PHPDSC201

LOGIC I

UNIT I

Understanding the structure of arguments, Deductive and Inductive reasoning, laws of thought

1. Write a note on the form of argument.

Ans:- In logic an argument is a set of one or more declarative sentences known as the premises along with another meaningful declarative sentence known as the conclusion. A deductive argument asserts that the truth of the conclusion is a logical consequence of the premises, an inductive argument asserts that the truth of the conclusion is supported by the premises. Deductive arguments are valid or invalid. and sound or not sound. An argument is valid if and only if the truth of the conclusion is a logical consequence of the premise and its corresponding conditional is necessarily true. A sound argument is a valid argument with true premises.

2. Distinguish between argument and argument form?

Ans: - By the form of an argument is meant the way in which the different mutually related propositions are structured . e.g.,

A. If the sun rises then we get light
   The sun rises
   ∴ We get light.
B. If we read then we will pass.
   we read
   ∴we pass.

If both these arguments are symbolised then we have the same form though their subject matter is different. Let us take another example -

A. If we read then we will pass.
   we read
   ∴we pass
B. Either Ram will come or Hari will come.
   Ram will not come.
   ∴ Hari will come will come

These two arguments are different from matter and form both. We are concerned, with the forms only in symbolic logic and not in any way with their subject matter. Symbolic logic replaces the words by variables.

3. Distinguish between argument and reasoning .

Answer: Reasoning is a mental process but when expressed in language it is called an argument. Every argument is expressed in a premise – conclusion structure.

4. What are the characteristics of deductive reasoning ?

Answer: 1. The conclusion follows from one or more premises.

2. The conclusion necessarily follows from premises as the conclusion is implicitly contained in the premise.

3. The conclusion cannot be more general than the premises as the conclusion necessarily follows from the premises.

4. As the conclusion is implicitly contained in the premises and necessarily follows from the premises, so if the premises are true the conclusion must be true.

5. It is not concerned with the material truth of the conclusion if the conclusion necessarily follows from the premises by following all the rules of the premises, the reasoning will be formally true or valid.

5. What are the characteristics of inductive reasoning ?

Answer – 1. The conclusion follows from more than one premise.

2. As the conclusion is not implicitly contained in the premises, so the conclusion does not necessarily follow from the premises.

3. The conclusion is more general than the premises.

4. As the conclusion goes beyond the premises, so the truth of the premises cannot prove the truth of the conclusion.

5. Although the conclusion of the inductive argument cannot prove the truth, yet it can help in the discovery of truth.

6. Distinguish between deductive and inductive reasoning .

Answer: 1. Deductive reasoning is mainly an reasoning from the general to the particular. On the other hand, inductive reasoning is reasoning from the particular to general.

2. In deductive reasoning the conclusion necessarily follows from the premises but in inductive reasoning the conclusion does not necessarily follows.

3. The conclusion of a deductive reasoning cannot be more general than the premises. But the conclusion of an inductive reasoning is always more general than the premises.

4. Deductive reasoning is concerned with the formal truth or validity. Inductive reasoning on the other and is concerned with material truth of the constituent proposition.

5. In a deductive reasoning the conclusion cannot go beyond the premises but in inductive reasoning the conclusion goes beyond the premises.

6. What are the three laws of thought?

Ans: The rules of logic are nearly 2500 years old and date back to Plato and Aristotle who set down the three laws of thought: identity, non-contradiction, and excluded middle. The use of language and logic has been adequate for us to develop mathematics, prove theorems, and create scientific knowledge.

7. What is the law of thought?

Ans: According to the 1999 Cambridge Dictionary of Philosophy, laws of thought are laws by which or in accordance with which valid thought proceeds, or that justify valid inference, or to which all valid deduction is reducible.

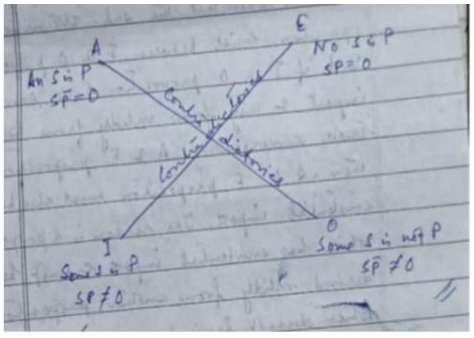
Unit II

Existential Import, Boolean Square of Opposition, Exercises based on Square of Opposition

1. Explain Boolean symbolisation of categorical proposition or Boolean square of opposition.

Ans: The Boolean interpretation of categorical proposition depends on the notion of empty class. It is the notion of an convenient to have a special symbol to represent it. For this purpose we use the symbol (zero) '0' to say that the class denoted by the term 'S' has no members, we write an equal sign between S and (zero) '0'. To assert that there are 'S's is to deny the proposition symbolised by "S=0" . We symbolise that denial by drawing a slanting line through me equality sign. Thus, the inequality S ≠0, saysthat there are S's. Standard form Categorical proposition refer to two classes, where each of two classes is already designated by a Symbol. The class of all things that belonged to them can be represented by just opposing the symbols for the two original classes.

