here ‘thought’ refers to both the processes and the products of thinking.

(iii) Creighton’s phrase ‘search for truth’ indicates that truth is the goal or aim of logic. Truth may be either formal or material. Formal truth means agreement of thoughts among themselves. It consists in self-consistency of ideas among themselves i.e., freedom of thought from contradiction. E.g., ‘Circular Square’ is a contradiction in terms. It is formally false because it is self-contradictory. However, a ‘golden mountain’ though not materially real is formally true because the two ideas ‘golden and ‘mountain’ are not contradictory to each other.

Copi and Cohen define the function of logic as ‘the study of the methods and principles used to distinguish correct from incorrect reasoning’. This definition highlights the precise function of logic. It provides the necessary rules and methods for evaluating the truth and falsity of judgments. Scientific study in any field is based on correct reasoning and hence logic is considered as the basic science of sciences.

The scope of logic as the science of sciences is implied in these definitions. Its rules and principles are the fingerpost to truth in any area of study- religion, philosophy or sciences. Yet, logic is not a positive science like biology or sociology. It is precisely a normative and regulative science. A positive science describes ‘what is given’ whereas a normative science prescribes ‘what ought to be’. Thus, logic is defined as the normative study of human reasoning that provides the norms/standards/ideals of correct thinking.

Logic is a regulative science as its main concern is to fix the precise rules and norms of evaluating correct judgments and arguments. Thus, it is crucial to scientific investigation and testing of hypotheses.

There has been much dispute on the question - Is logic a science or an art? Critics differ in their opinion as to whether logic is a science or an art. Logicians like Mansel and Thompson accept logic only as a science while Aldrich and others consider logic only as an art. Mill and Whately recognize logic as both a science and an art. We have already seen that it is basically the science of reasoning. It is also true that a proper study of logic will improve our reasoning skill and the ability to detect the errors and lapses in judgments and arguments. Hence, learning logic certainly involves training in making and analyzing arguments. It is therefore an art also. Logic is an art because it is a practical science that guides us in the ‘search for truth’.
There is no doubt about the value of logic in the fields of law and crime investigation. Judges and lawyers are always keen on the logical coherence of arguments in law courts. Detectives and police officers apply the tools of logic to discover the loopholes in crime investigation.

A careful study of logic guards us against the common errors in reasoning such as hasty generalization and ambiguity. Thus, the study of logic guarantees training in detecting fallacies in judgments and arguments. That is why we consider logic not only as the science of reasoning but also as the art of argumentation.

Logic is the reliable guide in our search for truth because it recognizes both the material and formal aspects of truth. Hence, it is divided into formal logic and material logic. The portion of logic concerned with formal truth is known as Deductive logic or Deduction and that which is concerned with material truth is known as Induction or Inductive Logic. The scope of logic in the search for truth is therefore all-inclusive.

2. Define logic and explain the uses of the study of logic.

Logic provides us with the methods and techniques for evaluating right and wrong reasoning. Thus, it is concerned with the norms / standards / ideals to distinguish between correct and incorrect reasoning. That is why logic is defined as the normative study of reasoning. According to Creighton, logic is the science which treats of the operations of the human mind in its search for truth. In other words, it is defined as the science of thought or as the science which investigates the process of thinking. Copi and Cohen define the function of logic as ‘the study of the methods and principles used to distinguish correct from incorrect reasoning’. Scientific study in any field is based on correct reasoning and hence logic is considered as the basic science of sciences.

Logic is the study of reasoning process as expressed in language. A student of logic can definitely grasp the means to analyze knowledge in any field according to specific standards of truth. Logic as the science of reasoning enables us to develop order and coherence in thinking. A careful study of logic will help us to avoid ambiguities in expression. It highlights the fallacies related the use of language.

Logic prescribes the methods to convert ordinary sentences into logical statements or propositions. This will help us to attain clarity in the structure and meaning of sentences and arguments. Hence, the study of logic will make us aware of the fallacies hidden under the metaphorical and ornamental language in newspaper reports and public speeches.

Scientific study in any field should be based on correct reasoning and hence logic is considered as the basic science of sciences. Logic is therefore crucial to the methodology of science. It is both the normative and regulative science of thinking. Its dual concern for material and formal truth is the core of the hypothetico-deductive method adopted in scientific investigation. Thus, logical analysis is essential for testing scientific hypotheses.
There is no doubt about the value of logic in the fields of law and crime investigation. Judges and lawyers are always keen on the logical coherence of arguments in law courts. Detectives and police officers apply the tools of logic to discover the loopholes in crime investigation.

A careful study of logic guards us against the common errors in reasoning such as hasty generalization and ambiguity. Thus, the study of logic guarantees training in detecting fallacies in judgments and arguments. That is why we consider logic not only as the science of reasoning but also as the art of argumentation.

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3. Define logic and distinguish between Formal and Material logic. Or

Define logic and distinguish between deduction and induction.

Logic provides us with the methods and techniques for evaluating right and wrong reasoning. Thus, it is concerned with the norms / standards / ideals to distinguish between correct and incorrect reasoning. That is why logic is defined as the normative study of reasoning. According to Creighton, logic is the science which treats of the operations of the human mind in its search for truth. In other words, it is defined as the science of thought or as the science which investigates the process of thinking. Copi and Cohen define the function of logic as ‘the study of the methods and principles used to distinguish correct from incorrect reasoning’. Scientific study in any field is based on correct reasoning and hence logic is considered as the basic science of sciences.

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Based on the method and type of inference, logic is divided into two - deductive logic or deduction and inductive logic or induction. In deduction, the form determines the validity of inference. Hence, deductive reasoning is the basis of formal logic, which is concerned with the form of the argument rather than its content. In deductive argument, the conclusion cannot be wider than the premises, but in induction, the conclusion is equal to or wider than the premises.

In deduction, the conclusion necessarily follows from the given premises. Hence, their relationship is of implication or entailment. See for example,

All humans are mortal.

Socrates is a human being.
Therefore, Socrates is mortal.

Induction refers to the process of drawing conclusion from observed instances that give specific evidence to support the inference. Inductive inferences are evaluated as sound or unsound by considering not only form but also the content or matter.

See for example,

Aristotle is human and mortal.
Bacon is human and mortal.
Descartes is human and mortal.

Therefore, all humans are mortal.

In deduction, the premises form the necessary ground for the conclusion. In induction, the conclusion is always probable. Hence, an inductive argument is neither true nor false, but only sound or unsound.

Anyway, logicians do not consider deduction and induction as opposites, but as complementary processes of reasoning. They together form the basis of scientific investigation by hypothetico-deductive method.

Deductive reasoning is the basis of formal logic, which is concerned with the form of the argument rather than its content. In a deductive argument, the conclusion is already contained in the premises. Hence, in formal logic the material truth or falsity of the premises is not important. The following deductive argument is invalid because although the premises are true the conclusion is false:

All cows are four-legged animals.
All horses are four-legged animals.
Therefore, all horses are cows.

Inductive inferences are evaluated as sound or unsound by considering not only form but also the content or matter. Hence, material logic is concerned with the content of the argument and hence it is based more on inductive reasoning. For example, from all the reported instances - ‘Crows are black’, we infer the conclusion - All crows are black. Yet, this inductive inference is only probable because as soon as we come across the material evidence for a non-black crow it becomes invalid.
PART - A - Multiple-choice questions

For model questions, see the Question Bank.

PART - B - Short answer questions

1. Differentiate a proposition from ordinary sentence.

A proposition is the verbal expression of an act of judgment. The precise logical form of a proposition differentiates it from grammatical sentences. Ordinary sentences express not only statements of facts but also wishes, feelings, commands, questions etc. Logical propositions are statements or indicative sentences in which something is said about something else either affirmatively or negatively. Hence, propositions precisely have the forms - ‘S is P’ or ‘Sis not P’. It is clear that even though a proposition is a sentence, not every sentence is a proposition.

2. What are the characteristics of a categorical proposition?

A categorical proposition either affirms or denies something about a certain class of things unconditionally. The main characteristics of a categorical proposition are:

(i) It is always in indicative mood.
(ii) It is always in present tense.
(iii) The copula must be separate from the subject and the predicate. For example, in common language, we say, “Bird flies”, but as a logical proposition it is stated as “Birds are flying creatures”.

3. Write a short note on the structure of categorical proposition.

A categorical proposition contains two terms connected by means of a copula. The thing about which the affirmation or denial is made is the subject(S). The attribute that is affirmed or denied of the subject is the predicate (P). There are only four kinds of copula, namely, ‘is’, ‘is not’, ‘are’ and ‘are not’. Thus, a categorical proposition is represented as -

S + Copula + P

4. Distinguish between a term and a word.

Words are the parts of ordinary grammatical sentences. Terms, on the other hand, are the constituents of logical propositions. A term is a word or a group of words which serves either as the
subject or as the predicate in a proposition. Propositions can have only two terms namely the subject and predicate, but a sentence can have any number of words.

5. **Distinguish between the quality and quantity of a proposition. Or Write a short note on the classification of categorical propositions.**

A categorical proposition can have only two terms namely the subject and predicate. The quality of a proposition indicates whether the predicate is affirmed or denied of the subject. Thus in terms of quality, a proposition is either affirmative or negative. For example, ‘S is P’ is an affirmative proposition while ‘S is not P’ is a negative proposition. The quantity of a proposition is determined by the extent of generalization of the subject. Accordingly, the proposition is universal if the subject refers to the whole class of objects. It is particular if the subject refers only to a part of the class. Quantity indicators are - All, No and Some. According to quantity and quality, we can classify propositions into four -

A proposition - All S is P
E proposition - No S is P
I proposition - Some S is P
O proposition - Some S is not P.

6. **What is meant by connotation of a term?**

Logicians suggest two different techniques to make the meaning of terms clear. Accordingly, a term has both denotation and connotation. Thus, every term connotes a quality and denotes a quantity. Connotation refers to the quality of the proposition. It is the set of qualities possessed by the objects referred by the term. The connotation of the term ‘human being’ is ‘mortality’ and ‘rationality’. Connotation is also termed intention as it shows the intended characteristics of the term.

7. **Define the denotation of a term.**

Logicians suggest two different techniques to make the meaning of terms clear. Accordingly, a term has both denotation and connotation. Thus, every term connotes a quality and denotes a quantity. A term denotes a quantity and connotes a quality. Denotation refers to the objects that possess the given qualities. The denotation of the term ‘human being’ is any particular individual like Socrates. Denotation is also termed extension as it shows the extent to which the term is applicable.

8. **What is meant by distribution of a term?**

A categorical proposition can have only two terms namely the subject and predicate. When a certain attribute is predicated to the whole class of the subject term, the term is said to be distributed. If only a part is referred to, then the term is characterized as undistributed. Hence, in universal propositions, subject term is distributed and in particular propositions, subject term is undistributed. In affirmative
propositions, predicate term is undistributed and in negative propositions, predicate term is distributed.

9. Demonstrate the position of distributed and undistributed terms in four categorical propositions.

In universal propositions, subject term is distributed and in particular propositions, subject term is undistributed. In affirmative propositions, predicate term is undistributed and in negative propositions, predicate term is distributed.

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We also can use a mnemonic formula to represent the distribution of terms - AsEbInOp, which means, ‘A’ distributes only S, ‘E’ distributes both Sand P, ‘I’ distributes neither S nor P, ‘O’ distributes only P.

PART - C - Paragraph answer questions

1. Show how a logical proposition is different from an ordinary sentence.

A proposition is the verbal expression of an act of judgement. A judgement is an act thought and the result of the thought process. The logical form differentiates propositions from grammatical sentences. Ordinary sentences express not only statements of facts but also wishes, feelings, commands, questions etc. E.g. ‘Come here’, ‘May God be merciful’, I wish good luck’, and so on. Logical propositions are precisely statements in which some thing is said about something else either affirmatively or negatively. Hence, a proposition is strictly in the form ‘S is P’ or ‘S is not P’. Another characteristic of a proposition is determined by the quality and quantity of the subject and predicate terms in it. Accordingly, a basic categorical proposition is of four types -

Universal affirmative - A proposition - All S is P

Universal negative - E proposition - No S is P

Particular affirmative - I proposition - Some S is P

Particular negative - O proposition - Some S is not P.

