UNIT 1 PROVING VALIDITY USING RULES OF INFERENCE

Contents

1.0 OBJECTIVES

The principal objective of this unit is to illustrate the Rules of Inference with examples and to make explicit the art of testing arguments, though these are dealt in the unit 3 of previous block. Here the focus is on formulating verbal form of arguments in their symbolic form and then prove the validity of argument. Such an exercise exposes the students to various Rules of Inference in proving validity of given argument.

1.1 INTRODUCTION

Logic is a science of right reasoning. All type of reasoning may not be valid. Hence, testing the rightness and wrongness of an argument becomes necessary. Logic classifies arguments as valid or invalid. We need a set of criteria for testing the validity of certain arguments. The symbolic logicians have spelt out certain Rules of Inference which would help us to see the correctness of certain arguments. In modern logic an argument is regarded as a sequence of statements. When proof is constructed to test the argument, the proof also takes the same form, which the argument takes. In this type of proof there is correspondence between the scheme of the given argument and the scheme of the proof. Every step, which is adduced while constructing proof, is the conclusion of the preceding statements, and in turn, becomes the premise for statements, which follow it (if not all, at least to some). Rules, which govern the process of deducing hidden conclusion, constitute what are known as 'Rules of Inference' in modern logic. Many of these Rules have their origin in traditional logic.

1.2 NECESSITY OF RULES OF INFERENCE

As we have already seen that there are various types of syllogism, disjunctive, hypothetical etc., the Rules of Inference have classified them into various forms of criteria using symbols. However, only limited types of arguments are covered by classical logic. All types of arguments is not alike in all respects. Some are Simple enough so that the truth-table technique is adequate for the purpose of testing. Generally, any argument, which consists of two or three simple but different propositions, can be easily put to test by truth-table method. If the argument consists of more than three different propositions, then the truth-table method is bit difficult and confusing. In those cases, the symbolic logicians have proposed an alternative.

Look at the following examples that makes this point clear. An argument, which is complex in this sense, is nothing but an aggregate of several simple (by simple, in this context, we mean short) arguments.

1)	2)	3)
p => q	q => r	p =>q
p	q	q => r
∴ q	∴ r	∴

(3) is the sum of (1) and (2) in which the conclusions, q & r is hidden. In classical logic we have 'complex' type of argument in the form of sorites. (We should remember that complex, simple, etc. are relative). An example for sorites is given:

All Indians are Asians.

All Dalits are Indians.

All Mahars are Dalits.

∴ All Mahars are Asians.

In this poly-syllogistic arrangement of argument there are three premises and a conclusion. Usually any sorites consists of at least two syllogistic arguments and therefore, two conclusions. So it is more complex than an ordinary syllogism. This point becomes clear when we break sorites into constituent syllogisms.

All Indians are Asians.	→All Dalits are Asians.
All Dalits are Indians.	
All Mahars are Dalits	→All Mahars are Dalits
∴All Mahars are Asians	

1.3 MEANING OF PROOF OF VALIDITY

The Rules of Inference in the sentential logic are based on the classical traditional logic. In symbolic or modern logic, an argument is regarded as a sequence of statements. While constructing the proof to test the argument, the proof has to take the same form of the argument to which it corresponds. So there is a correspondence between these two, the scheme of the argument and the proof to test it. Every step, which is adduced while constructing proof, is the conclusion of the preceding statements, and in turn, becomes the premise for statements, which follow it (if not all, at least to some). Rules, which govern the process of deducing hidden conclusion, constitute what are known as 'Rules of Inference' in modern logic.

A particular pattern of proof construction is devised by modern logic. Discarding more descriptive method, which consumes both space and time, modern logic has discovered much shorter and simpler method. Whatever conclusion can be drawn from any two given premises is written on left had side (LHS), while the Rule and the premises to which this particular Rule applies to derive the conclusion used in further proof, are written on the right hand side (RHS). The serial numbers are used instead of premises to make the procedure simpler and more economical in terms of time and effort to grasp the argument. Yet, one must ensure that the premises, the conclusion drawn from them and corresponding Rule are always juxtaposed.