Now, we can symbolise 'E' & ' I' propositions as equations and inequalities. The "E' proposition, 'No S is p' says that no members of class S are members of class P. It means that product of the two classes is empty which is symbolised by the equation 'SO = 0". The 'I proposition 'Some S is P ' says that at least one member of S is also member of P. This means that the product of the classes S & P is not empty and is symbolised by the inequality "SP ≠0" (zero). To symbolise



A & O propositions, it is inconvenient to introduce a new method of representing class compliments. The compliments of the class “All men” is the class of all things that all are not men, where the letter ‘S’ symbolises the class of “all men”. We symbolise the class of all non-men by S bar. The 'A' proposition, ‘All S is P’ says that all members of the class S are also members of the class P. It is symbolised by the equation, SP(bar) = 0. "The O' proposition 'Some S is not P’, which is logically equivalent to I proposition 'Some S is non-p’ is symbolised by the inequality SP(bar) ≠ 0. It is obvious that A and O propositions are contradictory, when they are symbolised as SP = 0 and SP(bar) ≠ 0. And it is equally obvious that E' & 'I' propositions are Symbolised SP = 0, SP(bar) ≠ 0 are contradictory.

2. Write a note on existential import and it’s impact on the traditional square of opposition.

Ans:- A proposition is said to have “existential import” if it asserts the existence of objects of some kinds, e.g., “There are books on my desk” has existential import because it asserts the existence of books on my table. But the proposition “There are no ghosts” has existential Import because this proposition does not assert existence of ghost. The difficulty can be appreciated when we consider ‘I’ and '0' propositions.

These propositions have existential import because these propositions say that there exists at least member. But if that be so, we face a problem. The opposition which exists between A & I proposition follows validly from its corresponding A proposition. We also know that the sub-alternation opposition exist between E and 0 proposition. But if I & O proposition have existential import & they follow validly from their corresponding A & E propositions then A& E proposition must also have existential import. The reason is a proposition which has existential import cannot be derived validly from another proposition which does not have such existential import.

Now there arises a problem which is very serious. According to the traditional square of opposition A & O propositions are contradictories. We know that two contradictories cannot both be true or false at the same time. But if the corresponding A and 0 propositions have existential import as mentioned above then both contradictions could be false. This means that there is some defect in the traditional square of opposition. According to the traditional square of opposition A & E propositions validly imply their corresponding I and 0 propositions. If it is correct then A & O propositions cannot be contradictories & in that case square is not correct.

To rid the traditional square of difficulties, the notion of pre- supposition has been introduced. We may say that, A, E, I, O pre- suppose that the classes to which they refer are not empty classes, they have members. The existential pre- supposition is criticized on the following ground :

(a) If We make me pre-supposition we shall never be in a position to assert proposition that denies that the class has members.

(b) Some propositions are there in which it is not supposed that the class has members.

(c) Often we reason without making any pre-suppositions as as we do in science and other theoretical studies.

Such criticisms show that we cannot accept the blanket existential pre-suppositions.

3. What do you mean by square of opposition?

Ans: This is one type of immediate inference because in this type of inference conclusion is drawn from one premise only. Eduction is another word used for immediate inference Opposition is a kind of logical relation

wherein propositions ‘stand against’ one another in terms of truth-value when they have the same subject and the same predicate, but differ in quantity or quality or both. Traditional logic called this relation square of opposition because these relations are represented by a square. Four such relations are discussed in Aristotelian system.

1. Contradiction: When two propositions differ in both ‘quantity’ and ‘quality’, the relation is called contradiction, e.g. ‘All men are wise’ (A) – ‘Some men are not wise’ (O). It is the most complete form of logical opposition because they are neither true nor false together. If one is true, the other is necessarily false and vice versa. This sort of self - contradiction is due to incompatibility between respective statements. Similarly, the statements, ‘No men are wise’ (E) – ‘Some men are wise’ (I) are contradictory.

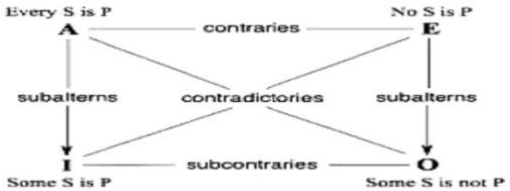
2. Contrariety: When two universal propositions differ only in ‘quality’, the opposition is called contrary; e.g. ‘All men are wise’ (A) – ‘No men are wise’ (E). By definition, both contraries can be false – precisely as in the example given – but they cannot be true at the same time. If one of them is true, the other must necessarily be false, but if one is false, the other may be true or false. One kind of proposition called singular proposition (also called simple), whose S is proper name, has no contrary and its contradiction differs only in quality. One example is ‘Jo is bad – Jo is not bad’. Another example is ‘The author of Hamlet, is an Englishman and ‘The author of Hamlet’ is not an Englishman.

3. Subcontrariety: When two particular propositions differ only in ‘quality’, the opposition is called subcontrariety. E.g. ‘Some men are wise’ (I) – ‘Some men are not wise’ (O). Subcontrary propositions can be true together – as in the example given, but they cannot be false at the same time. If one of them is true, the other may be true or false, but if one of them is false, the other must necessarily be true. The inverse order of ‘contrary’ and ‘subcontrary’ propositions is evident.

4. Subalternation: When two propositions differ only in 'quantity' (one is universal and the other is particular), the opposition is called subalternation, e.g. 'All men are wise' (A) - 'Some men are wise' (I). Notice that 'subaltern' propositions can be true together or false together. And this is to say that though from the truth of the universal, one can infer the truth of the particular the reverse order does not hold, namely that from the truth of the particular, one cannot infer the truth of the universal. On the other hand, though from the falsity of the particular, one can infer the falsity of the universal, one cannot infer the falsity of the particular from the falsity of the universal.

This type of relation is expressed in the form of a square.

