Bachelor of Computer Application (B.C.A.) Semester—I Examination

DISCRETE MATHEMATICS—I

Paper—IV

Time : Three Hours] [Maximum Marks : 50

Note :— All questions are compulsory and carry equal marks.

EITHER

1. (a) Construct the truth table for the following :

(i) $(P \rightarrow Q) \wedge (Q \rightarrow P)$

(ii) $\neg(P \wedge Q) \rightleftharpoons (\neg P \vee \neg Q)$ 5

(b) Show that the truth values of the following formula is independent of its components :

$(P \rightarrow Q) \rightleftharpoons (\neg P \vee Q)$ 5

OR

(c) What is well-formed formula ? What are the rules for well-formed formulas ? 5

(d) Show that :

$(\neg P \wedge (\neg Q \wedge R)) \vee (Q \wedge R) \vee (P \wedge R) \Leftrightarrow R$ 5

EITHER

2. (a) What is Disjunctive Normal Form and Conjunctive Normal Form ? Explain the procedure to obtain Conjunctive Normal Form. 5

(b) Obtain the Disjunctive Normal Form of $\neg(P \vee Q) \rightleftharpoons (P \wedge Q)$. 5

OR

(c) Show that the formula $Q \vee (P \wedge \neg Q) \vee (\neg P \wedge \neg Q)$ is a tautology. 5

(d) Obtain the Principal Conjunctive Normal Form of the formula, given by $(\neg P \rightarrow R) \wedge (Q \rightleftharpoons P)$. 5

EITHER

3. (a) Determine whether the conclusion C follows logically from the premises H_1 and H_2 :

(i) $H_1 : P \rightarrow Q$ $H_2 : \neg P$ $C : Q$

(ii) $H_1 : \neg P$ $H_2 : P \rightleftharpoons Q$ $C : \neg(P \wedge Q)$ 5

(b) Demonstrate the R is a valid inference from the premises $P \rightarrow Q$, $Q \rightarrow R$ and P. 5

OR

(c) What is meant by consistency of Premises ? Show that $\neg(P \wedge Q)$ follows logically from $(\neg P \wedge \neg Q)$. 5

(d) Explain the following Rules of Inference Theory :

(i) Rule P

(ii) Rule T

(iii) Rule CP. 5

EITHER

4. (a) Explain the following with the help of examples :

   (i) Predicate

   (ii) Quantifiers. 5

   (b) Show that (x) (H(x) $\rightarrow$ M(x)) $\wedge$ H(x) $\Rightarrow$ M(x). 5

OR

   (c) What is free and bound variables ? Also determine the scope of variables, free and bound occurrences of variables in the following formulas :

   (i) (x) (P(x) $\rightarrow$ Q(x))

   (ii) ($\exists$x) (P(x) $\wedge$ Q(x)). 5

   (d) Show that :

   (x) (P(x) $\rightarrow$ Q(x)) $\wedge$ (x) (Q(x) $\rightarrow$ R(x)) $\Rightarrow$ (x) (P(x) $\rightarrow$ R(x)). 5

5. (a) What is duality law ? Explain with examples. 2½

   (b) What is Minterms and Maxterms ? Write Minterms for 2 variables, P and Q. 2½

   (c) Show I_{12} : $\neg$Q, P $\rightarrow$ Q $\Rightarrow$ $\neg$P. 2½

   (d) Symbolize the expression "All the world loves a lover." 2½

NJR/KS/18/3209

Bachelor of Computer Application (B.C.A.) Semester—I (C.B.S.) Examination

DISCRETE MATHEMATICS—I

Paper—IV

Time : Three Hours] [Maximum Marks : 50

Note :— ALL questions are compulsory and carry equal marks.

EITHER

1. (A) Construct the truth table for
$(\neg P \wedge C \neg Q \wedge R)) \vee (Q \wedge R) \vee (P \wedge R)$. 5

(B) Prove that If $H_1, H_2, \ldots\ldots, H_m$ and P imply Q, then $H_1, H_2, \ldots\ldots, H_m$ imply $P \rightarrow Q$. 5

OR

(C) What do you mean by contradiction statement.
Check whether $((\neg Q \wedge P) \wedge \neg Q)$ is contradiction or not ? 5

(D) Show that :
$(\neg P \wedge (\neg Q \wedge R) \vee (Q \wedge R) \vee (P \wedge R) \Leftrightarrow R$. 5