For instance let us look at the following argument.:

$$
\begin{array}{l}
p \Rightarrow (q \lor r) \\
\neg r \\
\neg q \\
\text{-------} \\
\therefore \neg p
\end{array}
$$

There is a standard form in which we write the argument. After we write down the last premise we use a slash on the RHS which is followed by the conclusion. The given premises are numbered and the subsequent conclusions which are drawn also are progressively numbered. We enter the numbers on the RHS accordingly, we shall rewrite the argument.

1)	$p \Rightarrow (q \lor r)$	
2)	$\neg r$	
3)	$\neg q \,/ \therefore \neg p$	
4)	$\neg r \land \neg q$	2, 3, Conj.
5)	$\therefore \neg p$	1, 4, M.T.

M.T. stands for modus tollens. The Rule, which is familiar to those who have studied traditional logic. 1 and 4 signify 1st and 4th lines to which this Rule is applied. We need not mention which is the premise and which is a conclusion because except the last line all other lines consist of statements, which are regarded as premises.

It is not necessary that the premises should be written in the given order only. Care should be taken to omit conclusion from numbering. Finally, a word about symbols: We need not stick on to proposition form only. Hence when arguments are symbolized we use only uppercase letters.

1.4 NINE RULES OF INFERENCE

This section may be a repetition of a unit in the previous block which also lists out the same Rules of Inference. Modern logic considers nine Rules of Inference. It is sufficient to know them and how and where they should be applied. There is no need to prove them.

1) *Modus Ponens* (M.P.)

$p \Rightarrow q$
P
$\therefore q$

2) *Modus Tollens* (M.T.)

$p \Rightarrow q$
$\neg q$
$\therefore \neg p$

3) *Hypothetical Syllogism (H.S.)*

$p \Rightarrow q$
$q \Rightarrow r$
$\therefore p \Rightarrow r$

4) *Disjunctive Syllogism (D.S.)*

$p \vee q$
$\neg p$
$\therefore \neg q$

Or

$p \vee q$
$\neg q$
$\therefore \neg p$

5) *Constructive Dilemma (C.D.)*

$(p \Rightarrow q) \wedge (r \Rightarrow s)$
$P \vee r$
$\therefore q \vee r$

6) *Destructive Dilemma (D.D.)*

$(p \Rightarrow q) \wedge (r \Rightarrow s)$
$\neg q \vee \neg s$
$\therefore \neg p \vee \neg r$

7) *Simplification (Simp.)*

$p \wedge q$
$\therefore p$

8) *Conjunction (Conj.)*

P
Q
∴ p ^ q

9) *Addition (Add.)*

P
∴ p v q

Absorption Rule was added by Copi to the remaining Rules. In these Rules, the first six Rules are standard Rules of traditional logic. The last three Rules need a little explanation. In simplification, since p ? q is given to us, we accept that p is true, and q is true as well. So there is no harm in dropping any of them. The case of conjunction is slightly different. p is given to us, so we take it as true; q is given to us. So we take q also as true. Since both are taken as true we can conveniently conjoin them. The case of addition is slightly different. Suppose that we have only p in the premises. Since it is a premise, we take it as true. Suppose that we require q to be added to p. We do not know whether q is true or not. There is no harm in adding q to p because even if q is false p v q still remains true because p is true. After all, one true component can make disjunction true. But what is important is that conjunction does not mean addition. In logical language, addition means disjunction but not conjunction.

1.5 USAGE OF RULES OF INFERENCE TO TEST VALIDITY

1)	p => (q v r)	
2)	¬ r	
3)	¬ q / ∴ ¬ p	
4)	¬ r ^ ¬ q	2, 3 Conj.
5)	¬ q ^ ¬ r	4 Com.
6)		
7)	∴ ¬ p	1, 6, M.T.

Since this is the first argument, let us elaborate the process.