The following two schemes and one diagram offer visual aid to retain more easily in mind what we have just said about the 'opposition' of propositions:



For the sake of simplicity the truth relation which holds good between various relations provided in a nutshell. between various relations is :

Inferences in Subalternation

From truth of universal → truth of particular

From truth of particular→ truth of universal

From falsity of particular →falsity of universal

From falsity of universal → falsity of particular

→: Can infer

→:Cannot infer

4. Mnemonic Device for remembering the Square of Opposition (Lander University, Greenwood).

Ans: A. If you picture God at the top of the square of opposition and Devil at the bottom of the square and remember the phrase 'both cannot be ...' for contraries and subcontraries, the following memonic device might be helpful.

B. The big 'X' across the center of the Square represents contradictories with opposite truth -values. This should be very easy to remember.

C. Since God (or truth) is at the top of the diagram, both “contraries cannot be true."

D. Since the Devil (or falsity) is at the bottom of the diagram, both subcontraries cannot be false'.

E. With subalternation, God can send truth down, but we cannot know what it means for God to send falsity down (hence this would be indeterminate).

But, the Devil can send falsity up (since this is what Devils are good at), and we cannot know what it means for the Devil I to send truth up. So this relation is indeterminate.

'Bouncing Around the Square of Opposition."

Suppose we know that O (Some S is not P) is false. In how many ways can we determine the truth value of 1 ('Some S is P')?

There are four ways of determining the truth-value. These four ways consist in travelling between different points (here the propositions are points). The four routes are as follows. (Notice that we could set an itinerary of our journey along the selected four routes. The 'reason," given below, is, so to speak, our 'inference ticket' for travel Cf. Lander University, Greenwood).

Originating Point Through Terminating Point

1 SOP	Direct	SIP
2 SOP	SEP	SIP

3 SOP	SAP to SEP	SIP
4 SOP	SEP and SAP	SIP

Unit III

Analytical Reasoning, Fallacies: Fallacies of Ambiguity, Avoiding fallacies

1. How can we say that deductive logic provides a priori knowledge? Explain with an example.

Ans: All saints are pious.

All philosophers are saints.

∴All philosophers are pious.

Evidently, there is no need to examine saints and philosophers to know that the conclusion is true. Indeed, it is not even necessary that there should be saints who are pious as well as philosophers. This being the case, arg. 5 takes the following form without leading to any distortion of meaning.

If all saints are pious and all philosophers are saints, then all philosophers are pious.

The argument is transformed into a statement which involves relation. Implication (the present relation is one such) is such that without the aid of sense experience, but with the laws of formal logic alone, it enables us to derive the conclusion. Thus like an analytic statement, a valid deductive argument provides a priori knowledge and hence it is devoid of novelty. It is this sort of relation that precisely describes the relation between the premises and the conclusion in deductive inference. This does not mean that deductive argument is absolutely certain. This is because necessity is a logical property whereas certainty is a psychological state. The former is objective and the latter is subjective.

When sense experience takes back seat, reason becomes the prime means of acquiring knowledge. Following the footsteps of Descartes, who is regarded as the father of rationalism, we can conclude, somewhat loosely, that deductive logic is rational. So we have sketched three characteristics; logical necessity, a priori and rational. There is a thread which runs through these characteristics. Therefore one character presupposes another.

2. How can an analytic argument between characterised?

Ans: Analytic argument is characterized by qualitative difference in opposition to quantitative difference, i.e. the difference between valid and invalid arguments is only in kind but not in degree. Further, validity is not a matter of degree. Let us make matters clear: a valid argument cannot become more valid in virtue of the addition of premise or premises. On the other hand, if any one premise is taken out of a valid argument, then the argument does not become ‘less valid’; it simply

becomes invalid. So an argument is either valid or invalid. A valid argument is always satiated. In other words, the premises in a valid argument constitute the necessary and sufficient conditions to accept the conclusion. An argument is invalid due to a 'missing link' in the class of premises. Analytic argument, therefore, is regarded as demonstrative argument.

Acceptance of premises leaves no room for any reasonable or meaningful doubt. We have learnt that validity is an important facet of deductive logic. Any account of validity is incomplete without considering Strawson's analysis of the nature of deductive logic. Strawson lists three aspects of formal logic: generality, form and system. Generality is distinguishable, clearly, from matter. Generality means that individual is not the subject matter of logic. Formal logic concerns only with the relation between statements, but not objects. It is futile to embark upon a study involving objects because such a study has only beginning but no end. Consider two examples,

Arg. p1: The author of Abhijnana Shakuntala was in the court of king Bhoja.

p2: Kalidasa is the author of Abhijnana Shakuntala.

q : ∴Kalidasa was in the court of king Bhoja.

Arg. p1: The author of Monadology was in the court of the queen of Prussia.

p2: Leibniz is the author of Monadology.

q: ∴Leibniz was in the court of the queen of Prussia.

It is easy to decide prima facie that the structure of these arguments is identical. The difference consists in subject matter only and it is possible to construct, at least theoretically, countless arguments having an identical structure. Obviously, this is not a profitable exercise. The essence of formal logic consists in saying that p1 & p2 together imply q or that q follows from or entails p1 and p2 together. Only implication and entailment are relevant here. Strawson has made this aspect very clear. Implication or entailment is independent of subject matter. Therefore it is impossible to identify the subject matter in virtue of recognition of implication. This point can be further clarified with the help of variables. Let us represent Abhijnana Shakunthala or Monadology with x, Kalidasa or Leibniz with y and queen of Prussia or King Bhoja with z. Now the argument takes this form.

Arg : p1: The author of x was in the court of z.

p2: y is the author of x.

q : ∴y was in the court of z.

In this particular context, without knowing the contents of x, y, and z we can know that p1 and p2 together imply q. Therefore it is possible to determine the validity or invalidity of an argument without knowing the contents of the argument.

