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# Ramapuram campus

# Department of Mathematics

**18MAB302T- DISCRETE MATHEMATICS**

**Year/Sem: III/V Branch: CSE,ECE,EEE**

**Unit 3- LOGICS**

1. The proposition is



(a) Contradiction (b) tautology (c) contra positive (d) Converse **Ans : b**

**Solution:**

| P | Q | PQ | QP |  |
| --- | --- | --- | --- | --- |
| T | T | T | T | T |
| T | F | T | T | T |
| F | T | T | T | T |
| F | F | F | F | T |

It is a Tautology.

2.The proposition is **Ans :a**



(a) Contradiction (b) tautology (c) contra positive (d) Converse

**Solution:**

| P | Q | PQ | PQ |  |  |
| --- | --- | --- | --- | --- | --- |
| T | T | T | T | F | F |
| T | F | F | T | F | F |
| F | T | F | T | F | F |
| F | F | F | F | T | F |

1. Symbolic form of “If either ram takes calculus or krish takes sociology ,then arun will take English”.

(a) (b) (c) (d) **Ans : a**

**Solution:**

Let a: Ram takes calculus

b: Krish takes sociology

c: Arun will take English. Symbolically form is



1. Symbolic form of “ If tigers have wings then the earth travels round the sun”. **Ans : a**

(a) (b) (c) (d)



**Solution:**

Let P: Tiger have wings, Q: Earth travels round the symbolic form is



The given proposition is a contradiction

5. Give the converse of the implication “ If it is raining , then I get wet”.  **Ans :d**

(a) If I do not get wet ,then it is raining (b) If I do not get wet ,then it is not raining

(c) If I get wet ,then it is not raining (d) If I get wet ,then it is raining

**Solution:**

If PQ , then the converse of the implication is given by Q.



Hence, If I get wet ,then it is raining.

6. Give the contra positive of the implication “ If it is raining , then I get wet”.  **Ans :b**

(a) If I do not get wet ,then it is raining (b) If I do not get wet ,then it is not raining

(c) If I get wet ,then it is not raining (d) If I get wet ,then it is raining

**Solution:**

If PQ , then the contrapositive of the implication is given by Q



Let P: It is raining , Q: I get wet, : It is not raining, Q: I do not get wet



If I do not get wet ,then it is not raining.

7. Give the contra positive of the implication “ Only if Raju studies well he pass the test”. **Ans :c**

(a) If Raju does not study, then he will pass the test (b) If Raju study, then he will pass the test

(c)If Raju does not study, then he will not pass the test

(d) If Raju does not study, then he will pass the test

**Solution:**

Let P: Raju studies well Q: He will pass the test.

Contrapositive for PQ is Q



8. The proposition *p*∧ ∼ *p* is a

(a) Contradiction (b) tautology (c) contra positive (d) Converse **Ans : a**

**Solution :**

| p | ∼ *p* | *p*∧ ∼ *p* |
| --- | --- | --- |
| T  F | F  T | F  F |

From the above truth table, The proposition *p*∧ ∼ *p* is a Contradiction.

9. p, p, q **Ans :c**



(a) p (b) q (c) r (d) p



Using modus ponens p, p, we get q.



Again, Using modus ponens q, q, we get r



10. Logical equivalence of *p* → (*q* → *r*) is

(a) (*p* ∧ *q*) → *r* (b) (*p* ∧ *q*) →q v *r* (c) (d) r **Ans: a**



**Solution:**

*p* → (*q* → *r*) ≡ ¬*p* ∨ (¬*q* ∨ *r*) as *p* → *p* ≡ (¬*p*) ∨ *q*

≡ (¬*p* ∨ ¬*q*) ∨ *r* Associativity

≡ ¬(*p* ∧ *q*) ∨ *r* De Morgan

≡ (*p* ∧ *q*) → *r* as *p* → *p* ≡ (¬*p*) ∨ *q*

11. Logical equivalence of ¬(*p* ↔ *q*) ≡ -----------

(a) ¬*p* ↔ *q* (b) (*p* ∧ *q*) →q (c) q (d) r **Ans: a**



**Solution:**

¬(*p* ↔ *q*) ≡ ¬(*p* ∧ *q*) ∧ ¬(¬*p* ∧ ¬*q*) De Morgan

≡ (¬*p* ∨ ¬*q*) ∧ (*p* ∨ *q*) De Morgan, Double negation

≡ (¬*p* ∧ *p*) ∨ (¬*p* ∧ *q*) ∨ (¬*q* ∧ *p*) ∨ (¬*q* ∧ *q*) Distributivity

≡ (¬*p* ∧ *q*) ∨ (¬*q* ∧ *p*) Constants

≡ (¬*p* ∧ *q*) ∨ (¬¬*p* ∧ ¬*q*) Double negation

≡ ¬*p* ↔ *q*

12. The dual of ¬(p ∨ q) ∧ r and T is are **Ans :a**

(a) ¬(p ∧ q) ∨ r , F (b) (p ∧ q), T (c) ¬(p ∧ q) , F (d) (p ∧ q) ∨ r, T

**Solution:**

The dual P ∗ of a formula P involving the connectives ∨, ∧, ¬ is obtained by interchanging ∨

with ∧. Therefore, the dual of ¬(p ∨ q) ∧ r , T are ¬(p ∧ q) ∨ r and F.