2. Write a note on the structure of a categorical proposition.

A categorical proposition contains two terms connected by means of a copula. E.g., ‘Nehru is the first prime minister of India’. Here ‘Nehru’ is the subject (S), ‘the first prime minister of India’ is the
predicate (P) and ‘is’ is the copula. The term about which the affirmation or denial is made is the subject. The term which is affirmed or denied is the predicate. The connecting link is the copula. There are only four kinds of copula, namely, ‘is’, ‘is not’, ‘are’ and ‘are not’. A basic categorical proposition is of four types -

Universal affirmative - A proposition - All S is P
Universal negative - E proposition - No S is P
Particular affirmative - I proposition - Some S is P
Particular negative - O proposition - Some S is not P.

3. Differentiate ‘subject term’ from ‘predicate term’.

A categorical proposition contains two terms connected by means of a copula. A single word or a set of words can represent a term. The term about which the reference is made is the subject term (S) and what is referred to the subject is the predicate term (P). In the proposition ‘Mahatma Gandhi is the father of our nation’, ‘Mahatma Gandhi’ is the subject term and ‘the father of our nation’ is the predicate term. The ‘is’ is the copula, the connecting link between the subject term and the predicate term.

4. Explain how the terms are connected in a proposition? Or Write a short note on ‘copula’.

A categorical proposition contains two terms connected by means of a copula. The two terms are the subject term and the predicate term and the connecting link between the terms is the copula. The copula is always in the present tense. The copula has only four variants in logic. They are: (i) ‘is’, (ii) ‘is not’ (iii) ‘are’ and (iv) ‘are not’. In grammatical sentences, the connecting words can have many different forms. For the sake of clarity and precision logic accepts only four types of copula.

5. Distinguish between categorical and conditional propositions.

A categorical proposition states the relationship between the subject term and the predicate term unconditionally. For example: ‘All cows are quadrupeds’. Here, the class of ‘cows’ is attributed a particular quality. The conditional proposition, on the other hand, asserts the relationship on the basis of some conditions. There are two types of conditional propositions, namely, (i) Hypothetical and (ii) Disjunctive. A hypothetical proposition introduces the conditional form ‘if….then’. E.g., ‘If you consume poison then you will die’. The disjunctive proposition has the conditional form, ‘either…..or’. E.g., ‘Either I shall telephone him or I shall write to him’.

6. Define categorical proposition and give an account of its classification.

A categorical proposition states the relationship between the subject term and the predicate term unconditionally. For example: ‘All cows are quadrupeds’. Here, the class of ‘cows’ is attributed
a particular quality. Categorical propositions are classified according to quality and quantity into four -

(i). Universal affirmative - A proposition  E.g. All horses are fast running animals.
(ii). Universal negative - E proposition     E.g. No horses are flying animals.
(iii). Particular affirmative - I proposition E.g. Some horses are white.
(iv). Particular negative - O proposition   E.g. Some politicians are corrupt.

The above four types of proposition are called categorical because the predicate terms are unconditionally attributed to the subject terms. If, on the other hand, any condition is attached on the relation between subject term and predicate term, then the proposition becomes a conditional proposition.

7. What is the difference between universal and particular propositions?

According to quantity of the subject term, categorical propositions are classified into universal and particular. A universal proposition speaks about the whole class of the subject term. For example, ‘All horses are vertebrates’; the predicate is attributed to the entire class of horses. The predicate of a particular proposition is attributed only to a part of the subject term. For example, ‘Some horses are white’; here the quality of ‘whiteness’ is attributed only to some members of the class ‘horse’. Universal and particular propositions are either affirmative or negative. There are two types of universal propositions two types of particular propositions:

(a) Universal affirmative  E.g. All Indians are Asians.
(b) Universal negative    E.g., No Indians are Europeans.
(c) Particular affirmative E.g., Some horses are white.
(d) Particular negative   E.g., Some politicians are corrupt.

8. Describe the rules of distribution of the terms in categorical propositions.

A categorical proposition can have only two terms namely the subject and predicate. When a certain attribute is predicated to the whole class of the subject term, the term is said to be distributed. If only a part is referred to, then the term is characterized as undistributed. Hence, in universal propositions, subject term is distributed and in particular propositions, subject term is undistributed. In affirmative propositions, predicate term is undistributed and in negative propositions, predicate term is distributed.
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We also can use a mnemonic formula to represent the distribution of terms - AsEbInOp, which means, ‘A’ distributes only S, ‘E’ distributes both Sand P, ‘I’ distributes neither S nor P, ‘O’ distributes only P.

**PART – D - Essay questions**

1. **Define connotation and denotation of terms and explain their relationship in logic?**

Connotation and denotation are properties of the terms in a proposition. They are also known as intention and extension of terms. A term is meant to indicate an object or objects to which the name refers and also to suggest certain qualities residing in those objects. For example, the term ‘Man’ refers to all human beings and also it implies the qualities of rationality and animality. The function of suggesting the qualities possessed by the objects is known as connotation. The function of indicating objects to which the term applies is called denotation. In other words, every term denotes certain objects and connotes certain qualities. Denotation is also known as Extension, as it suggests the extent of objects to which the term is applied. Connotation also is called Intension because it refers to the qualities intended by the term.

The connotation of a term consists of the attributes implied by the term. A term may have a number of attributes, of these, what all attributes come within the range of connotation? There are three views regarding the exact meaning of connotation. They are: (i) Objective view, (ii) subjective and (iii) Logical or conventional view.

(i) Objective view: According to this view, connotation means all the attributes contained in the term, both known and unknown. In logic, we are not concerned with anything unknown to our reason; it is concerned with relatively agreed and common attributes of a term.

(ii) Subjective view: Here only those attributes known to subject or speaker is taken into consideration. But the term may suggest different qualities or attributes to different minds. In other words, the subjective meaning of connotation may vary from person to person according to different views. If we accept this view there will be no agreement regarding truth, and the very purpose of logic will be defeated.

(iii) Logical or conventional view: According to this view, connotation means only the essential and fixed attributes of the object on account of which the term is applied to the object. For example, the connotation of the ‘Man’ refers only the essential qualities like rationality and animality that is shared by one and all humans alike. It does not include the non - essential features like complexion,
height, weight etc. In short, logicians are concerned only with the conventional or logical view of connotation.

Relationship between connotation and denotation:

A quantitative relation can be observed between connotation and denotation of a term. One view suggests that as the connotation of the term increases or decreases, its denotation decreases or increases respectively, and vice versa. For example, let us take the term ‘politician’. It denotes all the politicians in the world, and connotes certain attributes. If we increase the connotation by adding ‘Indian’ to the term, now its extension is reduced in number. That is, when we increase the connotation the denotation decreases. Again, if we add another connotation ‘south’ to ‘Indian politician’ then the extension decreases further. Similarly, if we decrease connotation of the term ‘Man’ by cutting off the quality ‘rationality’ the term denotes greater number of objects, namely, all the animals in the world.

On basis of the above explanation, certain logicians formulated a mathematical expression to the quantitative relation between connotation and denotation of a term. They suggest this relation between denotation and connotation by the law of ‘inverse ratio’. This seems apparent, but on close analysis we can see that there is no strict quantitative increase or decrease as connotation increases or decreases or vice versa.

We can also see that there is only one-sided variation between connotation and denotation in many instances. The mathematical ‘inverse ratio’ is possible only when both sides of the relation vary together strictly in proportion. There are cases where the law of inverse ratio does not hold good. Hence, the law of inverse ratio relation is not applicable in all cases of denotation and connotation.

2. Examine the different theories of predication.

The real meaning of predication can be understood when the exact meaning of the subject and predicate is clearly known. The meaning of a proposition is suggested by the relation between the subject and the predicate. The meaning of the categorical proposition can be explicitly expressed by four types of relations.

(I) Denotative- connotative view or the predicative view.

(II) The denotative view or the class view.

(III) The connotative view or the attributive view.

(IV) The connotative –denotative view.

(I) Denotative- connotative view or the predicative view: Here the subject is taken in denotation and the predicate in connotation. That is, the proposition affirms or denies the quality connoted by the predicate. For example, the proposition “All men are mortal” means that the quality of mortality is
shared by all men. Generally, the categorical proposition is interpreted in this way. Hence, it is the most common way of understanding a proposition.

(II) The class view: This view is also known as the denotative view. In this case, the proposition indicates a relation between two classes of objects. In other words, both the subject and the predicate are taken in denotation. Here the class of objects denoted by ‘S’ is either included in or excluded from the class of objects denoted by ‘P’. The proposition “All prisoners are convicted criminals” implies the relation between the subject class and the predicate class.

(III) Attributive or connotative view: according to this view, both the subject and the predicate are taken in connotation. Thus, the proposition shows a relation between two attributes or two sets of attributes. For example, “No angels are earthly creatures’.

(IV) The connotative –denotative view: This is the opposite of the predicative view. This kind of proposition emphasizes the connotation of the subject term and the denotation of the predicate term. The proposition “All men are mortal” is an example for connotative-denotative model of proposition.

Even though these four types of propositions are different, they are not opposed to one another. They only bring out different aspects of the meaning of propositions.

3. What is meant by the distribution of terms? Explain the rules of distribution.

Distribution of terms:

A term is said to be distributed when it is expressed in its entire extent, i.e., referring to all objects denoted by the term. A term is undistributed when only a part of the denotation is taken into consideration. In other words, distribution of term means taking the extent universally or partially.

On the basis of quality and quantity of the terms, we get four kinds of propositions -

(a) Universal affirmative - A proposition E.g. All Indians are Asians.

(b) Universal negative - E proposition E.g., No Indians are Europeans.

(c) Particular affirmative - I proposition E.g., Some horses are white.

(d) Particular negative - O proposition E.g., Some politicians are corrupt.

If we represent subject term as S and predicate term as P, these four propositions can be symbolized as SAP, SEP, SIP and SOP.

The rules of distribution:

(a) ‘A’ proposition distributes only the subject term, this is evident from the sign of quantity, ‘All’. For example, ‘All birds are vertebrates’, here the subject term ‘birds’ is distributed because it extends to all members of the class of birds. The predicate term ‘vertebrates’ is not distributed
because only a part of the denotation of the predicate is referred to. The proposition only means that birds are only a part of the class of vertebrates. Apart from birds, there are other vertebrates like monkeys, lions, humans etc. A better expression would be ‘All birds are some vertebrates’.

(b) ‘E’ proposition distributes both the subject and the predicate terms. In the ‘E’ proposition, ‘No Indians are Europeans’ the subject term refers to ‘All Indians’ and the predicate term refers to ‘all Europeans’. In a universal negative proposition the subject term is totally excluded from the predicate term and hence both the subject and predicate terms are distributed.

(c) ‘I’ proposition distributes neither the subject nor the predicate term. For example, in the proposition ‘Some men are honest’, the subject term ‘men’ is not distributed, because the reference is only to some men and the predicate ‘honest’ also is not distributed, since it does not include all honest beings.

(d) ‘O’ proposition distributes only its predicate term. In the proposition ‘Some politicians are not honest’, the subject term ‘politician’ is not distributed, because we refer only to some politician. But the predicate ‘honest’ is distributed. Here a part of the subject class is excluded from the whole class of honest people.

Thus, we can refer to the distribution of terms in a categorical proposition as:

A universal affirmative proposition distributes the subject term only.

A universal negative proposition distributes both the subject and the predicate terms.

A particular affirmative proposition neither the subject nor predicate term.

A particular negative proposition distributes the predicate term only.

We can also state the distribution terms in a different way.

Affirmative propositions do not distribute their predicate.

Particular propositions do not distribute their subject.

Negative propositions distribute their predicate.

Universal propositions distribute their subject.

We can also use a mnemonic formula to represent the distribution of terms - AsEbInOp, which means, ‘A’ distributes only S, ‘E’ distributes both Sand P, ‘I’ distributes neither S nor P, ‘O’ distributes only P.