EITHER

2. (A) Define :
(i) Disjunctive Normal Form
(ii) Conjunctive Normal Form. 5

(B) Obtain the principal disjunctive normal form of $P \rightarrow ((P \rightarrow Q) \wedge \neg(\neg Q \vee \neg P))$. 5

OR

(C) Obtain a conjunctive normal form of the following formula :

$$\neg(P \vee Q) \rightleftarrows (P \wedge Q).$$ 5

(D) Show that the formula $P \vee (P \wedge Q) \Leftrightarrow P$ is equivalence formula. 5

EITHER

3. (A) Demonstrate that R is a valid inference from the premises $P \rightarrow Q$, $Q \rightarrow R$ and P. 5

(B) Show that the conclusion C is valid from the premises H_1 and H_2.
(i) $H_1 : P \rightarrow Q$ $H_2 : P$ $C : Q$
(ii) $H_1 : \neg P$, $H_2 : P \vee Q$ i $C : P \wedge Q$. 5

OR

(C) Show that $R \rightarrow S$ can be derived from the premises $P \rightarrow (Q \rightarrow S)$, $\neg R V S$ and Q. 5

(D) Show that $R \wedge (P \vee Q)$ is a valid conclusion from the premises $P \vee Q$, $Q \rightarrow R$, $P \rightarrow M$ and $\neg m$. 5

EITHER

4. (A) Explain Free and Bound variables with suitable example. 5

(B) Show that $\neg P(a, b)$ follows logically from $(x)(y)\ (P(x,y) \rightarrow W(x,y))$ and $\neg W(a,b)$. 5

OR

(C) Prove that :

$(\exists x)\ (P(x) \wedge Q(x)) \Rightarrow (\exists x)\ P(x) \wedge (\exists x) Q(x).$ 5

(D) Show that :

$(x)\ (P(x) \rightarrow Q(x)) \wedge (x)\ (Q(x) \rightarrow R(x)) \Rightarrow (x)\ (P(x) \rightarrow R(x)).$ 5

5. Attempt **ALL** :

(A) Define conjunction operation and state its truth table. 2½

(B) What is min-term ? Write down all the min-terms for three variables P, Q and R. 2½

(C) State the rules of Inferences. 2½

(D) Explain the rules of US and ES. 2½

Bachelor of Computer Application (B.C.A.) Semester—I (C.B.S.) Examination

DISCRETE MATHEMATICS—I

Paper—IV

Time : Three Hours] [Maximum Marks : 50

N.B. :— ALL questions are compulsory and carry equal marks.

EITHER

1. (a) What is well-formed formula ?

Check whether

(i) $(P \rightarrow (P \vee Q)$

(ii) $(P \wedge Q) \rightleftarrows P$

are well-formed formulas. 5

(b) Construct the truth table for the formula $\neg(P \wedge Q) \rightleftarrows (\neg P \vee \neg Q)$ 5

OR

(c) Explain Law of duality with example. 5

(d) Show that truth value of

$$(P \rightarrow Q) \rightleftarrows (\neg P \vee Q)$$

is independent of its components. 5

EITHER

2. (a) Obtain the principle conjunctive normal form of $(\neg P \rightarrow R) \wedge (Q \rightleftarrows P)$. 5

(b) Find disjunctive normal form of $(P \rightarrow (Q \rightarrow R))$. 5

OR

(c) Find CNF of :—

$$(P \vee Q \vee R) \wedge (P \rightarrow Q).$$ 5

(d) Obtain the principal disjunctive normal form of $(P \wedge Q) \vee (\neg P \wedge R) \vee (Q \wedge R)$. 5

EITHER

3. (a) Determine whether C : Q logically follows from :

   $H_1 : P \rightarrow Q$ and $H_2 : P$. 5

   (b) Show $S \vee R$ is tautologically implied by $(P \vee Q) \wedge (P \rightarrow R) \wedge (Q \rightarrow S)$. 5

OR

   (c) Check R is valid inference from $P \rightarrow Q$, $Q \rightarrow R$, and P. 5

   (d) Show that $\neg(P \wedge Q)$ follows from $\neg P \wedge \neg Q$. 5

EITHER

4. (a) Indicate whether the variables are free or bound, also show the scope.