3. What are called logical forms?

Ans: A logical form has two components: variables and constants. x, y, z etc are variables. In the case of categorical proposition the words all, some, no and not are constants. In the final analysis, the structure of an argument is determined by constants, but not variables. The dependence of the laws of an argument on constants is illustrated in this way. In life science the classification of animals is an important topic. The anatomical features of birds and aquatic creatures differ and there is difference in the function of those organs. Just as birds have some organs in common, aquatic creatures have certain other organs in common. These common organs correspond to constants and individual creatures correspond to variables. Similarly, every class of argument has definite constants. Just as the structure of birds is different from the structure of aquatic creatures, the structure of one class of arguments is different from the structure of some other class of arguments. The laws which explain the function of the organs of birds are different from the laws which explain the function of the organs of aquatic creatures. Similarly, in the case of arguments when the structure of an argument differs from that of another, the corresponding laws also differ from one another.

Integration of rules is another characteristic of formal logic. The structures of argument and rules are mutually dependent. If it is possible to decide the structure of an argument and also different classes of arguments, then is possible to achieve what is called formalization or systematization because formalization enables us to make a complete list of rules and also classify them so as to correlate them with respective arguments.. On the contrary, induction, in the first place, stands for any non-demonstrative argument where the premises, irrespective of their number, do not and cannot constitute conclusive evidences for the conclusion. The word ‘induction’ is the translation of what Aristotle called ‘epagoge’.

Peirce used the term ‘ampliative’ for epagoge because in this type of argument the conclusion always goes beyond the premises and the premises offer, at best, reasonable grounds to ‘believe’ such conclusion. Belief is not the same as proof, a distinction which was, more often than not, completely ignored by the protagonists of induction. Nor is it a measure of proof. This is one difference. Secondly, uncertainty and sense experience characterize inductive argument. Let us consider the latter first. Inductive inference begins with sense experience. The premises, therefore, can be called ‘observation-statements’ which directly result from experience.

However, the conclusion is not an observation-statement because it overshoots the material provided by observation– statements, which is why they cannot justify the conclusion. No matter how many black crows I have seen, they cannot prove that ‘all crows are black.’ At the stage, it is necessary to dispel a widespread and deep-rooted misconception. It is claimed erroneously that inductive argument always produces universal statement. On the contrary, what it provides is a statement which simply depends upon experience for further verification, but in itself is not an experiential statement. On some occasions, experience vouches for the conclusion, but on some other occasions, it does not. For example, considering the fact that, today I observed 5384 black crows, I may conclude that ‘tomorrow I will observe the same number of black crows’. This type of conclusion is characterized by a sort of leap, leap from ‘observed to unobserved or

unobservable'. This is called inductive leap or simply generalization. But this is not a universal statement as understood by traditional logic. It shows that induction is just inconceivable in the absence of generalization though universal proposition is not necessary for an inference to become inductive. It is possible to construct a universal statement within the limits of sense experience without involving generalization, for example, when I conclude after close scrutiny that every book in the library is a hardback edition. This has nothing to do with induction. Therefore inductive inference may or may not yield universal proposition though it has to yield necessarily generalization. The examples considered above are future-oriented and in principle, they are verifiable.

However, inductive inference need not be so always. It can also be past-oriented which is surely, 'unverifiable'. History, Anthropology, Geology, etc. consist of arguments which are past-oriented. But the mechanism, involved in both the cases is exactly the same. Therefore the prime characteristic of induction is that the conclusion does not necessarily follow from the premises and that experience precedes inference which means that inductive inference is dubitable and a posteriori. Whatever knowledge we acquire 'after experience', or whatever depends upon experience is called a posteriori as opposed to a priori. Uncertainty or dubious nature and a posteriori knowledge provided by inductive logic entitle it to be called empirical- again loosely- a characteristic disputed by Popper. The uncertainty of inductive conclusion brought in another term basic to the philosophy of science, viz. 'probability'. According to some inductivists all inductive conclusions are only probable. It is important to distinguish validity and probability. As mentioned earlier, validity is not a matter of degree, whereas probability is a matter of degree. Therefore an inductive inference may be less probable or highly probable.

4. What are analytic and apriori terms?

Ans: Two terms are introduced: analytic and a priori. Consider this example: 'all men with no hair on their heads are bald'. We know that this statement is true in virtue of the meaning of the word 'bald'; not otherwise. Such a statement is called analytic. In such statements the predicate term (here 'bald') is contained in the subject term (here 'men with no hair on their heads'). Knowledge obtained from an analytic statement is necessarily a priori, meaning knowledge prior to sense experience. In philosophical parlance, all analytic statements are necessarily a priori. Deductive logic provides knowledge a priori, though the premises and the conclusion considered independently are not analytic. It is the knowledge of the relation between the premises and the conclusion which is a priori. Therefore deductive argument and analytic statement share a common characteristic; in both the cases the denial leads to self-contradiction.

5. What is called fallacies of Ambiguity?

Ans: The fallacies arise as a result of the shift of meaning of words and phrases, shift from the meanings that they have in the premises to different meanings ascribed to them in the conclusion. Such mistakes are called fallacies of ambiguity. The deliberate use of such devices is usually crude

and readily detected; but at times the ambiguity may be obscure, the error accidental, and the fallacy subtle.

6. What are the varieties of fallacies of Ambiguity?

Ans: EQUIVOCATION is the fallacy which consists in using words or phrases with two or more meanings, deliberately or accidentally, while formulating an argument. Fallacies related to ambiguous terms discussed in categorical syllogism serve as examples in this context also. The Rule is: 'In a categorical syllogism there should be three and only three terms, each used twice in the same sense.' The violation of this Rule is the simplest way of committing this fallacy.