4. Explain the distribution of terms in a proposition with the help of Euler’s Circles.
Euler had explained the distribution of terms with the help of circles. He had used two circles to demonstrate the distribution relation between the subject (S) and the predicate (P) in the categorical propositions A, E, I and O. We can refer to the distribution of terms in a categorical proposition as:

A universal affirmative proposition distributes the subject term only.

A universal negative proposition distributes both the subject and the predicate terms.

A particular affirmative proposition neither the subject nor predicate term.

A particular negative proposition distributes the predicate term only.

The ‘A’ proposition is represented by a small circle within a larger circle, where the small circle stands for the subject term and the large circle for the predicate term.

**A Proposition**

![A Proposition Diagram](image)

All S is P

The ‘E’ proposition is represented by two circles, both outside each other. That is, the subject circle is completely outside of the predicate circle.

**E proposition**

![E proposition Diagram](image)

No S is P

The ‘I’ proposition is represented by two circle intercepting each other, which means that only a part of both subject and predicate that are in the area of interception is referred to. That is, only a part of subject and predicate terms are mentioned in, and hence neither of them is distributed.

**I proposition**

![I proposition Diagram](image)
Some S is P.

The ‘O’ proposition is also represented by two intercepting circles, with the only difference that the whole of predicate circle is outside per view of the subject circle. In other words, only a part of subject is referred to and the whole of predicate is negated to the subject.

**O proposition**

Some S is not P.

Thus, Euler explains that simply by looking at the circles we can know which term is distributed and which is not.
Module III
IMMEDIATE INFEERENCE

PART - A - Multiple-choice questions

For model questions, see the Question Bank.

PART - B - Short answer questions

Writes short notes on the following:

1. Immediate inference

In immediate inference, there is one and only one premise from which the conclusion is drawn. From a single proposition expressed in any one of the four standard forms, it is we can infer another proposition implied in it without a mediating proposition. Immediate inference is of two types:
   i. Inference by Opposition and
   ii. Eduction.

   In eduction, the meaning of premise and conclusion is the same, and their difference is only in form. Two categorical propositions are said to be opposite if they differ either in quality or in quantity or in both quality and quantity.

2. The Square of Opposition

There are various truth relations between the four categorical propositions A, E, I and O. These relations are termed ‘opposition’. Traditional logicians have explained these relationships by means of a diagram called the “Square of Opposition”. In the square of opposition, when we infer the opposite propositions from a given proposition, the subject and predicate of the implied proposition is the same as that of the implying one. Two categorical propositions are said to be opposite if they differ either in quality or in quantity or in both quality and quantity.

3. Contrary opposition

Universal affirmative ‘A’ proposition, “All S is P” and Universal negative ‘E’ proposition, “No S is P” are related to each other by contrary opposition. Contrary propositions ‘A’ and ‘E’ have same quantity (universal) but they differ in quality. Contrary proposition ‘A’ and ‘E’ cannot be both true together though they both can be false at the same time. If one of the contrary propositions is true then the other contrary proposition is necessarily false, whereas if one is false, the undetermined (it can be true or false).

4. Sub - contrary opposition
Particular affirmative ‘I’ proposition, “Some students are scholarship holders” is related to ‘O’ proposition “Some students are no scholarship holders” by sub contrary relation. Similarly, ‘O’ proposition, “Some animals are not carnivorous” is related to ‘I’ proposition, “Some animals are carnivorous” by sub contrary relation. Sub contrary propositions ‘I’ and ‘O’ have same quantity (particular) but they differ in quality. Sub contrary propositions ‘I’ and ‘O’ cannot both be false together though they both can be true together. If ‘I’ is true, ‘O’ is undetermined; whereas if ‘I’ is false, ‘O’ is necessarily true. Similarly, if ‘O’ is true, ‘I’ is undetermined but if ‘O’ is false, ‘I’ is definitely true.

5. **Contradictory opposition**

Contradictory propositions differ in both quantity and quality. The Universal affirmative ‘A’ proposition, ‘All S is p” is related to Particular negative ‘O’ proposition, “Some S is not P” by contradictory relation. The contradictory of ‘All men are mortal’ is “Some men are not mortal” and vice versa. The contradictory of ‘E’ proposition, “No crows are mammals” is the ‘I’ proposition, ‘Some crows are mammals’. Contradictory propositions ‘A’ and ‘O’ and ‘E’ and ‘I’ differ both in quantity and quality. Contradictory relation between ‘A’ and ‘O’, and also between ‘E’ and ‘I’ is of strict opposition. If ‘A’ is true ‘O’ is false; if ‘O’ is true, ‘A’ is false. Similarly, if ‘E’ is true, ‘I’ is false and if ‘I’ is true, ‘E’ is false.

6. **Subaltern**

Universal affirmative ‘A’ proposition, “All men are moral” is subaltern to ‘I’ proposition, “Some men are mortal”. Similarly, ‘E’ proposition, “No crow is mammal” is subaltern to ‘O’ proposition, “Some crows are not mammals”. Propositions related by subaltern relationship such as ‘A’ and ‘I’, and also ‘E’ and ‘O have the same quality, but they differ in quantity. Subaltern relationship shows that if ‘A’ is true, then ‘I’ is necessarily true, but if, ‘I’ is true, ‘A’ remains undetermined. It is also the case with ‘E’ and ‘O’. If ‘E’ is true, ‘O’ is true but it is not possible to infer the truth of E proposition from that of I.

7. **Eduction**

Eduction is the kind of immediate inference in which the meaning of the premise and the conclusion is the same. The difference between them is only in form. In inference by opposition, the premise and conclusion differ in both form and meaning. Eduction is of three types - Conversion, Obversion and Contraposition.

8. **Conversion**

Conversion is an independent form of immediate inference. Conversion is the eduction of one proposition from another by transposing the term. The original proposition is called the convertend, and that which is derived from it is named converse.

A proposition is converted by limitation to infer the I proposition.

E is converted to E, I to I, but in the case of O proposition, valid conversion is no possible.

9. **Obversion**
Obversion is an independent form of immediate inference. In obversion, the quality of the given proposition is changed in the inferred proposition, but the quantity remains the same. Subject of the conclusion is the same as that of the premise, but the predicate of the conclusion is the contradictory of that in the premise. The original proposition is called the obvertend, and that which is inferred from it is termed the obverse. A proposition is obverted into E, E into A, I into O and O into I.

10. **Contraposition**

Contraposition is not an independent form of immediate inference. It is a combination of conversion and obversion. In contraposition, the subject of the conclusion is contradictory of the predicate of the premise, and the predicate of the conclusion is contradictory of the subject of the premise. There is no change in the quality or quantity of the original proposition. For example, the contrapositive of A proposition ‘All S is P’ is ‘All non-S is non-P’. The contrapositive of E is O by limitation. I proposition has no valid contrapositive and the contrapositive of O is O.

**PART - C - Paragraph answer questions**

1. **Distinguish between mediate and immediate inference.**

The basis of classification into immediate and mediate inference is the number of premises that support the conclusion. In immediate inference, there is one and only one premise whereas in mediate inference there are at least two premises, which jointly imply the conclusion. From a single proposition expressed in any of the four standard forms, it is possible to infer other propositions implied in it without any mediating proposition. Immediate inference is of two types - Inference by Opposition and Eduction. In eduction, the meaning of premise and conclusion is the same, and their difference is only in form. Two categorical propositions are said to be opposite if they differ either in quality or in quantity or in both quality and quantity.

In mediate inference, the conclusion is derived from two or more premises. An argument having two and only two premises is called syllogistic mediate inference. Aristotle had introduced the concept syllogism. If the number of premises is more than two, the mediate inference becomes non-syllogistic. In both the types of deductive reasoning, it is necessary to follow the rule of distribution of terms. The rule states that a term that is distributed in the conclusion should be distributed in the premise also.

2. **Demonstrate the Square of Opposition.**

There are various truth relations between the four categorical propositions A, E, I and O. These relations are termed ‘opposition’. Traditional logicians have explained these relationships by means of a diagram called the “Square of Opposition”. In the square of opposition, when we infer the opposite propositions from a given proposition, the subject and predicate of the implied proposition is the same as that of the implying one. Two categorical propositions are said to be opposite if they differ either in quality or in quantity or in both quality and quantity.
A and E are contrary propositions.

I and O are sub-contraries.

A and O and E and I are contradictories.

A is superaltern to I and E is superaltern to O.

I is subaltern to A and O is subaltern to E.

To make the meaning of subaltern relationship clear, logicians recognize the relationship between universal and particular propositions as superaltern and that between particular and universal as subaltern.

3. What is conversion? State the rules of Conversion.

Conversion is an independent form of immediate inference. Conversion is the eduction of one proposition from another by transposing the terms. The original proposition is called the convertend, and that which is derived from it is the converse. The rules of conversion are the following:

i) The subject of the premise becomes predicate of the conclusion and predicate of the premise becomes subject of the conclusion.

ii) Quality of the premise and that of the conclusion remains the same. If the premise is affirmative, then the conclusion is also affirmative and if the premise is negative, the conclusion is also negative.

iii) Quantity of the premise and the conclusion should be same as far as possible. If the premise is universal, then the conclusion should also be universal. Similarly, if the premise is particular, then the conclusion should also be particular. However, in the conversion of A proposition this rule is not observed.

iv) The rule governing the distribution of terms must be observed.
Conversion of four categorical propositions A, E, I, and O is as follows:

Conversion of A proposition:

Keeping three rules in mind, the proposition “All S is P” is converted as:

All S is P.

Therefore, all P is S.

But it is invalid; for the term P which is distributed in the conclusion fails to be distributed in the premise. Then try the alternative conclusion.

All S is P.

Therefore, Some P is S.

This is valid. While proposition A could not be converted into A, it can be converted into I proposition by limitation because here we go from universal premise to particular conclusion.

Conversion of E proposition:

No S is P

Therefore, P is S

Conversion of I proposition:

Some S is P

Therefore, some S is P

Conversion of O proposition is not valid because the term S which is distributed in the conclusion is not distributed in the premise.

Some S is not p

Therefore, some P is not S

So, no conversion is possible for O proposition.


Obversion is an independent form of immediate inference. In obversion, the quality of the given proposition is changed in the inferred proposition, but the quantity remains the same. Subject of the conclusion is the same as that of the premise, but the predicate of the conclusion is the contradictory of that in the premise. The original proposition is called the obvertend, and that which is inferred from it is termed the obverse. The rules for obversion are as follows:
i. Subject of the premise is the subject of the conclusion.

ii. Predicate of the conclusion is contradictory of the predicate of the premise. One must notice that a negative proposition is different from the proposition having a contradictory predicate. For instance, “Some S is not P” I a negative proposition whereas “Some S is non-P” is affirmative proposition which contradictory predicate.

iii. Quantities of the premises and the conclusion must be same. If the premise is universal, conclusion is also universal and if the premise is particular, conclusion is also particular.

iv. Qualities of the premise and the conclusion, however, are different. If the premise is affirmative, then the conclusion is negative, the conclusion is affirmative.

v. The rule of distribution of the term is to be observed.

A is obverted into E
E is obverted into A
I is obverted into O
O is obverted into I.

5. Define contraposition and describe its features.

Contraposition is not an independent form of immediate inference. It is a combination of conversion and obversion. In contraposition, the subject of the conclusion is contradictory of the predicate of the premise, and the predicate of the conclusion is contradictory of the subject of the premise. There is no change in the quality or quantity of the original proposition. For example, the contrapositive of A proposition ‘All S is P’ is ‘All non-S is non-P’. The contrapositive of E is O by limitation. I proposition has no valid contrapositive and the contrapositive of O is O.

Contraposition of A proposition

All S is P
______________________________
= No S is non-P by obversion
= No non-P is S by conversion
= All non-P is non-S by obversion

The required subject and predicate are found. Therefore, the contraposition of A is A itself.

Contraposition of E proposition:

No S is P
____________________
= All S is non-P by obversion
= Some non-P is S by conversion
= Some non-P is not non-S by obversion

The required subject and predicate are found, therefore, contraposition of E proposition is O.