¬ r appears in 2nd line and ¬q appears in 3rd line. Therefore the Rule of 'Conjunction' is applied. We get ¬r ^ ¬q

This forms the fourth line in the sequence. Now we shall consider 1st and 4th line together.

1)	p => (q v r)
4)	¬ r ^ ¬ q
	∴¬ p

In (1), (q v r) is the consequent. q v r being a disjunction, when it is denied, in accordance with de Morgan's law, it becomes a conjunction with original disjuncts being replaced by their respective negation. Since consequent is denied in the second premise, the antecedent has to be denied in the conclusion and it is done. Therefore in traditional logic it is a valid mood, viz., modus tollendo tollens, which has become a Rule of Inference in modern logic. For brevity, we say modus tollens. The form of (1) and (4) corresponds exactly to the form of Rule 2. The conclusion, which we obtained through formal proof, is the same as the conclusion of the given argument. This is how an argument is tested for validity. This is a model of explanation, which suits any argument.

1.6 CONVERTING VERBAL FORMS OF ARGUMENT INTO SYMBOLS

For change, let us start with verbal form of argument and symbolize the statements and logical constants before proceeding to test the validity of the arguments.

Example 1

I) If Raja joins, then the club's social prestige will rise; and if Pandiyan joins, then the club's financial position will be more secure. Either Raja or Pandiyan joins. If the club's social prestige rises, then Pandiyan will join; and if the club's financial position becomes more secure, then Suresh will join. Therefore either Pandiyan or Suresh will join.

1)	Raja joins	= R
2)	The club's social prestige will rise	= S
3)	Pandiyan joins	= K
4)	The club's financial position rises	= F
5)	Suresh will join	= G

Now the argument becomes:

1) (R=>S) ^ (K=>F).
2) R v K.
3) (S=>K) ^ (F=>G)/ ∴ K v G.
4) S v F 1, 2, C.D.
5) ∴ K v G 3, 4, C.D.

Answer to the first argument makes one point very clear. Verbal expression is naturally very long and tedious, whereas symbolic representation is short and clear.

Example 2

II) If Mohan received the wire, then he took the plane; and if he took the plane, then he will not be late for the meeting. If the telegram was incorrectly addressed, then Mohan will be late for the meeting. Either Mohan received the wire or the telegram was incorrectly addressed. Therefore either Mohan took the plane or he will be late for the meeting.

1)	Mohan received the wire	=V
2)	He took the plane	= P
3)	He will not be late of the meeting	= ¬L

4) Telegram was incorrectly addressed = ¬T
5) Mohan will be late for the meeting = L

Now the arguments becomes:

1) (V=>P) ^ (P=>¬L)
2) (¬T=>L)
3) V v ¬T /∴ P v L
4) V=>P 1, Simp.
5) (V=>P) ^ (¬T=>L) 4, 2, Conj.
6) P v L 5, 3, C.D.

Check your progress I.

Construct the symbolic forms of the following arguments.

1) If Kumar buys the plot, then an office building will be constructed; whereas if Mahesh buys the plot, then it quickly will be sold again. If Ravi buys the plot, then a store will be constructed; and if the store is constructed, then Lakshmi will offer to lease it. Either Kumar or Ravi will buy the lot. Therefore either an office building or a store will be constructed.

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2) If Rahul goes to the meeting, then a complete report will be made; if Rahul does not go to the meeting, then a special election will be required. If a complete report is made, then an investigation will be launched. If Rahul going to the meeting implies that a complete report will be made, then if the making of a complete report implies that an investigation will be launched, then either Rahul goes to the meeting and an investigation is launched or Rahul does not go to the meeting and no investigation is launched. If Rahul goes to the meeting and an investigation is launched, then some members will have to stand trial. But if Rahul does not go to the meeting and no investigation is launched then the organization will disintegrate very rapidly. Therefore either some members will have to stand trial or the organization will disintegrate very rapidly.