AMBHIBOLY consists in a misunderstanding due to the ambiguous grammatical construction of propositions. Many advertisements inadvertently commit this fallacy. 'Why go elsewhere to be cheated? Come to us.' Consider another example: Suppose we are told that a number is equal to three times five plus four. This is an example of amphiboly since the answer might be either [(3x5) + 4 = 19] or [3 x (5 + 4) = 27].

ACCENT consists in lifting a word out of context resulting in illegitimate emphasis upon it. For example consider this sermon. 'Thou shall not bear false witness against your neighbour.' If we emphasize unduly the word neighbour, then it would mean that you are free to bear false witness against others. On the other hand, if against is stressed, then it would mean that you may bear false witness for your neighbor, and so on. The accent may be oral, or may make use of italics, or other devices in the language. Often much of what we mean depends on the accent of words in an argument. Propagandists deliberately distort statements to mislead audiences. Example: tabloid newspapers often use bold and large print to attract the reader's attention. Advertising relies on this device heavily. Consider this advertisement in a newspaper: 'TAKE ABSOLUTELY FREE' the contest entry form. If we consider the extent of the uses of emphasis in various forms and the use of meanings deliberately taken out of context, we can rename accent as 'the fallacy of emphasis.'

COMPOSITION occurs when what is true of the parts taken separately is said to be true of the whole taken collectively. Example: 'cotton cannot be strong enough to make clothes of; for, look, I can break this cotton thread quite easily.' It is true that when each thread is taken separately, but not true when they are taken together. Another example: J. S. Mill commits this fallacy when he argues that the general happiness is the greatest good because each individual desires happiness.

DIVISION is the opposite of composition: what is true of the whole is taken to be true of its parts. Here is an example. 'He must be a catholic, for he is an Italian and Italy is a catholic country.' True, Italy as a whole is Catholic but the same need not be true of every Italian. Another example is given below. Some people argue that what is best for the nation must necessarily be advantageous for each citizen.

Name the fallacies in the following:

R1. (i) One of Patrick Henry's famous speeches (in Virginia on 23 March 1775) concludes with this appeal: …There is no retreat but in submission and slavery. The next gale that sweeps from the north will bring to our ears the clash of resounding arms. …Is life so dear, or peace so sweet, as to be purchased at the price chains and slavery? Forbid it, Almighty God! I know not what course others may take; but as for me, give me liberty or give me death.' It is reported that the crowd, upon hearing his speech, jumped up and shouted: 'To arms! To arms!'

(ii) At his trial in Athens, Socrates referred with disdain to other defendants who had appeared before their jury accompanied by their children and families, seeking acquittal by evoking pity. Socrates continued: 'I, who am probably in danger of my life, will do none of these things. …and I have a family, yes, and sons, O Athenians, three in number, one almost a man, and two others who are still young; and yet I will not bring any of them here to petition you for acquittal. (Plato, Apology. 34)

R2. In the world of finance, a prospectus is issued to attract investors in a company about to go public, which speaks much about the company but does not mention the price of its shares.

R4. Mr. X has no appreciation of music; for, has he ever purchased a ticket for a musical performance?

R5. (i) The father tells his son, 'Sunny, next time before giving you pocket money, I will see your report card.'

(ii) The union workers threaten the establishment that if their demands are not met, they will go on a strike.

R6. Suppose a person emphasizes the importance of increasing funding for the public schools. His opponent responds by insisting that a child's education involves much more than schooling and gets underway long before its formal schooling begins

D1. (i) 'All experiments with recombinant DNA must be stopped immediately,' said one scientist, who asked: 'If Dr. Frankenstein must go on producing his little biological monsters … how can we be sure of what would happen once the little beasts escape from the laboratory?'

(ii) Another scientist who wanted to block any further experimentation with DNA made his appeal explicitly: 'Can we predict the consequences? We are ignorant of the broad principles of evolution … We simply do not know. We are ignorant of the various factors we currently perceive to participate in the evolutionary process. We are ignorant of the depth of security of our own environmental niche … We do not know.'

D2. 'We admire the depth and insight of great fiction, say, in the novels of R. K. Narayan. Therefore we resort to his judgment in determining the real culprit in some political dispute.'

D3. (i) ‘The death penalty in the U.S. has given us the highest crime rate and greatest number of prisoners per 100,000 populations in the industrialized world.’ Therefore death penalty is the cause of the highest crime rate.

(ii) ‘The slippery slope argument, although influential, is hard to deal with rationally. It suggests that once we allow doctors to shorten the life of patients, who make such request, doctors could and would wantonly kill burdensome patients who do not want to die. This suggestion is not justified….’

D4. The owner of a ‘fish and chips’ shop in England defended the healthfulness of his deep-fried cookery with this argument: ‘Take my son, Martin. He’s been eating fish and chips his whole life, and he just had a cholesterol test, and his level is below the national average. What better proof could there be than a fryer’s son?’

P1. i) ‘To charge interest on the money loaned is quite legitimate. Therefore to take interest loaned to a friend in distress is quite legitimate.’

ii) ‘All killers of humans are murderers. Soldiers are killers of humans in war. Therefore the soldiers are murderers.’

iii) ‘To give charity to young, healthy beggar is wrong. Therefore, charity is bad.’

P2. i). ‘How exactly did you feel when you murdered your brother?’

ii) ‘Why are our politicians so corrupt?’

iii) ‘How can we change our education system to make our studies more effective?’

P3. ‘You ought to give alms because it is a duty to be charitable.’