Since E is contraposited into O, it is called contraposition by limitation because the premise is universal whereas the conclusion is particular.

Contraposition of I proposition:

Some S is P

= Some S is not non-P by obversion

Here we get an O proposition; its conversion is not possible. Therefore, there is no valid contraposition of I proposition.

Contraposition of O proposition:

Some S is not P

= Some S is non-P by obversion

= Some non-P is S by conversion

= Some non-P is not non-S by obversion

The required subject and predicate are found, therefore, contraposition of O proposition is O itself.

6. Differentiate between obversion and conversion.

Obversion is an independent form of immediate inference. In obversion, the quality of the given proposition is changed in the inferred proposition, but the quantity remains the same. Subject of the conclusion is the same as that of the premise, but the predicate of the conclusion is the contradictory of that in the premise. The original proposition is called the obvertend, and that which is inferred from it is termed the obverse. The rules for obversion are as follows:

i. Subject of the premise is the subject of the conclusion.

ii. Predicate of the conclusion is contradictory of the predicate of the premise. One must notice that a negative proposition is different from the proposition having a contradictory predicate. For instance, “Some S is not P” I a negative proposition whereas “Some S is non-P” is affirmative proposition which contradictory predicate.

iii. Quantities of the premises and the conclusion must be same. If the premise is universal, conclusion is also universal and if the premise is particular, conclusion is also particular.

iv. Qualities of the premise and the conclusion, however, are different. If the premise is affirmative, then the conclusion is negative, the conclusion is affirmative.

v. The rule of distribution of the term is to be observed.
Conversion is an independent form of immediate inference. It is made by transposing the terms in the original proposition. The original proposition is called the convertend, and that which is derived from it is named converse. The rules of conversion are the following:

i) The subject of the premise becomes the predicate of the conclusion and predicate of the premise becomes the subject of the conclusion.
ii) Quality of the premise and that of the conclusion remains the same.
iii) Quantity of the premise and the conclusion should be same as far as possible. If the premise is universal, then the conclusion should also be universal. Similarly, if the premise is particular, then the conclusion should also be particular. However, in the conversion of A proposition this rule is not observed.
iv) The rule governing distribution of terms must be observed.

7. Compare and contrast conversion and contraposition.

Conversion is an independent form of immediate inference, which is obtained by transposing the terms. The original proposition is called the convertend, and that which is derived from it is named converse. For example,

Conversion of A proposition:

Keeping three rules in mind, the proposition “All S is P” is converted as:

All S is P.

Therefore, all P is S.

But it is invalid; for the term P which is distributed in the conclusion fails to be distributed in the premise. Then try the alternative conclusion.

All S is P.

Therefore, Some P is S.

This is valid. While proposition A could not be converted into A, it can be converted into I proposition by limitation because here we go from universal premise to particular conclusion.

The following are the rules of conversion:

i) The subject of the premise becomes the predicate of the conclusion and predicate of the premise becomes subject of the conclusion.
ii) Quality of the premise and that of the conclusion remains the same. If the premise is affirmative, then the conclusion is also affirmative and if the premise is negative, the conclusion is also negative.
iii) Quantity of the premise and the conclusion should be same as far as possible. If the premise is universal, then the conclusion should also be universal. Similarly, if the premise is particular, then
the conclusion should also be particular. However, in the conversion of A proposition this rule cannot observed.

iv) The rule governing distribution of terms must be observed.

**Contraposition** is a kind of immediate inference, which combines conversion and obversion. Hence, it is not an independent form of immediate inference. In contraposition, the subject of the conclusion is the contradictory of the predicate of the premise, and the predicate of the conclusion is the contradictory of the subject of the premise. In order to obtain the contrapositive, we have to apply obversion and conversion in turn until the required subject and predicate is found. For example,

Contraposition of A proposition

All S is P

= No S is non - P by obversion
= No non-P is S by conversion
= All non-P is non-S by obversion

The required subject and the required predicate are found. Therefore, the contraposition of A is A itself.

8. Make the conversion, obversion and contraposition of the following propositions:

a. All cat eat meat  
b. All boys play football  
c. No politicians are honest

‘All cats eat meat.’ is not in the standard logical form. After changing it into standard form, it becomes ‘All cats are meat eaters’.

Obversion- No cats are non- meat eaters.
Conversion- No non- meat eaters are cats.

Contraposition - All non-meat eaters are non-cats.

‘All boys play football’ – Logical form of the proposition is - All boys are football players.

Obversion - No boys are non- football players.
Conversion - No non-football players are boys.
Contraposition - All non- football players are non- boys.

‘No politicians are honest’- Logical form of the proposition is - No politicians are honest persons.

Obversion- All politicians are dishonest persons.
Conversion - Some dishonest persons are politicians.

Contraposition - Some dishonest persons are not non-politicians.

9. **Distinguish between obversion and contraposition.**

**Obversion** is an independent form of immediate inference. In obversion, the quality of the given proposition is changed in the inferred proposition, but the quantity remains the same. Subject of the conclusion is the same as that of the premise, but the predicate of the conclusion is the contradictory of that in the premise. The original proposition is called the obvertend, and that which is inferred from it is termed the obverse. The rules for obversion are as follows:

i. Subject of the premise is the subject of the conclusion.
ii. Predicate of the conclusion is contradictory of the predicate of the premise. One must notice that a negative proposition is different from the proposition having a contradictory predicate. For instance, “Some S is not P” I a negative proposition whereas “Some S is non-P” is affirmative proposition which contradictory predicate.
iii. Quantities of the premises and the conclusion must be same. If the premise is universal, conclusion is also universal and if the premise is particular, conclusion is also particular.
iv. Qualities of the premise and the conclusion, however, are different. If the premise is affirmative, then the conclusion is negative, the conclusion is affirmative.
v. The rule of distribution of the term is to be observed.

**Contraposition** is a kind of immediate inference, which combines conversion and obversion. Hence, it is not an independent form of immediate inference. In contraposition, the subject of the conclusion is the contradictory of the predicate of the premise, and the predicate of the conclusion is the contradictory of the subject of the premise. In order to obtain the contrapositive, we have to apply obversion and conversion in turn until the required subject and predicate is found. For example,

Contraposition of A proposition

All S is P

\[ \begin{align*}
\text{by obversion} \\
\text{by conversion} \\
\text{by obversion}
\end{align*} \]

The required subject and the required predicate are found. Therefore, the contraposition of A is A itself.

**PART – D - Essay questions**

1. What is immediate inference? Elaborate the different kinds of immediate inference.
The basis of classification into immediate and mediate inference is the number of premises that support the conclusion. In immediate inference, there is one and only one premise whereas in mediate inference there are at least two premises, which jointly imply the conclusion. From a single proposition expressed in any of the four standard forms, it is possible to infer other propositions implied in it without any mediating proposition. Immediate inference is of two types - Eduction and Inference by Opposition. In eduction, the meaning of premise and conclusion is the same, and their difference is only in form. Two categorical propositions are said to be opposite if they differ either in quality or in quantity or in both quality and quantity.

**Eduction** - Eduction is the kind of immediate inference in which the meaning of the premise and the conclusion is the same. The difference between them is only in form. In inference by opposition, the premise and conclusion differ in both form and meaning. Eduction is of three types:

i. Conversion
ii. Obversion
iii. Contraposition

**Conversion**

Conversion is an independent form of immediate inference. Conversion is the eduction of one proposition from another by transposing the terms. The original proposition is called the convertend, and that which is derived from it is named converse.

A proposition is converted by limitation to infer the I proposition.

E is converted to E, I to I, but in the case of O proposition, valid conversion is no possible.

**Obversion**

In obversion, the quality of the given proposition is changed in the inferred proposition, but the quantity remains the same. Subject of the conclusion is the same as that of the premise, but the predicate of the conclusion is the contradictory of that in the premise. The original proposition is called the obvertend, and that which is inferred from it is termed the obverse.

A proposition is obverted into E, E into A, I into O and O into I.

**Contraposition**

Contraposition is not an independent form of immediate inference. It is a combination of conversion and obversion. In contraposition, the subject of the conclusion is contradictory of the predicate of the premise, and the predicate of the conclusion is contradictory of the subject of the premise. There is no change in the quality or quantity of the original proposition. For example, the contrapositive of A proposition ‘All S is P’ is ‘All non-S is non-P’. The contrapositive of E is O by limitation. I proposition has no valid contrapositive and the contrapositive of O is O.

**Inference by Opposition** - There are various truth relations between the four categorical propositions A, E, I and O. These relations are termed ‘opposition’. Traditional logicians have explained these relationships by means of a diagram called the Square of Opposition. In the square of opposition, when we infer the opposite propositions from a given proposition, the subject and predicate of the implied proposition is the same as that of the implying one. Two categorical
Propositions are said to be opposite if they differ either in quality or in quantity or in both quality and quantity.

A and E are contrary propositions.

I and O are sub-contraries.

A and O and E and I are contradictories.

A is superaltern to I and E is superaltern to O.

I is subaltern to A and O is subaltern to E.

To make the meaning of subaltern relationship clear, logicians recognize the relationship between universal and particular propositions as superaltern and that between particular and universal as subaltern.

2. Bring out the relation of opposition between categorical propositions by means of the traditional square of opposition.

There are various truth relations between the four categorical propositions A, E, I and O. These relations are termed ‘opposition’. Traditional logicians have explained these relationships by means of a diagram called the Square of Opposition. In the square of opposition, when we infer the opposite propositions from a given proposition, the subject and predicate of the implied proposition is the same as that of the implying one. Two categorical propositions are said to be opposite if they differ either in quality or in quantity or in both quality and quantity.

The following square demonstrates the various relations of opposition between categorical propositions:
Contrary - Universal affirmative ‘A’ proposition, “All S is P” and Universal negative ‘E’ proposition, “No S is P” are related to each other by contrary relation. Contrary propositions ‘A’ and ‘E’ have same quantity (universal) but they differ in qualities. Contrary proposition ‘A’ and ‘E’ cannot be both true together though they both can be false at the same time. If one of the contrary propositions is true then the other contrary proposition is necessarily false, whereas if neither contrary proposition is false, the other contrary proposition is undetermined (it can be true or false).

Sub-contrary - Particular affirmative ‘I’ proposition, “Some students are scholarship holders” is related ‘O’ proposition “Some students are no scholarship holders” by sub contrary relation. Similarly, ‘O’ proposition, “Some animals are not carnivorous” is related to ‘I’ proposition, “Some animals are carnivorous” by sub contrary relation. Sub contrary propositions ‘I’ and ‘O have same quantity (particular) but they differ in qualities. Sub contrary propositions ‘I’ and ‘O’ cannot both be false together though they both can be true together. If ‘I’ is true, ‘O’ is undetermined; whereas if ‘I’ proposition is false, ‘O’ is necessarily true similarly, if ‘O’ is true, ‘I’ is undetermined but if ‘O’ is false, ‘I’ is definitely true.

Contradictory - The Universal affirmative ‘A’ proposition, “All S is p” is related to Particular negative ‘O’ proposition, “Some S is not P” by contradictory relation. The contradictory of ‘All men are mortal’ is “Some men are not mortal” and vice versa. The contradictory of ‘E’ proposition, “No crows are mammals” is ‘I’ proposition, “Some crows are mammals”. Contradictory propositions ‘A’ and ‘O’ and ‘E’ and ‘I’, however, differ both in quantity and quality. Contradictory relation between ‘A’
and ‘O’, and also between ‘E’ and ‘I’ is of strict opposition. If ‘A’ is true ‘O’ is false; if ‘O’ is rue, ‘A’ is false. Similarly, if ‘E’ is true, ‘I’ is false and if ‘I’ is true, ‘e’ is false.

Subaltern – Universal affirmative ‘A’ proposition, “All men are moral” is subaltern to ‘I’ proposition, “some men are mortal”. Similarly, ‘E’ proposition, “No crow is mammal” is subaltern to ‘O’ proposition, “Some crows are not mammals”. Propositions related by subaltern relationship such as ‘A’ and ‘I’, and also ‘E’ and ‘O’ have the same quality but they differ in quantity. Subaltern relationship shows if ‘A’ is true, then ‘I’ is necessarily true, but if, ‘I’ is true, ‘A’ is undetermined. It is so with E and O.