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3) If Mr. Vijay is Kumar's next-door neighbour, then Mr. Vijay's annual earnings are exactly divisible by three. If Mr. Vijay's annual earnings are exactly divisible by 3, then Rs.20, 000/= is exactly divisible by 3. But Rs.20,000/= is not exactly divisible by 3. If Mr. Roshan is Kumar's next-door neighbour, then Mr. Roshan lives half way between Bengaluru and Chennai. If Mr. Roshan lives in Bengaluru, then he does not live half way between Bengaluru and

Chennai. Mr. Roshan lives in Bengaluru. If Mr. Vijay is not Kumar's next-door neighbour, then either Mr. Roshan or Mr. Kishore is Kumar's next-door neighbour. Therefore Mr. Kishore is Kumar's next-door neighbour.

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1.7 EXAMPLES FOR USING RULES OF INFERENCE

1)
1. (B v N) => (K ^ L)
2. ¬K
3. ¬M / ∴ ¬B ^ ¬M
4. ¬K v ¬L 2, Add.
5. ¬B ^ ¬N 1, 4, M.T.
6. ¬B 5, Simp.
7. ¬B ^ ¬M 6, 3, Conj.

2)
1. (M v N) => (P ^ Q)
2. N /∴ P
3. M v N 2, Add.
4. P ^ Q 1, 3, M.P.
5. ∴P 4, Simp.

3)
1. (T => K) ^ (R => S)
2. S => D
3. D => T
4. R / ∴ T
5. R => S 1 Simp.
6. S 5,4, M. P.
7. D 2, 6, M. P.
8. ∴ T 3, 7, M.P.

4)
1. (P =>Q) ^(R=>S)
2. ¬A=> ¬Q
3. A => ¬B
4. ¬B /∴ ¬PV ¬S
5. ¬A 3,4, M.T.
6. ¬Q 2,5, M.P.
7. P=>Q 1, Simp.
8. ¬P 7, 6, M.T.
9. ¬P v ¬S 9, Add.

5)
1. A ^ (B v C)
2. A=>P
3. Q / ∴ P ^ Q
4. A 1, Simp.
5. P 2,4, M.P.
6. P ^ Q 5,3, Conj.

6)
1. (K => A) ^ (M => D)
2. ¬A /∴ ¬K v ¬M
3. ¬A v ¬D 2, Add.
4. ¬K v ¬M 1, 3 M.T.

7)
1. (A ^ B) => (C v D)
2. A
3. B /∴C v D
4. A ^ B 2, 3, Conj.
5. C v D 1,4, M.P.

8)
1. (A v B) ^ (¬D ^ E)
2. A v B =>K/∴K ^ (¬D ^ E)
3. A v B) 1, Simp.
4. K 2, 4, M.P.
5. ¬D ^ E 1, Simp.
6. K ^ (¬D ^ E) 4, 5, Conj.

9)
1. Av(B ^ C)
2. A=>P
3. ¬P / ∴ C
4. ¬A 2,3, M.T.
5. B ^ C 1,4, D.S.
6. C 5, Simp.

10) 1. ¬B
2. ¬D
3. (A=>B) ^ (C=>D)
4. K / ∴ C (¬K ^ ¬A)
5. A=>B 3, Simp.
6. ¬A 5, 1, M.T.
7. C=>D 3, Simp.
8. ¬C 7, 2, M.T.
9. ¬C^ (¬K ^ ¬A) 8,4,6, Conj.

11) 1. (B≡K)=>(Z ^ D)
2. ¬(Z ^ D) /∴¬(B≡K)
3. ∴¬ (B≡K) 1,2, M.T.

12) 1. (K ^A)=>(¬ B v C)
2. M=>(K ^ A)
3. M /∴¬B v C
4. M=> (¬B v C) 2,1. H.S.
5. ∴¬B v C 4,3, M.P.

13) 1. A=>D
2. B=>C
3. ¬D v ¬C/∴¬A v ¬B
4. (A=>D)^(B=>C)1,2,Conj.
5. ∴¬Av ¬B 4,3, D.D.

