



KTU
NOTES
The learning companion.

**KTU STUDY MATERIALS | SYLLABUS | LIVE
NOTIFICATIONS | SOLVED QUESTION PAPERS**

Module 1

Propositional Logic

- Q.1 Tautology & Contradiction (by using truth table & without using truth table (can be solved by laws of logic))
- Q.2 Find the dual (principle of duality)
- Q.3 Problems on converse, converse, & contrapositive
- Q.4) Equivalence Problem
- a) with using truth table
 - b) without using truth table (i.e. by using laws of logic)
- Q. Eg.: Show that $p \vee (q \rightarrow p)$ and $(p \vee q) \wedge (p \vee r)$ are logically equivalent (can solve using truth table).
- Without using truth table prove
- $$p \rightarrow (q \rightarrow p) \Leftrightarrow \neg p \rightarrow (p \rightarrow q)$$
- Q.5) Theory of inference \Rightarrow Prove validity of the argument pblm.
- Show that t is a valid conclusion from the premises $p \rightarrow q, q \rightarrow r, r \rightarrow s, 7s$ and $p \vee t$
 - Check the validity of the following argument
"Riya is baking a cake. If Riya is baking a cake then she is not practising the flute. If Riya is not practising the flute then she is not baking a cake." (Refer pdf)
 - Show that $t \wedge s$ can be derived from the premises $p \rightarrow q, q \rightarrow r, r \rightarrow s, p \vee (t \wedge s)$

Rule CP

- Determine the validity of the argument using rule CP, $p \rightarrow (q \rightarrow s), (7r \vee p), q \Rightarrow r \rightarrow s$

Q.7 Indirect method of proof (proof by contradiction)

- Use the indirect method of proof to show that $\neg p$ logically follows from the premises $\neg q \rightarrow \neg p$, $\neg r \vee s$, $s \rightarrow \neg q$, $p \rightarrow q$.

Q.8 Inconsistency problems : Proof that the premises $a \rightarrow (b \rightarrow c)$, $d \rightarrow (b \wedge \neg c)$ and $a \wedge d$ are inconsistent.

Predicate logic

Q.1 What are free and bound variables

Q.2 Problem on equivalence. • prove the following equivalence

$$(\forall x) (P(x) \vee Q(x)) \Rightarrow (\forall x) P(x) \wedge (\exists x) Q(x)$$

Q.3 Problem on converse, inverse & contrapositive

Q.4 Symbolise the statements

i) All students are clever. ii) Some men are clever.

iii) Some students are not successful.

Q.5 Negation problem.

• Express the negation of the following statement

"If the teacher is absent, then some students don't keep quiet".

Q.6 Validity of the argument problem \rightarrow Rule US, ES, EG, UG.

Q. Check the validity of the argument "All mathematics professors have studied calculus. Leona ...". (Refer pdf)

Other Problems

Q.1 Problem on proof by contradiction & contrapositive.

Q. Prove by contradiction that if n^2 is an even integer, then n is even.

Q. Show that 'if x is an integer and x^2 is even, then x is also even' by contrapositive.

Module 2

1. Rule of Sum & Rule of Product
2. Problems on permutation and combinations
3. Binomial Theorem
 - Q. Determine the coefficient of x^9y^3 in the expansion of $(x+y)^{12}$, $(x+2y)^{12}$ and $(2x-3y)^{12}$ (most imp)
4. Problems on combination with repetition
5. Pigeon hole principle and problems (most imp)
6. Principle of inclusion & exclusion theorem
 - 2 types
(Refer pdf and video).
 - Q. Find the no. of integers between 1 and 150 both inclusive that are not divisible by any of integers 2, 3, 5 & 7. (Refer pdf)
 - Q. In a class of 25 students, 12 have taken Maths, 8 have taken Maths but not Biology. Find the no. of students who have taken Maths and Biology and those who have taken Biology not Maths. (Refer video).
7. Rearrangement problems.
 - (Must study permutation, combination, binomial principle of inclusion & exclusion).

Module 3

1. Equivalence relation & equivalence class
2. POSET
3. Hasse Diagram
4. Maximal, Minimal, greatest element, least element
5. Find lub, glb.
6. Lattice (All properties).
 - Q. Let (L, \leq) be a lattice and $a, b, c, d \in L$.
Prove that if $a \leq c$ and $b \leq d$ then $ab \leq cd$.
 - Q. Check whether the following is distributive lattice or not
7. Composition of functions & Relations.
 - Q. Find fog and gof (functions) {V.Vimp}
 - Q. Find $R \circ S$, $S \circ R$ (Relation)
8. Every chain is a distributive lattice } V-V-1mp

Module 4

Q.1 Questions on generating functions & exponential generating functions

Q. Find the generating function for the sequence

Q. Find the coefficient of x^5 in $(1-2x)^{-7}$

Q. Find the exponential gf for the sequence

Q.2 Problems on Recurrence relation (V.Vimp)

(2 cases \rightarrow homogeneous & non-homogeneous)

\rightarrow Homogeneous. (3 cases)

a) Roots are real and distinct

b) Roots are equal and real

c) Complex Roots

\rightarrow Non-Homogeneous.

a) If $f(n) = a^n$.

b) If $f(n) = \text{polynomial}$

c) If $f(n) = C$, and is related with combinations

\rightarrow Questions on non-homogeneous with combinations

of functions - eg: $a_{n+2} + a_{n+1} + a_n = 9 \cdot 2^n$

$$a_n - 4a_{n-1} + 4a_{n-2} = (n+1)2^n$$

Q.3 Solve recurrence relation by generating function

Module - 5

1. Semi group, monoid, sub semi group, sub monoid, group, abelian group.

(Proofs using properties like closure, associativity, commutative, distributive, inverse, identity etc.)

2. Subgroup, symmetric group on three symbols, direct product of groups, cyclic group

q. Find the subgroup of $\langle Z_{12}, +_{12} \rangle$ (Must try).

q. find the cyclic group generated.

q. Prove the direct product of groups is also a group.

3. Homomorphism, Isomorphism.

Proofs

1. Identity of a group is unique

2. Inverse of a group is unique

3. Necessary and sufficient condition of sub group.

Must Study.

4. Every subgroup of a cyclic group is cyclic

5. Lagrange Theorem.

6.

5. Cosets problem.

optional proofs: proofs provided for cyclic group.