   $(x)\,(P(x) \rightleftarrows Q(x) \wedge (\exists x)\, R(x)) \wedge S(x)$. 5

   (b) Negate the following Statements :

   (i) Ottawa is small town

   (ii) Every city in India is not clean. 5

OR

   (c) Show :

   $(x)\,(P(x) \rightarrow Q(x)) \wedge (x)\,(Q(x) \rightarrow R(x)) \Rightarrow (x)\,(P(x) \rightarrow R(x))$. 5

   (d) Demonstrate the implication :

   $\neg((\exists x)\, P(x) \wedge Q(a)) \Rightarrow (\exists x)\, P(x) \rightarrow \neg Q(a)$. 5

5. Attempt **ALL** :—

   (a) What is tautology ? Explain with example. 2½

   (b) What is max-term ? 2½

   (c) What are the Rules of Inference ? 2½

   (d) Write a statement ''This painting is red'' in predicate logic. 2½

(H) What is rule T ?

(I) What is indirect method of proof ?

(J) Symbolize the statement :

"All men are giants"

(K) What is free and bound variables ?

(L) What is universe of discourse ? 1×10=10

Bachelor of Computer Application (B.C.A.) Semester—I Examination

DISCRETE MATHEMATICS—I

Paper—IV

Time—Three Hours] [Maximum Marks—50

N.B. :— All questions are compulsory and carry equal marks.

EITHER

1. (A) Show that :

$$P \rightarrow (Q \rightarrow R) \Leftrightarrow P \rightarrow (\neg Q \lor R) \Leftrightarrow (P \land Q) \rightarrow R.$$ 5

(B) Show that :

$$\neg(P \land Q) \rightarrow (\neg P \lor (\neg P \lor Q) \Leftrightarrow (\neg P \lor Q).$$ 5

OR

(C) Write an equivalent formula for

$$P \land (Q \rightleftarrows) \lor (R \rightleftarrows P)$$

which does not contain the biconditional. 5

(D) Write in symbolic form the statement :

"The crop will be destroyed if there is a flood". 5

EITHER

2. (A) Obtain the principal conjunctive normal form

$$(\neg P \rightarrow R) \wedge (Q \rightleftarrows P).$$ 5

(B) Show that :

$$\neg(P \wedge Q) \rightarrow (\neg P \vee (\neg P \vee Q)) \leftrightarrow (\neg P \vee Q).$$ 5

OR

(C) Obtain the conjunctive normal of following :

$$(P \rightarrow (Q \wedge R) \wedge (\neg P \rightarrow (\neg Q \wedge \neg R))).$$ 5

(D) Show that the following is equivalent formula :

$$P \vee (P \wedge Q) \Leftrightarrow P.$$ 5

EITHER

3. (A) Show that R is a valid inference from the premises $P \rightarrow Q$, $Q \rightarrow R$ and P. 5

(B) Show that $R \wedge (P \vee Q)$ is a valid conclusion from the premises ,

$$P \vee Q,\ Q \rightarrow R,\ P \rightarrow M \text{ and } \neg M.$$ 5

OR

(C) Show that $R \rightarrow S$ can be derived from the premises $P \rightarrow (Q \rightarrow S)$, $\neg R V P$ and Q. 5

(D) Show that $\neg(P \wedge Q)$ follows from $\neg P \wedge \neg Q$. 5

EITHER

4. (A) Show that :

$$(x)\ (P(x) \rightarrow Q(x) \wedge (x)\ (Q(x) \rightarrow R(x))$$
$$\Rightarrow (x)\ (P(x) \rightarrow R(x).$$ 5

(B) Show that $(\exists x)\ M(x)$ follows logically from the premises

$$(x)\ (H(x) \rightarrow M(x)) \text{ and } (\exists x)\ H(x).$$ 5

OR

(C) Indicate the variables that are free and bound. Also show that scope of the quantifiers :

$$(x) \cdot (P(x) \wedge (\exists x)\ Q(x)) \vee ((x)\ P(x) \rightarrow Q(x)).$$ 5

(D) Show that :

$$P(x) \wedge (x)\ Q(x) \Rightarrow (\exists x)\ (P(x) \wedge Q(x)).$$ 5

5. Solve any **TEN** :

(A) Construct the truth tables for the following formula :

$$(P \vee Q) \vee \neg P$$

(B) What is conjunction ?

(C) Write the duals of $(P \vee Q) \wedge R$.

(D) What is PDNF ?

(E) What is minterms ?

(F) What is conjunctive normal form ?