14) 1. J v (K ^ L)
2. J=>D
3. ¬D/∴K ^ L
4. ¬J 2,3, M.T.
5. ∴ (K ^ L) 1,4 D.S.

15) 1. A ^ (B=>C)
2. B /∴C
3. B=>C 1, Simp.
4. ∴C 3,2, M.P.

16) 1. Av(B ^ C)
2. A=>D
3. ¬D /∴B
4. ¬A 2,3, M.T.
5. B ^ C 1,2, D.S.
6. ∴B 5, Simp.

17) 1. (A v B)=>C
2. D=>¬C
3. D /∴¬(A v B)
4. ¬C 2,3, M.P.
5. ∴¬(A v B) 1,4, M.T.

18) 1. (K ^ T)=>(A v B)
2. (A v B)=>(P ^ ¬L)
3. (P ^ ¬L)=>D
4. ¬(D) /∴¬(K ^ T)
5. (K ^ T)=>(P ^ ¬L) 2, H.S.
6. (K ^ T)=>D 5,3, H.S.
7. ∴¬(K ^ T) 6,4 M.T.

19) 1. A=>D
2. B=>C
3. A v B /∴ D v C
4. (A=>D)^(B=>C)1,2, Conj.
5. ∴D v C 4,3, C.D.

20) 1. (A=>G)=>(K v ¬D)
2. ¬(K v ¬ D) /∴¬(A=>G)
3. ∴¬(A=>G) 1,2, M.T.

21) 1. D v (A=>B)
2. (A=>B)=>(C v K)
3. ¬(C v K) /∴D
4. ¬(A=>B) 2,3, M.T.
5. ∴D 1,4, D.S.

22) 1. (A=>B) ^ (C=>D)
2. A/∴B v D
3. A v C 2, Add.
4. ∴B v D 1,3, C.D.

23) 1. A=>B
2. B=>C
3. ¬C /∴¬A
4. ¬B 2,3, M.T.
5. ∴¬A 1,4, M.T.

24) 1. (A=>C) ^ (B=>D)
2. K=>A
3. K /∴C v D
4. A 2,3, M.P.
5. A v B 4, Add.
6. ∴C v D 1,5, C.D.

1.8 RULES OF REPLACEMENT

Not all arguments can be tested if restricted to Rules of Inference only, though as shown above somewhat complex and diverse arguments succumb to these Rules. Just as modern logic tried to supplement traditional logic, within modern logic, the need was felt to supplement the Rules of Inference. Hence we have the Rules of Replacement. The structure of argument may be such that it may require only one of the kinds or both. We have ten such Rules, which are called the Rules of Replacement. The difference between these two sets of Rules is that the Rules of Inference are themselves inferences whereas Rules of Replacement are not. This is because the Rules of Replacement are restricted to change or changes in the form of statements. For example, if A or B is changed to B or A, then such change is governed by one Rule. Similarly, if A ^ (B v C) is changed to (A ^ B) v (A ^ C), then this change is governed by some other Rule. Also, in the mode of application of Rules there is a restriction. Unlike Rules of Inference which should be applied to the whole line only any Rule of Replacement can be applied to any part of the line. This is because all Rules of Replacement are, logically, equivalent expressions.

Now let us list Rules of Replacement.

1)	De Morgan's Law (De.M.)	¬ (p ^ q) ≡ ¬ p v ¬q ¬ (p v q) ≡ ¬ p ^ ¬q
2)	Commutation Law (Com.)	p v q ≡ q v p p ^ q ≡ q v p
3)	Double Negation(D.N.)	¬ (¬ p) ≡ p
4)	Transposition (Trans.)	(p => q) ≡ (¬q => ¬ p)
5)	Material Implication (Impl.)	(p => q) ≡ ¬ p v q
6)	Material Equivalence (Equiv.)	(p ≡ q) ≡ (p => q) ^ (q => p) {(p ≡ q) ≡ {(p ^ q) v (¬ p ^ ¬q)}
7)	Exportation (Exp.)	{(p ^ q) => r} ≡ {p => (q => r)}
8)	Tautology (Taut.)	p ≡ p v p p ≡ p ^ p
9)	Association (Ass.)	{p v (q v r)} ≡ {(p v q) v r} {p ^ (q ^ r)} ≡ {p ^ q) ^ r}
10)	Distribution (Dist.)	{p ^ (q v r)} ≡ {(p ^ q) v (p ^ r)} {p v (q ^ r)} ≡ {p v q) ^ (p v r)}