A1. ‘Idle men are inefficient. Idle men are incapable. Therefore, idle men are invaluable.’

A2. ‘The farmer blew out his brains after receiving an affectionate farewell of his family with a shotgun.

A3. ‘Since every part of a certain machine is light in weight the machine as a whole is light in weight.’

A4. i) ‘That cricket team is a good team. So, each of its players must be good.’

ii) This corporation is very important and Mr. Das is an official of this corporation and therefore Mr. Das is very important.’

Unit IV

Disjunctive and Hypothetical syllogism, Dilemmas and their testing

1. Write a note on Disjunctive syllogism.

Ans: Disjunctive Syllogism (D.S.): In the subclass of syllogism the major premise (usually the first one) expresses alternatives connected by connectives, 'either… or'. So they are constants too. Such a proposition is called disjunctive proposition. In disjunctive proposition the connective either is implicit many times. Therefore its presence or absence does not alter the structure of the proposition. Second premise and the conclusion are simple or general. In D.S. itself there are two types. While regarding these two types the emphasis is on the connective or because as mentioned above either is implicit many times. One use of or is called inclusive and another is called exclusive. Or is used in inclusive sense if both alternatives are admissible and it is used in exclusive sense when the alternatives are mutually exclusive and totally exhaustive and the acceptance of one alternative excludes the other. In the proposition 'either he is stupid or stubborn' or is used in inclusive sense because the same person may be both stupid and stubborn.

However, in the proposition 'either he is generous or miser' or is used in exclusive sense because no one can be both generous and miser at the same time. In order to bring both usages under one class a rule is devised which says that one of the alternatives must be denied in the minor so that the remaining alternative is affirmed in the conclusion. The following argument illustrates the explanation.

Either he is stupid or stubborn. Either A or B

He is not stupid. Not A.

∴ He is stubborn. ∴ B.

Here again there is no middle term. However, one component (A) appears in the first premise in affirmative mode and in the second in negative mode. This occurrence corresponds to the affirmative mode of common component in one premise and its negative mode in another in PHS. A disjunctive argument with this structure is identified as Modus Tollendo Ponens.

In a disjunctive proposition the components are commutable, i.e., 'either A or B' means the same as 'either B or A'. Therefore in the minor premise any component can be denied. Affirming of a component in the minor premise is not permissible. If this rule is violated, then the fallacy committed is called the fallacy of Modus Ponendo Tollens. The following example illustrates this fallacy.

Either I or J

I

∴ not-J

However, this is not a fallacy if the alternatives are mutually exclusive and totally exhaustive.

2. Write a note on Pure Hypothetical Syllogism.

Ans: Pure Hypothetical Syllogism (P. H. S.): In this subclass of syllogism all propositions are hypothetical. They are called hypothetical because they express a condition. The words if …. then constitute the condition and also constant because in the absence of this particular constant the proposition ceases to be hypothetical. The statement which appears immediately after if is called antecedent and the statement which appears immediately after then is called consequent.

P. H. S. is governed by one rule which says that one statement must be common to two premises. If quality is constant, then it should appear in one premise as antecedent and in another as consequent. The common statement can appear as antecedent in one and as consequent in another provided it is affirmative in one and negative in another. In the latter case the conclusion becomes negative.

P. H. S. is illustrated below.

If this party wins, then we shall have a good government.

If we shall have a good government, then we shall prosper.

∴If this party wins, then we will prosper.

If A, then C.

If C, then B.

∴ If A, then B.

A and C constitute the components of the first premise, C and B constitute the components of second and A and B constitute the components of the conclusion.

3. Write a note on Mixed Hypothetical Syllogism.

Ans: Mixed Hypothetical Syllogism (M. H. S.): If the major premise (usually the first one) alone is hypothetical, then the syllogism is called M. H. S.. Second premise and the conclusion are simple or general. M. H. S. is illustrated below.

If I do my duty, then I shall be happy.

I do my duty.

∴ I shall be happy.

If A, then B.

A

∴ B

In these kinds, there is no ‘middle term’. However, middle term is replaced by a proposition which is common to both the premises. In 14 ‘we shall have a good government’ is common to both the

premises and in the example 'I do my duty' is common to both the premises. Hence we shall introduce a new word; middle proposition. An important limitation should be noted at this stage itself. It is fallacious to affirm B, in the minor premise instead of A and thereby affirm A in the conclusion instead of B. It is a fallacy because it violates a rule of M. H. S. which states that antecedent and consequent must be affirmed in the minor and the conclusion respectively. The only legitimate alternative is to deny the consequent and the antecedent in the minor and the conclusion respectively. In terms of prohibition it only means that the consequent and the antecedent should not be affirmed in the minor and the conclusion respectively. When antecedent and consequent are affirmed in the legitimate manner, the structure (technically known as mood) of the argument is identified as Modus Ponendo Ponens (in brief Modus Ponens). When the consequent and the antecedent are denied in the minor and the conclusion respectively, then the structure is identified as Modus Tollendo Tollens (in brief Modus Tollens). When we undertake a study of symbolic logic, we will come to know the importance of these moods which are called the Rules of Inference. If antecedent is denied in the minor instead of affirming, then the fallacy committed is called the fallacy of denying the antecedent. If the consequent is affirmed in the minor instead of denying, then the fallacy committed is called, the fallacy of affirming the consequent. Modus Ponendo Ponens is illustrated by the given example . The rest of the structures (both valid and invalid) are given below.

Modus Tollendo Tollens

If C, then D.

not-D

∴ not-C

Fallacy of denying the antecedent Fallacy of affirming the consequent

If E, then F. If G, then H.

not- E. H.