(G) What is deduction ?

KNT/KW/16/5242

Bachelor of Computer Application (B.C.A.) Semester—I (C.B.S.) Examination

DISCRETE MATHEMATICS—I

Paper—IV

Time : Three Hours] [Maximum Marks : 50

N.B. :— (1) **All** questions are compulsory.

(2) Draw diagrams wherever necessary.

EITHER

1. (A) Show that the truth table of the formula is independent of the components :

$(P \rightarrow Q) \rightleftarrows (\neg P \vee Q)$ 5

(B) State Duality Law. Verify duality law for $A(P, Q, R) = \neg P \wedge \neg(Q \vee R)$. 5

OR

(C) Given the truth values of P and Q as T and those of R and S as F, find the truth values of the following :

$(\neg (P \wedge Q) \vee \neg R) \vee ((Q \rightleftarrows \neg P) \rightarrow (R \vee \neg S))$. 5

(D) Show the equivalence :

$\neg(P \rightleftarrows Q) \Leftrightarrow (P \wedge \neg Q) \vee (\neg P \wedge Q)$. 5

EITHER

2. (A) Show that the formula $Q \vee (P \wedge \neg Q) \vee (\neg P \wedge \neg Q)$ is a tautology by using conjunctive normal form. 5

(B) Obtain the Principal Conjunctive normal form of the formula $(\neg P \rightarrow R) \wedge (Q \rightleftarrows P)$. 5

OR

(C) Obtain the Principal Disjunctive Normal Form for the formula :

$P \rightarrow (P \rightarrow Q) \wedge \neg(\neg Q \vee \neg P)$. 5

(D) Show that the following is equivalent formula :

$(P \vee (\neg P \vee Q)) \rightleftarrows P \vee Q$. 5

EITHER

3. (A) Determine whether the conclusion C is valid when H_1, H_2 are the premises.

$H_1 : \neg P \quad H_2 : P \rightleftarrows Q \quad C : \neg(P \wedge Q)$. 5

(B) Show that $R \wedge (P \vee Q)$ is a valid conclusion from the premise :

$P \vee Q, \; Q \rightarrow R, \; P \rightarrow M$ and $\neg M$. 5

OR

(C) Show that $\neg(P \wedge Q)$ follows from $\neg P \wedge \neg Q$. 5

(D) Show that the following premises are inconsistent.

$$P \rightarrow Q, \quad P \rightarrow R, \quad Q \rightarrow \neg R, \; P.$$ 5

EITHER

4. (A) Show that :

$$(x)\,(P(x) \rightarrow Q(x)) \wedge (x)\,(Q(x) \rightarrow R(x)$$

$$\Rightarrow (x)\,(P(x) \rightarrow R(x)).$$ 5

(B) Indicate in following the variables are free or bound, also show the scope :

$$(x)\,(P(x) \wedge R(x), \rightarrow (x)\,P(x) \wedge Q(x).$$ 5

OR

(C) Symbolize the statement using the set of positive integers as the universe of discourse. "Given any positive integer, there is a greater positive integer." 5

(D) Show that $(\exists x)\,M(x)$ follows logically from the premises :

$$(x)\,(H(x) \rightarrow M(x)) \text{ and } (\exists x)\,H(x).$$ 5

5. (A) Construct the truth table for $(P \vee Q) \vee \neg P$. 2½

(B) Define elementary sum, elementary product and give the examples. 2½

(C) Show I_{12} : $\neg Q,\; P \rightarrow Q \Rightarrow \neg P$. 2½

(D) Explain the rules of specification and generalization. 2½

Bachelor of Computer Application (B.C.A.) Semester—I Examination

DISCRETE MATHEMATICS—I

Paper—IV

Time : Three Hours] [Maximum Marks : 50

N.B. :— ALL questions are compulsory and carry equal marks.