To make the meaning of subaltern relationship clear, logicians recognize the relationship between universal and particular propositions as superaltern and that between particular and universal as subaltern.

3. Define Eduction and bring out the different forms of Eduction.

Eduction is the kind of immediate inference in which the meaning of the premise and the conclusion is the same. The difference between them is only in form. In inference by opposition, the premise and conclusion differ in both form and meaning. Eduction is of three types:

a) Conversion
Conversion is an independent form of immediate inference. Conversion is the eduction of one proposition from another by transposing the terms. The original proposition is called the convertend, and that which is derived from it is named converse.

- A proposition is converted by limitation to infer the I proposition.
- E is converted to E, I to I, but in the case of O proposition, valid conversion is no possible.

The following are the rules of conversion:

i) The subject of the premise becomes the predicate of the conclusion and predicate of the premise becomes subject of the conclusion.

ii) Quality of the premise and that of the conclusion remains the same. If the premise is affirmative, then the conclusion is also affirmative and if the premise is negative, the conclusion is also negative.

iii) Quantity of the premise and the conclusion should be same as far as possible. If the premise is universal, then the conclusion should also be universal. Similarly, if the premise is particular, then the conclusion should also be particular. However, in the conversion of A proposition this rule cannot observed.

iv) The rule governing distribution of terms must be observed.

b) Obversion
In obversion, the quality of the given proposition is changed in the inferred proposition, but the quantity remains the same. Subject of the conclusion is the same as that of the premise, but the predicate of the conclusion is the contradictory of that in the premise. The original proposition is called the obvertend, and that which is inferred from it is termed the obverse.
A proposition is obverted into E, E into A, I into O and O into I.

The rules for obversion are as follows:

i) Subject of the premise is the subject of the conclusion.
ii) Predicate of the conclusion is contradictory of the predicate of the premise. One must notice that a negative proposition is different from the proposition having a contradictory predicate. For instance, “Some S is not P” I a negative proposition whereas “Some S is non-P” is affirmative proposition which contradictory predicate.
iii) Quantity of the premises and the conclusion must be same. If the premise is universal, conclusion is also universal and if the premise is particular, conclusion is also particular.
iv) Quality of the premise and the conclusion, however, are different. If the premise is affirmative, then the conclusion is negative, the conclusion is affirmative.
v) The rule of distribution of the term is to be observed.

c) Contraposition

Contraposition is not an independent form of immediate inference. It is a combination of conversion and obversion. In contraposition, the subject of the conclusion is contradictory of the predicate of the premise, and the predicate of the conclusion is contradictory of the subject of the premise. There is no change in the quality or quantity of the original proposition. For example, the contrapositive of A proposition

‘All S is P’ is ‘All non-S is non-S’. The contrapositive of E is O by limitation. I proposition has no valid contrapositive and the contrapositive of O is O.

4. Write notes on any three of the following: (See short and paragraph answers)
   a. Square of Opposition
   b. Conversion by limitation
   c. Obversion
   d. Contraposition
PART - A - Multiple-choice questions

For model questions, see the Question Bank.

PART - B Short answer questions

1) Define Syllogism. Or

Define categorical syllogism.
Any deductive argument in which a conclusion is drawn from two premises is a syllogism. It is the mediate inference in which the two premises jointly imply the conclusion. In a categorical syllogism, all propositions are categorical.
E.g. All planets revolve round the sun.
   Earth is a planet.
   Therefore, earth revolves round the sun.

2) Define pure hypothetical syllogism.

In pure hypothetical syllogism, all the propositions are hypothetical propositions.

For example,

If John catches the train then he will meet his family.
If he meets his family then the company will appoint a new person.
Therefore, if John catches the train then the company will appoint a new person.

3) Write a short note on the fallacy of undistributed middle.

In a valid categorical syllogism, the middle term must be distributed at least in one premise.

A syllogism that violates this rule is said to commit the fallacy of undistributed middle.

Eg:    All Europeans are self-centered.
       All Indians are self-centered.
   ∴  All Europeans are Indians.
Here the middle term ‘self-centered’ is undistributed in minor premise and major premise. Hence, the syllogism commits the fallacy of undistributed middle.

4) Define Existential Fallacy.

A syllogism having both the premises universal must have universal conclusion.

A syllogism with both universal premises and particular conclusion is considered as invalid and the fallacy here is called Existential fallacy. However, this rule was not there in the traditional logic.

All foxes are mammals.
All mammals are animals.
∴ Some animals are foxes.

5) State the valid moods of AAA.

There are four valid moods in first figure. They are,

1. A A A – BARBARA
2. A I I – DARII
3. E A E – CELARENT
4. E I O – FERIO

Here the first vowel stands for major premise, second for Minor premise and last for conclusion. For instance, BARBARA represents AAA, CELARENT is EAE and so on.

6) What is the standard form of a syllogism?

Syllogism is a mediate inference in which a new proposition is drawn from two given propositions taken jointly. The inferred one is the conclusion and the two given propositions are the premises. Jevons says “a syllogism is an act of thought by which from two given propositions we proceed to a third proposition, the truth of which necessarily follows from the truth of two given proposition.” In a categorical syllogism, there are three terms.

1) Minor term
2) Major term
3) Middle term
Minor term is the subject of the conclusion. The letter ‘S’ stands for minor term. Major term is the predicate of the conclusion represented as ‘P’. Middle term is the term that occurs in both premises but not in the conclusion. In other words, middle term is common to both major premise and minor premise. The letter ‘M’ stands for the middle term.

For example, 

All men are mortal.

Socrates is a man.

Socrates is mortal.

In this syllogism ‘Socrates’ is minor term (S). ‘Mortal’ is major term (P). ‘Man’ is middle term (M).

In syllogism, the premise in which the minor term occurs is known as minor premise. The premise in which major term occurs is known as major premise. So in the above example ‘All men are mortal’ is the major premise and ‘Socrates is a man’ is the minor premise. In a standard form of categorical syllogism, the major premise is stated first, then minor premise and last conclusion.

7) Distinguish between Modus Ponens and Modus Tollens.

The two forms of hypothetical syllogism are:

Modus Ponens (Constructive hypothetical syllogism)

It is a form of hypothetical syllogism in which the minor premise affirms the antecedent and the conclusion affirms the consequent.

Example: If a man is a Gandhian, then he is a vegetarian.

X is a Gandhian.

∴ X is a vegetarian.

Modus Tollens (Destructive Hypothetical Syllogism)

It is a form of hypothetical syllogism in which the minor premise denies the consequent and the conclusion denies the antecedent of major premise.

Example: If he is a thief, he will hide the goods.

He has not hidden the goods.

∴ He is not a thief.

8) Check the validity of the following syllogism.
All Gandhians are vegetarians.
Some Hindus are vegetarians.

∴ Some Hindus are Gandhians.

Here the middle term ‘vegetarians’ is undistributed in both the premises and hence the syllogism commits the fallacy of undistributed middle.

9) Briefly explain the valid moods of the second figure of a syllogism.

Valid Mood of 2\textsuperscript{nd}Figure: P M

\[
\begin{array}{c}
\text{S M} \\
\hline
\therefore \text{S P}
\end{array}
\]

Rules:

1. One premise must be negative. (Violation of this rule leads to fallacy of undistributed middle).
2. Major premise must be universal. (Violation leads to fallacy of illicit major).

There are four valid moods in second figure. They are,

1. A E E – \textit{CAMESTRES}
2. A O O – \textit{BAROCO}
3. E A E – \textit{CESARE}
4. E I O – \textit{FESTINO}

10) Define ‘dilemma’.

A dilemma is a mixed syllogism in which major premise consist of two hypothetical propositions, the minor premise is a disjunctive proposition and the conclusion is categorical or disjunctive. A dilemma is constructive when disjunctive minor premise affirms the antecedent of the major and destructive when it denies the consequent of the major premise.

PART - C - Paragraph answer questions

1) Define Syllogism and distinguish between pure and mixed syllogism.
A syllogism is a form of mediate deductive inference in which the conclusion is drawn from two premises taken jointly.

E.g. All men are mortal.
     All kings are men.
     ∴ All kings are mortal.

Here “All kings are mortal” is drawn not from any of the two premises singly, but it follows from them jointly.

Syllogism is classified into Pure and Mixed. In a Pure Syllogism, all the constituent propositions are of the same type. If all of them are categorical, the syllogism is pure categorical syllogism.

E.g. All men are mortal.
     X is a man.
     ∴ X is mortal.

If all of the propositions are hypothetical, then the syllogism is known as pure hypothetical. For example,

| If John catches the train then he will meet his family. |
| If he meets his family then the company will appoint a new person. |
| Therefore if John catches the train then the company will appoint a new person. |

In a Mixed Syllogism, the constituent propositions are of different kinds. Mixed syllogism is of three kinds:

1. Mixed Hypothetical syllogism: Here the major premise is hypothetical, the minor premise and the conclusion are categorical.

2. Disjunctive syllogism: Here the major premise is disjunctive, the minor premise and the conclusion are categorical.

3. Dilemma: In this case, the major premise is a compound hypothetical, the minor premise is disjunctive and the conclusion is either categorical or disjunctive.
2) Briefly explain the figures of a syllogism.

The figure of a syllogism means the form of a syllogism which is determined by the position of middle term in its two premises. Accordingly, there are four possible arrangements of middle term (M) in the two premises, and the figures of syllogism are as follows:

<table>
<thead>
<tr>
<th>1(^{st}) figure</th>
<th>2(^{nd}) figure</th>
<th>3(^{rd}) figure</th>
<th>4(^{th}) figure</th>
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<tr>
<td>M P</td>
<td>P M</td>
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</tbody>
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Special Canons of 1\(^{st}\) Figure

\[
M P
\]
\[
S M
\]
\[
\therefore S P
\]

In the first figure, middle term is the subject of major premise and predicate of minor premise.

2\(^{nd}\) Figure:

\[
P M
\]
\[
S M
\]
\[
\therefore S P
\]

In the second figure, the middle term is both predicate of major premise and minor premise.

3\(^{rd}\) Figure

\[
M P
\]
\[
M S
\]
\[
\therefore S P
\]

In the third figure, the middle term is both the subject of major and minor premise.

4\(^{th}\) Figure

\[
P M
\]

M S

\[ \therefore S \ P \]

In the fourth figure, the middle term is the predicate of the major premise and subject of the minor premise.

**Describe the moods of a Syllogism.**

The moods of a syllogism is determined by the quality and quantity of the constituent propositions. If all the three propositions of a syllogism are ‘A’ propositions, the mood of that syllogism is AAA.

Valid Mood of 1\text{st} figure: M P

\[ S \ M \]

\[ \therefore S \ P \]

**Rules:**

1. Major premise must be affirmative.
2. Major premise must be universal.

There are four valid moods in the first figure. They are,

1. A AA – **BARBARA**
2. A I I – **DARII**
3. E A E – **CELARENT**
4. E I O – **FERIO**

Valid Mood of 2\text{nd} Figure: P M

\[ S \ M \]

\[ \therefore S \ P \]

**Rules:**

3. One premise must be negative.
4. Major premise must be universal.
There are four valid moods in second figure. They are,

5. \( A\ E\ E - \text{CAMESTRES} \)
6. \( A\ O\ O - \text{BAROCO} \)
7. \( E\ A\ E - \text{CESARE} \)
8. \( E\ I\ O - \text{FESTINO} \)

Valid Moods of 3\textsuperscript{rd} Figure: \( M\ P \)

\[
\begin{array}{c}
M \ V \\
\hline
\therefore \ S\ P \\
\end{array}
\]

Rules:
1. Minor premise must be affirmative.
2. Conclusion must be particular.