∴ not-F. ∴ G.

4. Write a note on Dilemma.

Ans: The dilemma consists of three propositions of which two constitute premises and third one is the conclusion. One of the premises is a conjunction of two hypothetical propositions and the other one is disjunctive. The conclusion is either disjunctive or simple. Since the dilemma consists of two hypothetical propositions conjoined by the word 'and', it is possible that two different propositions are found in place of antecedents and two different propositions are found in place of consequents. But it is not necessary that it should be so. It is likely that both propositions have a common consequent. If such consequent becomes the conclusion, then, the conclusion is a simple proposition.

5. How to avoid fallacies of dilemma?

Ans: Use of dilemma is restricted to some situations. When neither unconditional affirmation of antecedent nor unconditional denial of consequent is possible, logician may use this route. It indicates either ignorance or shrewdness. When we face dilemma, we only try to avoid, but not to refute. There are three different ways in which we can try to avoid dilemma. All these ways only reflect escapist tendency. Only an escapist tries to avoid a problematic situation. Therefore, in logic they do not carry much weight.

1. Escaping between the horns of dilemma: Two consequents mentioned may be incomplete. If it is possible to show that they are incomplete then we can avoid facing dilemma. This is what is known as 'escaping between the horns of dilemma'. It should be noted that even when third consequent is suggested it does not mean that this new consequents is actually true. In other words, the new consequent also is questionable.

2. Taking the dilemma by horns: In this method of avoiding dilemma, attempts are made to contradict the hypothetical propositions, which are conjoined. A hypothetical proposition is contradicted when antecedent and negation of consequent are accepted. However, in this particular case it is not attempted at all. Moreover, since the major premise is a conjunction of two hypothetical propositions, the method of refutation is more complex. (The negation of conjunction will be introduced at a later stage. For the time being it is enough to know that in this particular instance there is no such attempt.)

3. Rebuttal of dilemma: It appears to be the contradiction of dilemma. But, in reality, it is not. In all these cases, the dilemma becomes a potent weapon to mislead the opponent in debate. Therefore none of these methods amounts to the contradiction of opponent's view.Since the dilemma is a medley of both types of conditional propositions, i. e., hypothetical and disjunctive, it should follow the basic rules of hypothetical and disjunctive syllogisms. It should affirm disjunctively the antecedents in the minor or deny disjunctively the consequents in the minor. The dilemma is powerful if in the major there is a strong cause-effect relationship between the antecedent and the consequent and in the minor the alternatives are exhaustive and mutually exclusive. Again, the former is debatable.

Unit V

Preliminary Set Theory

1. What is predicate logic?

Ans: Predicate logic, is a branch of logic, which is concerned with predicates or with predication of properties, and also with things or objects to which the predicates may be ascribed. This statement, in general, and the words in italics, in particular, must act as springboard for our further study and its significance becomes evident shortly. Quantification logic has its roots in 'Set Theory'.

2. What is Set theory?

Ans: Set theory itself is of recent origin. This theory took its birth in the nineteenth century in the works Georg Cantor. However, other mathematicians, most notably, Boole, Venn and de Morgan meant it though they did not develop the theory. Nor did they use the term in the sense in which Cantor used. Such things are not uncommon in the development of science. For example, Michael Faraday did not use the word field in his work on physics though he meant it. This piece of fact from the History of Mathematics must be borne in mind in order to pay what is due to Aristotle. Prior to this, we must understand that the important concepts developed by Cantor viz. subset, proper subset, the difference between the two, null set (empty set), denumerable and equivalence are some of the key concepts.

3. Where is the error in Aristotle's theory?

Ans: As a matter of Aristotle did not err. That is the reason why the word defect is not the right word to be used while assessing Aristotelian system. Instead, limitation is the apt word to be used in our analysis of Aristotelian system. Aristotle had an idea of class at elementary level. He evolved the concepts of class inclusion (total or partial) and class exclusion (total or partial), but could not proceed further. This explains the limits of his analysis of categorical proposition based on quality and quantity of proposition and the outcome of his analysis. Since Set theory in the sense in which Cantor developed was unknown during Aristotle's age, it, surely, would be anachronistic to criticize Aristotle for his limited perspective of predicate logic. Therefore let us first identify the loose ends in Aristotelian system. This will help us to understand the significance of 'Quantification Logic' in particular and modern logic in general.

Aristotle did not differentiate between universal proposition and singular proposition. A proposition is singular when the subject is a proper name. In this respect, singular proposition differs from particular proposition, though later we understand that both are existential propositions. In his analysis these two are, more or less, the same. An understanding of subtle difference and its consequences is quite illuminating. Any universal proposition of the form 'All S are P' or 'No S are P' reveals that S and P are merely class-names.

4. What is called Set?

Ans: If the concept of denotation is closely examined, then it becomes clear that all class-indicators include or exclude a certain number of elements known as members of a particular class, otherwise called sets. Therefore every set represented by a term in the proposition is very much similar to denumerable set which is a set of positive integers. A set is said to be denumerable when it is a set of positive integers because only then members are countable. If members are countable, then denotation makes sense, not otherwise. Similarly, the concept of intension reveals that to be a well-defined member the member must possess a definite set of properties without which it ceases to be a member of that particular set.

Against this background, we should try to know what the difference or differences between universal and singular on the one hand and particular and singular propositions on the other signify. First let us consider universal and singular propositions. The proposition 'All men are mortal' has both contrary and contradictory relations. However, the proposition 'Socrates is mortal' has only contradictory relation, but not contrary. It may be necessary to point out that, though it amounts to repetition, two propositions are contraries only when two conditions are satisfied; when p is true, q is false and when p is false q is doubtful. On the other hand, contradiction arises when p is true, q is false and when p is false q is true and vice versa.