[Note: When the expression includes both 'Λ' and 'v' only distribution law can be applied but not association law.]

Let us restate de Morgan's law differently. Negation of a conjunction is equivalent to the disjunction of the negation of components and negation of disjunction is equivalent to the conjunction of negation of components. Similarly, in the case of implication the expression is equivalent to the transposition of the negation of components. Likewise the rest of the Rules can be interpreted. This relation becomes further clear if we construct truth-table for any Rule (for both sides of the equation). The student is advised to construct truth-table for any Rule of Replacement to verify the equivalence. Our immediate task is to become familiar with the technique of testing arguments.

1)

1. {I => (J => K)} ^ (J => ¬I) / ∴ {(I ^ J) => K} ^ (J => ¬I)}
2. {(I ^ J) => K} ^ (J => ¬I) 1, Exp.

2)

1. (R ^ S) => (¬R v ¬S) / ∴ ¬ (¬R v ¬S) => ¬ (R ^ S)
2. ¬ (¬R v ¬S) => ¬ (R ^ S) 1, De.M.

3)

1. (T v ¬U) ^ {(W ^ ¬V) => ¬T} /∴ (T v ¬U) ^ {(W=>(¬V=>¬T)}
2. (T v ¬U) ^ {(W=>(¬V=>¬T)} 1, Exp.

4)

1. X v Y) ^ (¬X v Z) /∴ (X v Y ^ ¬X) v {(X v Y) ^ Z}
2. (X v Y ^ ¬X) v {(X v Y) ^ Z} 1,Dist.

6)

1. Z => (A => B) /∴ Z => ¬{ ¬ (A => B}
2. Z => ¬{ ¬ (A => B} 1,D.N.

6)

1. (¬F v G) ^ (F => G) /∴ F => G.).
2. (F => G) ^ (F => G) 1, Impl.
3. F => G 2, Taut.

Now we shall consider different types of arguments, which may involve both kinds of Rules.

1)

1. (O => ¬P) ^ (P => Q)		
2. Q => O		
3. ¬R => P /∴ R		
4. ¬ Q v O	2,	Impl.
5. O v ¬ Q	4,	Com.
6. (O => ¬ P) ^ (¬ Q => ¬P)	1,	Trans,
7. ¬P v ¬P	6, 5,	C.D.
8. ¬P	7,	Taut.
9. ¬ ¬ R	3, 8,	M.T.
10. ∴R	9,	D.N.

2)

1. X => (Y => Z)
2. X => (A => B)
3. X ^ (Y v A)
4. ¬Z /∴ B

5. $(X \wedge Y) \Rightarrow Z$	1,	Exp.
6. $(X \wedge A) \Rightarrow B$	2,	Exp.
7. $(X \wedge Y) \vee (X \wedge A)$	3,	Dist.
8. $\{(X \wedge Y) \Rightarrow Z\} \wedge \{(X \wedge A) \Rightarrow B\}$	5,6,	Conj.
9. $Z \vee B$	8, 7,	C.D.
10. $\therefore B$	9, 4,	DS.

3)

1. $C \Rightarrow (D \Rightarrow \neg C)$		
2. $C \equiv D \;/\therefore \neg C \vee \neg D$		
3. $C \Rightarrow (\neg\neg C \Rightarrow \neg D)$	1,	Trans.
4. $C \Rightarrow (C \Rightarrow \neg D)$	3,	D.N.
5. $(C \wedge C) \Rightarrow \neg D$	4,	Exp.
6. $C \Rightarrow \neg D$	5,	Taut.
7. $\neg C \vee \neg D$	6,	Impl.