13. Logical equivalence of *p* → *q, p* → *r* , *p* → *q* ∧ *r is*  **Ans :b**

a) F (b) (T (c) ¬(p ∧ q) (d) (p ∧ q) ∨ r

**Solution:**

Suppose p is T . Since p → q is T , q is T . Since p → r is T , r is T . Then q ∧ r is T . Hence

p → q ∧ r is T .

14. ¬ (p ∨ (¬ p ∧ q)) ≡ **Ans :d**

(a) (b) (c) (d)

**Solution:**

Using equivalence laws properties

¬(p ∨ (¬p ∧ q)) ≡ ¬p ∧ ¬(¬p ∧ q) DeMorgan

≡ ¬p ∧ (p ∨ ¬q) DeMorgan

≡ (¬p ∧ p) ∨ (¬p ∧ ¬q) Distributivity

≡ F∨(¬p ∧ ¬q) Because ¬p ∧ p ≡ F

≡ ¬p ∧ ¬q Because F ∨r ≡ r for any r

15. What is the valid inference from the premises .  **Ans :b**



(a) P (b) R (c) Q (d)



**Solution:**

(1) PQ Rule P



( 2) QR Rule P



(3) P Rule P

(4) PR Rule T, Hypothetical Syllogism(1), (2)



(5) R Rule T, Modus ponens, (3), (4)

16. ( p ∧ q) → (p ∨ q) ≡ **Ans :a**

(a)T (b) F (c) p v q (d) p-q

**Solution:**

(p ∧ q) → (p ∨ q) ≡ ¬(p ∧ q) ∨ (p ∨ q)

≡ (¬p ∨ ¬q) ∨ (p ∨ q) DeMorgan

≡ (¬p ∨ p) ∨ (¬q ∨ q) Commutativity and Associativity

≡ T∨T ≡ T Because ¬p ∨ p ≡ T

17. (p → q) ∧ (p → r) ≡ p → (q ∧ r) **Ans :a**

(a) p → (q ∧ r) (b) p - p → (q ∧ r)

(c) p → (q ∧ r) vp (d) p →p v (q ∧ r)

**Solution:**

(p → q) ∧ (p → r) ≡ (¬ p ∨ q) ∧ (¬ p ∨ r)

≡ ¬p ∨ (q ∧ r)

≡ p → (q ∧ r)

18. The proposition *p* → *q* ≡ -------------

(a) p → (q ∧ p) (b) ¬*q* → *p* (c) p → q v p (d) p →p v q **Ans :b**

**Solution:**

***p*** → *q* is false if and only if *p* is true and *q* is false if and only if ¬*p* is false and ¬*q* is true

if and only if ¬*q* → ¬*p* is false. Hence *p* → *q* ≡ ¬*q* → *p*.

19. *p, p* → *q* ⇒

(a) p (b) *q* (c) p → q v p (d) p →p v q **Ans :b**

**Solution:**

Suppose *p* and *p* → *q* are *T* (under an assignment). Suppose *q* is *F* (under the same assignment). As *p* → *q* is *T* , *p* must be *F* . This is a contradiction

20**.** ¬*q, p* → *q* ⇒

(a) ¬p (b) *q* (c) p → q v p (d) p →p v q **Ans :a**

**Solution :**

Suppose ¬*q* and *p* → *q* are *T* . If ¬*p* is *F* , then *p* is *T* . Now that *p* → *q* is *T* , we see that *q* is *T* . This is a contradiction.

21.The proposition p is a



(a) Tautology (b) Contradiction (c) Implication (d) Quantifier **Ans :a**

**Solution :**

| P |  | p |
| --- | --- | --- |
| T | F | F |
| F | T | F |

It is a contradiction.

22. The proposition p is a



(a) Tautology (b) Contradiction (c) Implication (d) Quantifier **Ans :a**

**Solution :**

| P |  | p |
| --- | --- | --- |
| T | F | T |
| F | T | t |

It is a Tautology

23. The proposition *p* → *q, q* → *r* ⇒ *p* → *r is*

(a) F (b) T (c) contingency (d) pq **Ans : b**



**Solution:**

Suppose *p* → *r* is *F* . Then *p* is *T* and *r* is *F* . As *r* is *F* and *q* → *r* is *T* , *q* must be *F* . As *q* is *F* and *p* → *q* is *T* , *p* is *F* , a contradiction.

24. The proposition is *p* → *q, p* → *r* ⇒ *p* → *q* ∧ *r*

(a) p q (b) *p* → *r*. (c) *T* (d) q **Ans : c**



**Solution :**

Suppose *p* is *T* . Since *p* → *q* is *T* , *q* is *T* . Since *p* → *r* is *T* , *r* is *T* . Then *q* ∧ *r* is *T* . Hence

*p* → *q* ∧ *r* is *T* .

25. The proposition is  *p* → *r, q* → *r* ⇒ *p* ∨ *q* → *r*

(a) F (b) *p* → *r*. (c) q (d) *T*  **Ans : d**

**Solution :**

Suppose *p* ∨ *q* → *r* is *F* . Then *p* ∨ *q* is *T* and *r* is *F* . Since *r* is *F* and the premise *p* → *r* is *T* , we have *p* is *F* . Similarly, the premise *q* → *r* gives *q* is *F* . Now, the three statements *p* is *F* , *q* is *F* and *p* ∨ *q* is *T* lead to a contradiction**.**