There are six valid moods in the third figure. They are,

1. \( A\ A\ I - \text{DARAPII} \)
2. \( A\ I\ I - \text{DATISI} \)
3. \( E\ A\ O - \text{FELAPTON} \)
4. \( E\ I\ O - \text{FERISON} \)
5. \( I\ A\ I - \text{DISAMIS} \)
6. \( O\ A\ O - \text{BOCARDO} \)

Valid Moods of 4\textsuperscript{th} Figure: \( P\ M \)

\[
\begin{array}{c}
M \ V \\
\hline
\therefore \ S\ P \\
\end{array}
\]

Rules:
1. If one premise is negative, major premise must be universal.
2. If the major premise is affirmative, minor premise must be universal.

There are five valid moods in the fourth figure. They are,

1. \( A\ A\ I - \text{BRAMANTIP} \)
2. \( A\ E\ E - \text{CAMENES} \)
3. \( E\ A\ O - \text{FESAPQ} \)
4. \( E\ I\ O - \text{FRESISON} \)
5. **I A I – DIMARIS**

**4. Define hypothetical syllogism and explain the rules.**

In a hypothetical syllogism, one or all the propositions are hypothetical.

The rules of pure hypothetical syllogism are as follows:

i) Both of the premises should have one common categorical proposition.

ii) This common proposition is antecedent in one premise and consequent in other premise.

iii) The conclusion should not have this common term, but instead it should contain the antecedent of one premise as antecedent (other than the common term) and consequent other premise as consequent (other than the common term)

There are two valid forms of pure hypothetical syllogism. They are,

| If p then q | If John catches the train then he will meet his family. |
| If q then r | If he meets his family then the company will appoint a new person. |
| Therefore if p then r | Therefore, if John catches the train then the company will appoint a new person. |

| If q then r | If he meets his family then the company will appoint new person |
| If p then q | If john catches the train then he will meet his family |
| Therefore if p then r | Therefore if john catches the train then the company will appoint a new person |

**5. Give an account of Disjunctive Syllogism.**

A disjunctive syllogism is a mixed syllogism in which major premise is a disjunctive proposition (Alternatives are joined by either ---- or). The minor premise and conclusion are categorical propositions.

E.g. Ram is either mad or drunk.

He is not mad.

∴ He is drunk.
Rules

1) First premise is disjunctive proposition.

2) Second premise is negation of one of the disjuncts of major premise.

3) Conclusion is remaining disjunct or disjuncts.

A valid disjunctive syllogism can be one of the following types:

1) Either p or q  
   Not p  
   Therefore, q.

2) Either p or q  
   Not q  
   Therefore, p

6. Give an account of the methods of meeting a Dilemma.

A dilemma is a mixed syllogism in which major premise consist of two hypothetical propositions, the minor premise is a disjunctive proposition and the conclusion is categorical or disjunctive. A dilemma is constructive when disjunctive minor premise affirms the antecedent of major and destructive when it denies the consequent of major premise.

For a dilemma to be materially valid, we must show that all its constituent propositions agree with facts. In the major premise, there must be a real connection between the antecedent and consequent; and in the minor premise, the alternatives must be exhaustive. Nevertheless, it is very often found that dilemma does not conform to these material conditions. In most cases, the dilemma is materially false even though it may be formally correct. We can prove the material falsity of a dilemma in three ways.

i) By showing the defects of major premise (“Taking the dilemma by horns”).

The method is to show that there is no causal connection between the antecedent and consequent of major premise.

E.g. If a man is single, he would be unhappy and if he is married, he would be unhappy. 
    Either a man is single or married.
In either case, he would be unhappy.

Here there is no necessary connection between antecedent and consequent. The major premise is not true because there are people who are single and quite happy. Similarly, there are married people who are also happy. Therefore, the dilemma is proved false.

   ii) By showing the defect of minor premise (Escaping between the horns of dilemma).

The method is to show that alternatives of minor premise are not exhaustive. The rule states that the alternatives of minor premise must be exhaustive.

E.g. If students are intelligent, then there is no need of prizes and if students are idiots, then there is no need of prizes.

Students are either intelligent or idiots.

∴ There is no need of prizes.

This dilemma is formally valid but materially invalid because the alternatives of minor premise are not exhaustive. Here the average students to whom prize giving is effective are omitted.

   iii) Rebuttal

Rebutting a dilemma is by presenting a counter dilemma with the opposite conclusion of the original.

Rules

1. Transpose the consequent of major premise.

2. Change their quality.

   E.g. If you act justly, men will hate you, if you act unjustly, God will hate you. You must act either justly or unjustly. Therefore, either God will hate you or men will hate you.

   Rebuttal

   If you act justly god will love you, if you act unjustly men will love you.

   You must act either justly or unjustly. Therefore, either God will love you or men will love you.
7. Write a short note on fallacy of illicit process.

In a valid categorical syllogism, a term, which is distributed in the conclusion, must necessarily be distributed in the concerned premise.

A syllogism that violates this rule commits the fallacy of (a) Illicit major, and (b) Illicit minor.

a) Fallacy of illicit major – In a syllogism, if major term is undistributed in the major premise and distributed in the conclusion, the syllogism commits the fallacy of **illicit major**.

   All boys are mortal.
   No girls are boys.
   ∴ No girls are mortal.

This syllogism is invalid because major term mortal is undistributed in the major premise and distributed in the conclusion.

b) Fallacy of illicit minor – In a syllogism, if minor term is undistributed in the minor premise and distributed in the conclusion, the syllogism commits the fallacy of **illicit minor**.

   No Gandhians are communists.
   All Gandhians are vegetarians.
   ∴ No vegetarians are communists.

This syllogism is invalid because minor term vegetarian is undistributed in the minor premise and distributed in the conclusion.

**PART – D - Essay questions**

1) Define Syllogism and describe the rules and fallacies of pure categorical syllogism.

Syllogism is a mediate inference in which a new proposition is drawn from two given propositions taken jointly. The inferred proposition is called the conclusion and the two given propositions are called premises. Jevons says “a syllogism is an act of thought by which from two given propositions we proceeds to a third proposition , the truth of which is necessarily follows from the truth of two given proposition.” In a categorical syllogism, there are three terms.

1) Minor term
2) Major term
3) Middle term
Minor term is the subject of the conclusion. The letter S stands for minor term. Major term is the predicate of the conclusion and the letter P stands for the major term. Middle term is the term that occurs in both premises but not in the conclusion. In other words, middle term is common to both major premise and minor premise. The letter M stands for the middle term.

For example,  
All men are mortal.  
Socrates is a man.  
\therefore \text{Socrates is mortal.}

In this syllogism, ‘Socrates’ is the minor term (S). ‘Mortal’ is the major term (P). ‘Man’ is the middle term (M). The premise in which the minor term occurs is the minor premise. The premise in which major term occurs is the major premise. In the above example, ‘All men are mortal’ is the major premise and ‘Socrates is a man’ is the minor premise. In the standard form of categorical syllogism, the major premise is stated first, then minor premise and finally the conclusion.

The Rules of Syllogism

Formal validity of categorical syllogism depends on certain conditions which are called the rules or cannons of syllogism. There are six basic rules that must satisfied by a valid syllogism. If a syllogism violates any one of these rules, there arises a mistake in syllogistic reasoning. This is called a fallacy of syllogism which makes it invalid.

The rules may be classified as follows:

a) Rules related to structure
b) Rules related to distribution of terms
c) Rules related to quality
d) Rules related to quantity.

The rules related to structure

1) A categorical syllogism contains exactly three terms (minor, major and middle term), each of which is used twice in the same sense throughout the syllogism.

Violation of this rule leads to two types of fallacies:

i) Fallacy of four terms

ii) Fallacy of ambiguous use of terms (equivocation)
i) Fallacy of four terms

The rule states that a syllogism must contain three and only three terms. Any syllogism that contains more than three terms commits the fallacy of four terms.

For example,  
All crows are black.  
All cranes are white.  
∴ No crows are cranes.

ii) Fallacy of ambiguous use of terms (equivocation)

If a term is used in different sense in the same syllogism, the fallacy committed is known as the fallacy of equivocation or the fallacy of ambiguous use of terms. Fallacy of equivocation is known as fallacy of ambiguity because the terms are used in an ambiguous manner. There are three types fallacy of equivocation;

a) Fallacy of ambiguous major  
b) Fallacy of ambiguous minor  
c) Fallacy of ambiguous middle

Fallacy of ambiguous major

This fallacy occurs when the major term is used in different sense in major premise and conclusion.

For example,  
Light is essential to guide our steps.  
Lead is not essential to guide our steps.  
∴ Lead is not light.

Here major term ‘light’ is used in different senses. In the major premise, it is used in the sense of ‘brightness’ and in the conclusion it is used in the sense of ‘not heavy’. Hence, the syllogism commits the Fallacy of ambiguous major.

Fallacy of ambiguous minor

This fallacy occurs when the minor term is used in different senses in syllogism.

For example,  
No men is made up of paper.  
All pages are men.  
∴ No pages are men.
Here the minor term ‘page’ means male servant in the conclusion and side of paper in the minor premise. The syllogism commits the Fallacy of ambiguous minor.

**Fallacy of ambiguous middle**

This fallacy occurs when the middle term is used in different senses in syllogism.

For example, Food is indispensable to life.

\[ \text{Banana is food.} \]

\[ \therefore \text{Banana is indispensable to life.} \]

Here the middle term ‘food’ is used in different sense in major premise and minor premise.

**Rules related to structure**

2) In a valid categorical syllogism, the middle term must be distributed at least in one premise.

**Fallacy of undistributed middle**

A syllogism that violates this rule commits the fallacy of undistributed middle.

E.g. All Europeans are self-centered.

\[ \text{All Indians are self-centered.} \]

\[ \therefore \text{All Europeans are Indians.} \]

Here the middle term ‘self-centered’ is undistributed in minor premise and major premise. Hence, the syllogism commits the fallacy of undistributed middle.

3) In a valid categorical syllogism, a term which is distributed in the conclusion must be necessarily be distributed in the concerned premise.

A syllogism that violates this rule commits the fallacy of

i) Illicit major

ii) Illicit minor

**Fallacy of illicit major** – In a syllogism, if the major term is undistributed in the major premise and distributed in the conclusion, the syllogism commits the fallacy of illicit major.

\[ \text{All boys are mortal.} \]
No girls are boys.
∴ No girls are mortal.

This syllogism is invalid because major term ‘mortal’ is not distributed in the major premise, but it is distributed in the conclusion.

Fallacy of illicit minor – In a syllogism, if minor term is undistributed in the minor premise and distributed in the conclusion, the syllogism commits the fallacy of illicit minor.

No Gandhians are communists.
All Gandhians are vegetarians.
∴ No vegetarians are communists.

This syllogism is invalid because minor term ‘vegetarian’ is not distributed in the minor premise, but it is distributed in the conclusion.

Rules of Quality

4) From two negative premises no valid conclusion is possible.

Violation of this rule leads to the fallacy of two negatives or the fallacy of exclusive premises.

No men are perfect.
No men are immortal.
∴ No immortal beings are perfect.

5) If one premise of a syllogism is negative, the conclusion must be negative.

Violation of this rule commits the fallacy of drawing an affirmative conclusion from negative premise.

All athletes are strong built persons.
No strong built persons are lazy men.
∴ All lazy men are athletes.

Rules related to quantity

6) A syllogism having both the universal premises must have universal conclusion.
A syllogism having both universal premises and particular conclusion is considered as invalid and the fallacy occurs in the syllogism is called Existential fallacy. However, this rule was not there in the traditional logic.

- All foxes are mammals.
- All mammals are animals.
  \[ \therefore \text{Some animals are foxes.} \]

2) Explain the rules and fallacies of mixed hypothetical syllogism.

A hypothetical syllogism is a mixed syllogism in which the major premise is a hypothetical proposition; the minor and conclusion are categorical propositions.

Example: If a man takes poison, he will die.

  This man takes poison.

  Therefore, this man will die.

In the hypothetical major premise, there are two parts – antecedent and consequent. Antecedent is the part, which expresses a supposition or condition, and it is introduced by ‘if’. Consequent is the clause, which states the result that follows from the antecedent. Only if these two parts are necessarily connected as cause and effect, the hypothetical proposition becomes logical. In the above example, ‘if a man takes poison’ is the antecedent and ‘he will die’ is the consequent.