4)

1. $E \wedge (F \vee G)$		
2. $(E \wedge G) \Rightarrow \neg (H \vee I)$		
3. $\neg (\neg H \vee \neg I) \Rightarrow \neg (E \wedge F) \;/ \therefore H \equiv I$		
4. $(E \wedge G) \Rightarrow (\neg H \wedge \neg I)$	2,	De.M.
5. $\neg (H \wedge I) \Rightarrow \neg (E \wedge F)$	3,	De.M.
6. $(E \wedge F) \Rightarrow (H \wedge I)$	5,	Trans.
7. $\{(E \wedge F) \Rightarrow (H \wedge I)\} \wedge \{(E \wedge G) \Rightarrow (\neg H \wedge \neg I)\}$	6,4,	Conj.
8. $(E \wedge F) \vee (E \wedge G)$	1,	Dist.
9. $(H \wedge I) \vee (\neg H \wedge \neg I)$	7,8,	C.D.
10. $\therefore H \equiv I$	9,	Equiv.

5)

1. $J \vee (\neg K \vee J)$		
2. $K \vee (\neg J \vee K) \quad / \therefore J \equiv K$		
3. $(\neg K \vee J) \vee J$	1,	Com.
4. $\neg K \vee (J \vee J)$	3,	Ass.
5. $\neg K \vee J$	4,	Taut.
6. $K \Rightarrow J$	5,	Impl.
7. $(\neg J \vee K) \vee K$	2,	Com.
8. $\neg J \vee (K \vee K)$	7,	Ass.
9. $\neg J \vee K$	8,	Taut.
10. $J \Rightarrow K$	9,	Impl.
11. $(J \Rightarrow K) \wedge (K \Rightarrow J)$	10, 6,	Conj.
12. $\therefore J \equiv K$	11,	Equi.

Check Your Progress II

Note: Use the space provided for your answers.

1)
1. $A \vee (B \Rightarrow C)$
2. $A \Rightarrow D$
3. $\neg D \;/\therefore B \Rightarrow C$
4. $\neg A$
5. $\therefore B \Rightarrow C$

2)
1. $(K \equiv L) \Rightarrow A \wedge B$
2. $D \Rightarrow (K \equiv L) / \therefore A$
3. $A \wedge B$
4. $\therefore A$

3)
1. I=>J
2. J=>K
3. L=>M
4. I v L /∴ K v M
5. I=>K 1,2 HS
6. (I=>K) ^ (L=>M)
7. ∴K v M

4)
1. (A=>B)=>(C=>D)
2. (E=>F)=>(A=>B)
3. ¬(C=>D) /∴¬ (E=>F)
4. (E=>F)=>(C=>D)
5. ∴¬(E=>F)

5)
1. A ^ B
2. (A v C)=>D/∴A ^ D
3. A
4. A v C
5. D
6. A ^ D

6)
1. (E v F) ^ (G v H)
2. (E=>G) ^ (F=>H)
3. ¬G /∴H
4. E v F
5. G v H
6. ∴H

1.9 LET US SUM UP

Modern Logic is an extension of traditional logic. However, there is qualitative difference in testing. Difference consists in accuracy and clarity of proof. Nine Rules of Inference include many Rules from traditional logic like modus ponens. All nine Rules are not required always. Only some Rules are required. There is no Rule, which says that one line must be considered only once.

1.10 KEY WORDS

Modus Ponens (MP) : It is a valid and simple argument form sometimes referred to as affirming the antecedent or the law of detachment.

Modus Tollens (MT): It is a valid and simple argument form that is denying the consequent.

Validity: An argument is valid if and only if the truth of its premises entails the truth of its conclusion.

1.11 FURTHER READINGS AND REFERENCES

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