Suppose that the second proposition, 'Socrates is mortal' is negated. We get 'Socrates is not mortal'. When the first statement is true, the second statement is false. Though the first condition is satisfied, the second condition is not satisfied because when the first statement is false, the second statement is not doubtful, but turns out to be true. If logical relations matter, then the distinction between universal and singular proposition also ought to matter. This is a point which Aristotle failed to notice. Further, both particular and singular are existential propositions which make matters still worse. Like universal propositions, particular propositions also have two distinct relations which distinguish them from singular propositions. Instead of contrary, sub-contrary explains one type of relation between two particular propositions. If 'some men are mortal' is true, then 'some men are not mortal' is doubtful and if 'some men are mortal' is false, then 'some men are not mortal' is true. Of course, contradiction explains the relation between universal and particular. Here is the difference. Though both particular and singular propositions are existential, sub-contrary relation is not common to both. This means that universal and particular propositions, on the one hand, and particular and singular, on the other, deserve to be classified separately. They are called general propositions distinct from singular propositions because the subject of such propositions is a general term. A term which refers to an indefinite number of things is a general term which is called common noun in grammar. What we call quantifiers are applicable to general propositions, but not to singular propositions. This is one difference. Second difference is crucial. In this context, the emphasis is on the word existence.

5. If a certain proposition is characterized as existential, how do we understand such characterization?

Ans: When we discussed Venn's diagram in connection with the distribution of terms, we learnt that universal propositions do not carry existential import whereas particular propositions carry existential import. The statement 'All men are mortal' does not affirm the existence of men whereas 'Some men are….' affirm the existence of men irrespective of the quality of proposition. Same is the case with 'No men are…' No assertion is made about the existence of men. Existence presupposes the presence of members in a given class. If existence makes sense, then in negative sense nonexistence also must make some sense. Suppose that a set does not contain a single member. Then what is its status? Till nineteenth century this question did not occur to anyone. In other words, the concept of null set paved the way for further progress in Aristotelian logic.

6. Discuss nul set .

Ans: The concept of null set plays crucial role in distinguishing Aristotelian system from modern logic. Let us recall the very first statement of introduction; 'Predicate logic, is a branch of logic, which is concerned with predicates or with predication of properties, and also with things or objects to which the predicates may be ascribed'. In the strict sense of the term, predicate may be ascribed to only things or individuals actually existing. Otherwise, the commonplace difference between fact and fiction will be completely obliterated. Therefore in a restricted sense existential propositions make matters of fact relevant. When matters of fact become relevant, purely formal character of formal logic makes room for the relevance of content to a certain extent. But generalization, which is a characteristic of deductive inference, does not lose its significance. The only requirement is that the content of the argument must be factual, but not fictitious.

One fundamental relation between propositions with which we are concerned, presently, is contradiction. The law of contradiction holds good when terms include members as a matter of fact. However, the situation is different when the terms represent null sets. Consider this proposition.

1. All female philosophers of Karnataka are the residents of New York.

This sentence is obviously false. Therefore according to the law of its contradiction, the statement mentioned below must be true.

2. Some female philosophers of Karnataka are not the residents of New York.

Statements 1 and 2 are supposed to be contradictories. The second statement ought to be true according to the law of contradiction since the first statement is false. But, in reality, this statement is also false. But two contradictories cannot be false. This problem arises because we are dealing with nonexistent members. Therefore in the strict sense of the word second statement also, like universal statement, does not carry existential import. Within the framework of traditional logic this problem remains unnoticed because there was no concept of set at all-whether null set or non-null set. Modern logic corrected this mistake by making null set a distinct entity. The underlying principle is that all existential propositions should include only non-null sets. This stipulation marks one difference between traditional and modern systems.

Equivalence is second major factor. Consider these propositions.

3. All triangles are plane figures.

4. All equilateral triangles are equiangular triangles.

Statements 3 and 4 assume the forms as follows.

3a. If any figure is a triangle, then it is a plane figure.

4a. A figure is equilateral triangle if and only if it is equiangular.

Let us symbolize these statements.

3a ≡ F => P

3b ≡ F <=> P

Again, traditional logic did not distinguish these propositions. The difference between 3a and 3b becomes clear only within the framework of modern logic. This is another important progress made by modern logic over traditional logic. Such differences matter in quantification logic.

This aspect has something to do with the difference between subset and proper subset. Proposition 3 discloses that the set of triangles is a proper subset of the set of plane figures.

However, the set of equilateral triangles is equivalent to the set of equiangular triangles. This explains why the sentential connectives differ from 3a to 3b.

Traditional logic made one type of distinction among propositions; conditional and unconditional and within the latter four kinds of propositions. Modern logic not only discovered a new aspect in conditional proposition but also it added new kinds of propositions which were not considered by traditional logic. Hence it could evolve new set of rules. But these rules had limitations. In the absence of further augmentation of new rules they could not be applied to arguments which consisted of singular propositions. So the search for relevant rules did not stop.

7. What is the difference between propositional logic and predicate logic?

Ans: This difference lies in dealing with the internal structure of simple as well as compound propositions. Therefore predicate logic includes rules hitherto used and also a new set of rules. Predicate logic is concerned with the internal structure of propositions. It is not the case with propositional logic. In strict technical terms, this is also known as Quantification Theory or the Predicate Calculus. It has its own syntax, which helps us to devise statements, which are considered well-formed statements.