Rules of valid hypothetical syllogism

1. Affirm the antecedent in the minor premise and then affirm the consequent in the conclusion.
   
   If p, then q
   
   P
   
   \[ \therefore q \]

2. Deny the consequent in the minor and deny the antecedent in the conclusion.
   
   If p, then q
   
   Not q
   
   \[ \therefore \text{Not } p \]

There are two forms of hypothetical syllogism.

Modus Ponens (Constructive hypothetical syllogism)
It is a form of hypothetical syllogism in which the minor premise affirms the antecedent and the conclusion affirms the consequent.

Example: If a man is a Gandhian, then he is a vegetarian.

   X is a Gandhian.

   \( \therefore \) X is a vegetarian.

**Modus Tollens** (Destructive Hypothetical Syllogism)

It is a form of hypothetical syllogism in which the minor premise denies the consequent and the conclusion denies the antecedent of major premise.

Example: If he is a thief, he will hide the goods.

   He has not hidden the goods.

   \( \therefore \) He is not a thief.

**Fallacies of Hypothetical syllogism**

Two fallacies may occur in hypothetical syllogism.

**Fallacy of denying the antecedent**

When the minor premise denies the antecedent of major premise instead of denying the consequent, the hypothetical syllogism commits the fallacy of denying the antecedent.

   If \( p \), then \( q \)
   
   Not \( p \)

   \( \therefore \) Not \( q \)

Example: If a man is industrious, he will be successful.

   X is not industrious.

   \( \therefore \) X is not successful.

**Fallacy of affirming the consequent**

When the minor premise affirms the consequent of major premise instead of affirming the antecedent, hypothetical syllogism commits the fallacy of affirming the consequent.

   If \( p \) then \( q \)

   \( q \)

   \( \therefore \) \( p \)

Example: If a man is deaf, he talks loud.
This man talks loud.
∴ He is deaf.

3) Define ‘dilemma’ and bring out the methods of meeting a dilemma.

A dilemma is a mixed syllogism in which the major premise consists of two hypothetical propositions, the minor premise is a disjunctive proposition and the conclusion is categorical or disjunctive proposition. A dilemma is constructive when disjunctive minor premise affirms the antecedent of major and destructive when it denies the consequent of major premises

Different Types of Dilemma

a) Simple/complex - In simple dilemma conclusion is a categorical proposition. In complex dilemma the conclusion is a disjunctive proposition.

b) Constructive/destructive - if the minor premise affirms the antecedents, dilemma is constructive. If the minor premise denies the consequences, then dilemma is destructive

Thus, there are four types of dilemma -

1) Simple constructive dilemma
2) Complex constructive dilemma
3) Simple destructive dilemma
4) Complex constructive dilemma

Simple constructive dilemma

E.g. If the authorities are lenient, they are criticized and if they are strict, they are criticized.

Either authorities are lenient or they are strict.
∴ They are criticized.

If A is B, C is D and E is F, C is D.

Either A is B or E is F.
∴ C is D

This is simple because, the conclusion is a categorical proposition and constructive because minor premise affirms the antecedents
Complex constructive dilemma

<table>
<thead>
<tr>
<th>E.g. If the salaries are increased, the economy is adversely affected and If the salaries are not increased there will be wide spread agitation.</th>
<th>Either the salaries are increased or not increased.</th>
<th>∴ Either the economy is adversely affected or there will be wide spread agitation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>If A is B, C is D and E is F, G is H.</td>
<td>Either A is B or E is F.</td>
<td>∴ Either C is D or G is H.</td>
</tr>
</tbody>
</table>

This is Complex because the conclusion is a disjunctive and constructive because Minor premise affirms the antecedents.

Simple destructive dilemma

<table>
<thead>
<tr>
<th>E.g. if I am to continue in politics, I must feel able to support my conviction and if I am to continue in politics, I must support my party.</th>
<th>I must either act against my party not support my convictions</th>
<th>I cannot continue in politics.</th>
</tr>
</thead>
<tbody>
<tr>
<td>If A is B, C is D and if A is B, E is F.</td>
<td>Either C is not D or E is not F.</td>
<td>∴ A is not B.</td>
</tr>
</tbody>
</table>

This is simple because, the conclusion is a **categorical proposition** and destructive because the minor premise denies consequences.

Complex destructive dilemma

<table>
<thead>
<tr>
<th>If your education is broad, you can read anything and if you are virtuous, you have not read immoral literature.</th>
<th>Either you have not read anything or you have read immoral literature.</th>
<th>Either your education is not broad or you are not virtuous.</th>
</tr>
</thead>
<tbody>
<tr>
<td>If A is B, C is D and E is F, G is H.</td>
<td>Either C is not D or G is H.</td>
<td>∴ A is not B.</td>
</tr>
</tbody>
</table>

This is Complex because, the conclusion is a disjunctive and destructive.
Either A is not B or E is F.

This is complex because the conclusion is a disjunctive proposition and it is destructive because the minor premise denies the consequences.

Formal Validity of Dilemma

In order to test the formal validity of dilemma, we must follow the rules of hypothetical syllogism - Affirming the antecedents and affirming the consequents. Denying the consequents and denying the antecedents.

For a dilemma to be materially valid, all its constituent propositions should agree with facts. In the major premise, there must be a real connection between the antecedent and consequent; and in the minor premise, the alternatives must be exhaustive. However, it is very often found that dilemma does not conform to these material conditions. In most cases, the dilemma is materially false even though it may be formally correct. We can prove the material falsity of a dilemma in three ways.

i) By showing the defects of major premise (“Taking the dilemma by horns”)

The method is to show that there is no causal connection between the antecedent and consequent of major premise.

E.g. If a man is single, he would be unhappy and if he is married, he would be unhappy.

   Either a man is single or married.

   In either case, he would be unhappy.

Here there is no necessary connection between the antecedent and the consequent. The major premise is not true because there are people who are single and quite happy. Similarly, there are married people who are also happy. Therefore, the dilemma is proved false.

ii) By showing the defect of minor premise (Escaping between the horns of dilemma)

The method is to show that alternatives of minor premise are not exhaustive. The rule states that the alternative, of minor premise must be exhaustive.

E.g. If students are intelligent, then there is no need of prizes and if students are idiots, then there is no need of prizes.

   Students are either intelligent or idiots.
There is no need of prizes

This dilemma is formally valid but materially invalid because the alternatives of minor premise are not exhaustive. Here the average students to whom prize giving is more effective are omitted.

iii) Rebuttal

Rebutting a dilemma is by presenting a counter dilemma with the opposite conclusion of the original.

Rules

1. Transpose the consequent of major premise.
2. Change their quality.
   
   E.g. If you act justly, men will hate you, if you act unjustly, God will hate you. You must act either justly or unjustly. Therefore, either God will hate you or men will hate you.

   Rebuttal

   If you act justly god will love you, if you act unjustly men will love you.
   
   You must act either justly or unjustly. Therefore, either God will love you or men will love you.

Only a complex constructive dilemma can be rebutted.

4. Write notes on the following: (See short and paragraph answers)
   a) The structure of syllogism
   b) Disjunctive syllogism
   c) Categorical syllogism
   d) Hypothetical syllogism
   e) Figure and moods of syllogism
   f) Rebuttal of dilemma
   g) Figures and Moods
PART A - Multiple-choice questions

For model questions, see the Question Bank.

PART B - Short answer questions

1. Which are the material grounds of induction?

Observation and experiment form the material grounds of induction. Observation involves the attentive perception and study of phenomena as they occur. In experiment, conditions to be observed are arranged artificially. Hence, experiment involves observation of phenomena under controlled conditions. In sciences like astronomy and geology, observation is the common method, but in most of the physical sciences like chemistry, experiment is widely used.

2. Define observation.

Observation is a material ground of inductive reasoning that involves the direct perception and understanding of a given phenomenon. Observation involves watching with attention the phenomena as they occur in nature. Observation is a keen process that requires special skill for selecting the necessary things for making a hypothesis. In most of the scientific investigation, observation and experiment are used in combination, but in areas like astronomy and geology, observation is used independently.

3. Define experiment.

Experiment is a material ground of inductive reasoning that involves the observation of a given phenomenon under artificially set conditions. Hence, in experiment conditions can be controlled and regulated as required for making a hypothesis. In observation, the scientist has to wait for the conditions to occur, but in experiment, the scientist can create the conditions in a laboratory and repeat them as and when required.

4. Distinguish between observation and experiment. Or

Summarize the advantages of experiment over observation.

Observation and experiment form the material grounds of induction. They are different but complementary means to form hypotheses. Observation involves the attentive perception and study of phenomena as they occur. In experiment, conditions to be observed are arranged artificially. In observation, the scientist has to wait for the expected conditions to occur naturally. Hence, observation is mostly a time-consuming process. In experiment, one can set the conditions as desired. It is possible to isolate, change and multiply the conditions at will.
Experiment gives quicker results and makes observation more accurate. Anyway, experiment is not fulfilled without observation.

5. **State the problem of induction. Or**
   **Define ‘inductive leap’.

Inductive reasoning involves generalization from particular or individual instances. Normally, we infer a general truth about a class based on a set of observed instances. Here it is necessary to apply what is already observed to what is yet to be observed. For example, it is not possible to observe all the human beings before we conclude that all humans are mortal. Hence, in induction it is necessary to make a leap or jump from the observed phenomena to an unobserved phenomenon. This is the problem of induction known as inductive leap.

6. **Give a brief account of the postulates of induction.**

There are definite laws or axioms that guide inductive reasoning. They are in fact the laws of nature namely the Law of Uniformity of Nature and the Law of Causation. Both are different ways of expressing the necessary order and regularity of natural phenomena. According to the Law of Uniformity of Nature, everything in the world forms a coherent whole and there is a systematic unity between things and events. According to the Law of Causation, every event has a cause and nothing is uncaused. Nothing happens by chance. It is obvious that the Law of Causation implies the Law of Uniformity of Nature.

7. **Define hypothesis and bring out its significance.**

A hypothesis is a tentative conclusion about a given phenomenon based on observed facts. It is only a provisional explanation of a fact. There will be different hypotheses, which are to be verified to prove only one of them to be good/valid/legitimate. The formation, verification and testing of hypotheses is fundamentally important in scientific investigation which is necessary for all natural and social sciences. In day-to-day life also we make use of hypotheses in solving difficult problems.

8. **Give a brief account of the stages of hypothesis.**

A hypothesis is a tentative conclusion about a given phenomenon based on observed facts. The formation of hypothesis begins with the observation of the necessary facts. It is followed by the colligation and analysis of the collected data. Then the hypothesis is to be tested and verified by deducing consequences from it. The final stage is proving the hypothesis by demonstrating that not only the consequence ‘E’ occurs from the cause ‘C’ but also E does not occur in the absence of C.

**PART - C - Paragraph answer questions**

1. **Describe the material grounds of induction. Or**
   **Distinguish between observation and experiment.**
Inductive reasoning begins with the observation of the necessary facts required for deriving a hypothesis. For this, a scientist uses two distinct but complementary methods namely observation and experiment. Hence, they together form the material grounds of induction. Observation involves the direct perception and understanding of a given phenomenon. Experiment involves controlled observation of a given phenomenon under artificially set conditions. In observation, the scientist has to wait for the conditions to occur, but in experiment, the scientist can create the conditions in a laboratory and repeat them as required. In experiment, the scientist can isolate the conditions essential for the study. Experiment gives more precision in results and it is quicker than observation. Anyway, observation and experiment are complementary basis of inductive reasoning and in combination they make scientific investigation more efficient and successful.

2. Bring out the postulates of induction.

As we have observation and experiment as the material grounds of induction, there are also definite laws or axioms that guide inductive reasoning. They are in fact the laws of nature namely the Law of Uniformity of Nature and the Law of Causation. Both are different ways of expressing the necessary order and regularity of natural phenomena. Creighton says, “Things not only are together, but belong together. According to the Law of Uniformity of Nature, everything in the world forms a coherent whole and there is a systematic unity between things and events. According to the Law of Causation, every event has a cause and nothing is uncaused. Nothing happens by chance. It is obvious that the Law of Causation implies the Law of Uniformity of Nature. Logicians insist that a good hypothesis should not contradict these axioms of inductive reasoning.

3. Bring out the stages of hypothesis.

A hypothesis is the tentative conclusion about a given phenomenon based on observed facts. Normally, scientific investigation will lead to more than one hypothesis. It is necessary to confirm the valid one among these rival hypotheses and to give up the invalid ones. Inductive reasoning begins with observation and experiment as the material grounds. Scientific investigation in any field of study begins with the observation of the necessary facts and leads to the formation of a set of probable hypotheses. Observation/experiment is followed by the colligation and analysis of the collected data. Then the hypothesis is to be tested and verified by deducing consequences from it. A hypothesis withstands the test only if it can produce the expected consequences and results. The final stage of inductive reasoning is proving the hypothesis. By verification, we can show that the consequence ‘E’ occurs from the cause ‘C’. To prove the hypothesis, it is also necessary to demonstrate that E does not occur in the absence of C.

4. Define hypothesis and bring out its significance.

A hypothesis is a tentative conclusion about a given phenomenon based on observed facts. It is only a provisional explanation of a fact. There will be different hypotheses, which are to be
verified to prove only one of them to be good/valid/legitimate. The formation, verification and testing of hypotheses is fundamentally important in scientific investigation which is necessary for all natural and social sciences. In day-to-day life also we make use of hypotheses in solving difficult problems. Hypotheses are necessary for the advancement of knowledge in all walks of life and in all fields of study. Hypotheses are formed through observation and experiment, but at the same time, they are also necessary guides to efficient observation and experiment. For example, Darwin’s observations of biological evolution were indeed based on his hypothetical presuppositions.

5. Bring out the conditions of a valid hypothesis.

A good/valid hypothesis should be a logically consistent and practically workable explanation of the given phenomenon. It should explain the facts that we analyze. Hence, a valid hypothesis should be consistently explanatory. A valid hypothesis should be verifiable with reference to empirical facts. A good hypothesis should be the basis of further deductive inferences. If a hypothesis states that A is the cause of B, it must be the ground for predicting B from any further instance of A. A hypothesis is considered good only if it satisfies the standards of relevance. Hence, a good hypothesis should be purposeful and useful in solving a problem. For example, the knowledge of insulin deficiency as the cause of diabetes has made possible the effective treatment of the disease. A vague hypothesis cannot be a good one and hence a good hypothesis must be clear and conceivable. Finally, a valid hypothesis is not supposed to go against previously established truths in the field of knowledge.

Copi and Cohen have identified three conditions to decide the merit of rival hypotheses:

i) Compatibility with previously established hypotheses
ii) Predictive power and
iii) Simplicity.

PART – D - Essay questions

1. Describe the material grounds of induction and bring out the problem of induction. Or

Bring out the nature and scope of scientific method.

The aim and task of a scientist is to explain a phenomenon with reference to a law or general principle. Hence, scientific investigation begins with inductive reasoning based on the observation of the necessary facts required for deriving a hypothesis. For this, a scientist uses two distinct but complementary methods namely observation and experiment. Hence, they together form the material grounds of induction. Observation involves the direct perception and understanding of a given phenomenon. Experiment involves controlled observation of a given phenomenon under artificially set conditions. In observation, the scientist has to wait for the conditions to occur, but in experiment, the scientist can create the conditions in a laboratory and repeat them as required. In experiment, the scientist can isolate the conditions essential for the study. Experiment gives more precision in results and it is quicker than observation. Anyway, observation and experiment are complementary basis of inductive reasoning and in combination they make scientific investigation more efficient and successful.
Inductive reasoning involves generalization from particular or individual instances. Normally, we infer a general truth about a class based on a set of observed instances. Here it is necessary to apply what is already observed to what is yet to be observed. For example, it is not possible to observe all the human beings before we conclude that all humans are mortal. Hence, in induction it is necessary to make a leap or jump from the observed phenomena to an unobserved phenomenon. This is the problem of induction known as inductive leap.

Scientific investigation in any field of study begins with the observation of the necessary facts and leads to the formation of a set of probable hypotheses. Observation/experiment is followed by the colligation and analysis of the collected data. Then the hypothesis is to be tested and verified by deducing consequences from it. Hence, scientific method is termed hypothetico-deductive as it begins with inductive reasoning and produces a hypothesis that makes further deductions possible. A hypothesis withstands the test only if it can produce the expected consequences and results. The final stage of inductive reasoning is proving the hypothesis. By verification, we can show that the consequence ‘E’ occurs from the cause ‘C’. To prove the hypothesis, it is also necessary to demonstrate that E does not occur in the absence of C.

2. Define hypothesis and bring out its various stages. Add a note on the significance of hypothesis.

The aim and task of a scientist is to explain a phenomenon with reference to a law or general principle. Hence, scientific investigation begins with inductive reasoning based on the observation of the necessary facts required for deriving a hypothesis. For this, a scientist uses two distinct but complementary methods namely observation and experiment. Hence, they together form the material grounds of induction. A hypothesis is a tentative conclusion about a given phenomenon based on observed facts. It is only a provisional explanation of a fact. There will be different hypotheses, which are to be verified to prove only one of them to be good/valid/legitimate.

Hypothesis - The stages

Normally, a scientific investigation will lead to more than one hypothesis. It is necessary to confirm the valid one among these rival hypotheses and to give up the invalid ones. Inductive reasoning begins with observation and experiment as the material grounds. Scientific investigation in any field of study begins with the observation of the necessary facts and leads to the formation of a set of probable hypotheses. Observation/experiment is followed by the colligation and analysis of the collected data.

Then the hypothesis is to be tested and verified by deducing consequences from it. A hypothesis withstands the test only if it can produce the expected consequences and results. The final stage of inductive reasoning is proving the hypothesis. By verification, we can show that the consequence ‘E’ occurs from the cause ‘C’. To prove the hypothesis, it is also necessary to demonstrate that E does not occur in the absence of C. Hence, scientific method is termed
hypothetico-deductive as it begins with inductive reasoning and produces a hypothesis that makes further deductions possible. Copi and Cohen have listed the following seven steps in hypothetico-deductive process:

1. Identifying the Problem

2. Devising Preliminary Hypotheses

3. Collecting Additional Facts

4. Formulating the Explanatory Hypothesis

5. Deducing Further Consequences

6. Testing the Consequences

7. Applying the Theory.

Hypothesis - The significance
The formation, verification and testing of hypotheses is fundamentally important in scientific investigation which is necessary for all natural and social sciences. In day-to-day life also we make use of hypotheses in solving difficult problems. Hypotheses are necessary for the advancement of knowledge in all walks of life and in all fields of study. Hypotheses are formed through observation and experiment, but at the same time, they are also necessary guides to efficient observation and experiment. For example, Darwin’s observations of biological evolution were indeed based on his hypothetical presuppositions.

The process of testing and proving hypotheses finally establishes one of them to be valid and good. The practical value of this proven hypothesis is important not only in sciences but also in our everyday life. For example, the knowledge of insulin deficiency as the cause of diabetes has made possible the effective treatment of the disease.

3. Define hypothesis and bring out the conditions of a valid hypothesis.

The aim and task of a scientist is to explain a phenomenon with reference to a law or general principle. Hence, scientific investigation begins with inductive reasoning based on the observation of the necessary facts required for deriving a hypothesis. For this, a scientist uses two distinct but complementary methods namely observation and experiment. Hence, they together form the material grounds of induction. A hypothesis is a tentative conclusion about a given phenomenon based on observed facts. It is only a provisional explanation of a fact. There will be different hypotheses, which are to be verified to prove only one of them to be good/valid/legitimate.
A good hypothesis should be a logically consistent and practically workable explanation of the given phenomenon. It should explain the facts that we analyze. Hence, a valid hypothesis should be consistently explanatory.

A valid hypothesis should be verifiable with reference to empirical facts. A good hypothesis should conform to the facts and conditions observed further. Hence, a hypothesis is to be tested and verified by deducing consequences from it. A hypothesis is valid only if it can produce the expected consequences and results.

A hypothesis is considered good only if it satisfies the standards of relevance. Hence, a good hypothesis should be purposeful and useful in solving a problem. For example, the knowledge of insulin deficiency as the cause of diabetes has made possible the effective treatment of the disease.

A vague hypothesis cannot be a good one and hence a good hypothesis must be clear and conceivable.

Finally, a valid hypothesis is not supposed to go against previously established truths in the field of knowledge.

Copi and Cohen have identified three conditions to decide the merit of rival hypotheses:

i) Compatibility with previously established hypotheses - A hypothesis to be valid shall not contradict already established truths of science. This makes science a continuous search for truth. Anyway, there are cases in which a new hypothesis has disproved an older established hypothesis. For example, Einstein’s Relativity Theory had replaced some aspects of Newton’s theory.

ii) Predictive power - When there are many different hypotheses of a phenomenon, it is right to accept the one with greater predictive power.

iii) Simplicity - When we have two rival hypotheses that satisfy the above two conditions, it is right to favour the one that is simpler than the other.

Sciences progress through the proper use of its hypothetico-deductive method. For this, it is necessary to identify the legitimate and valid hypothesis and to eliminate the invalid and irrelevant hypotheses.
UNIVERSITY OF CALICUT
BA DEGREE (SDE) EXAMINATION
PHILOSOPHY
SECOND SEMESTER
PHL2B02 - LOGIC AND SCIENTIFIC METHOD

Time: Three hours                                                                                                        Maximum: 80 Marks

PART A
Multiple-choice questions
Answer all questions. Each question carries ½ marks.

1. ---------- is the science of correct thinking.
   (a) Ethics       (b) Psychology   (c) Logic            (d) Aesthetics
2. A logical sentence is called-----------.
   (a) Proposition   (b) Syllogism    (c) Preposition   (d) Clause
3. The study of logic helps us to avoid ----------- in reasoning.
   (a) errors        (b) correctness    (c) opposition   (d) none of these
4. A and O propositions are ____________.
   a) contradictories b) contraries       c) sub-contraries   d) subalterns
5. Modus ponens is a mood of ----------- syllogism.
   (a) disjunctive        (b) categorical (c) hypothetical   (d) none of these.
6. -------------- is an immediate inference.
   (a) Connotation       (b) Denotation    (c) Conversion    (d) None of these
7. A hypothesis is a --------------- theory.
   (a) probable          (b) barren         (c) working       (d) wrong
8. A dilemma is a --------------- syllogism.
   (a) mixed             (b) conditional    (c) hypothetical   (d) categorical.
9. Truth and falsity are the characteristics of-----------.
   (a) sentences         (b) propositions  (c) arguments       (d) All these
10. A syllogism has only -------- terms.
    (a) four             (b) three            (c) two            (d) none of these

(10 x ½ = 5 marks)

PART B
Short answer questions
Answer any five out of eight questions. Each question carries three marks.

Write short notes on:

11. The scope of logic
12. Normative science
13. Connotation
14. Proposition
15. Eduction
16. Law of Uniformity of Nature
17. Obversion
18. Barren hypothesis

(5 x 3 = 15 marks)
PART C
Paragraph answer questions. Answer any six out of nine questions. Answer not to exceed 100 words. Each question carries five marks.
19. Bring out the relationship between psychology and logic.
20. Explain the uses of studying logic.
21. Write a note on the opposition of propositions.
22. What is meant by the quality and quantity of a proposition?
23. State and explain the rules of obversion.
24. Explain the figure and mood of a syllogism.
25. Bring out the fallacies of hypothetical syllogism.
26. Define ‘induction’ and explain the problem of induction.
27. Elucidate the characteristics of a good hypothesis.

(6 x 5 = 30 marks)

PART D
Essay questions. Answer any two out of four questions. Answer not to exceed 1000 words. Each question carries 15 marks.
28. Explain the classification of proposition with examples.
29. State and explain the rules of categorical syllogism.
30. What is dilemma? Explain the four types of dilemmas.
31. Describe the different stages of a hypothesis.

(2 x 15 = 30 marks)