EITHER

1. (A) What is the truth table and statement formulas ? Write the steps to construct the truth table. 5

(B) Show that :

$$\neg(P \wedge Q) \rightarrow (\neg P(\neg P \vee Q)) \Leftrightarrow (\neg P \vee Q).$$ 5

OR

(C) Show that :

$$((P \vee Q) \wedge \neg(\neg P \wedge (\neg Q \vee \neg P))) \vee (\neg P \wedge \neg Q) \vee (\neg P \wedge \neg R)$$

is a tautology. 5

(D) Prove that $\{\wedge, \neg\}$ and $\{\vee, \neg\}$ are functionally complete. 5

EITHER

2. (A) Obtain principal conjunctive normal form of formula :

$$(\neg P \rightarrow R) \wedge (Q \rightleftarrows P).$$ 5

(B) Define DNF and CNF. Also describe the procedure to obtain DNF and CNF. 5

OR

(C) Obtain conjuctive normal form of :

$$\neg(P \vee Q) \rightleftarrows (P \wedge Q).$$ 5

(D) Define PDNF. Discuss the truth table and replacement method to obtain PDNF. 5

EITHER

3. (A) Determine whether the conclusion C is valid for the premises H_1, H_2 and H_3.

$H_1 : P \vee Q$, $H_2 : P \rightarrow R$, $H_3 : Q \rightarrow R$ and $C : R$. 5

(B) Show that $\neg(P \wedge Q)$ follows from $\neg P \wedge \neg Q$. 5

OR

(C) What is theory of inference for statement calculus ? What are the rules of inference ? 5

(D) Demonstrate that R is valid inference from the premises $P \rightarrow Q$, $Q \rightarrow R$ and P. 5

EITHER

4. (A) Show that :

$$(x)\ (H(x) \rightarrow M(x)) \wedge H(s) \Rightarrow M(s).$$ 5

(B) Explain free and bound variables with respect to predicate calculus. Give an example. 5

OR

(C) Symbolise the expression "ALL the world lovers a lover". 5

(D) Define variable and quantifier. Also explain various types of quantifier. 5

5. Attempt **ALL** :

(A) Negate and simplify the following statement :

$$(P \vee Q) \wedge \neg(\neg P \wedge Q).$$ 2½

(B) Obtain PDNF of the following using truth table method :

$$(P \vee Q).$$ 2½

(C) Show that :

$$\neg Q, P \rightarrow Q \Rightarrow \neg P.$$ 2½

(D) What is universe of disclosure ? Give one example. 2½

NIR/KW/18/2209

Bachelor of Computer Application (B.C.A.) Semester—I Examination

DISCRETE MATHEMATICS—I

Paper—IV

Time : Three Hours] [Maximum Marks : 50

N.B. :— ALL questions are compulsory and carry equal marks.

EITHER

1. (A) Define Well-Formed Formula. Write rules to generate Well-Formed Formula. Give any two examples of Well-Formed Formula. 5

(B) Construct the truth tables of the following formulae :

(i) $(Q \wedge (P \rightarrow Q)) \rightarrow P$.

(ii) $\neg(P \vee (Q \wedge R)) \rightleftarrows ((P \vee Q) \wedge (P \vee R))$. 5

OR

(C) What is Duality law ? Write the duals of the following :

(i) $(P \vee Q) \wedge R$.

(ii) $\neg(P \vee Q) \wedge (P \vee \neg(Q \wedge \neg S))$. 5

(D) Define and give example of the following connectives :

(i) Negation

(ii) Conjunction

(iii) Disjunction. 5

EITHER

2. (A) Obtain the principal conjunctive Normal form of the formula, given by $(\neg P \rightarrow Q) \wedge (Q \rightleftarrows P)$. 5

(B) Obtain Disjunctive Normal form of :

(i) $P \wedge (P \rightarrow Q)$.

(ii) $\neg(P \vee Q) \rightleftarrows (P \wedge Q)$. 5

OR

(C) Obtain the principal disjunctive normal form of :

$P \rightarrow ((P \rightarrow Q) \wedge \neg(\neg Q \vee \neg P))$. 5

(D) Show that the formula :

$Q \vee (P \wedge \neg Q) \vee (\neg P \wedge \neg Q)$ is a tautology. 5

EITHER

3. (A) Determine whether the conclusion 'C' follows logically from the premises H_1 and H_2 :

   (i) $H_1 : P \rightarrow Q \quad H_2 : \neg(P \wedge Q) \quad C : \neg P$

   (ii) $H_1 : \neg P \quad H_2 : P \rightleftarrows Q \quad C : \neg(P \wedge Q)$ 5

   (B) What are the rules of Inference ? Prove that :

   $\neg P \wedge (P \vee Q) \Rightarrow Q.$ 5

OR

   (C) Show that, $\neg(P \wedge Q)$ follows from $\neg P \wedge \neg Q$. 5

   (D) Show that $R \rightarrow S$ can be derived from the premises $P \rightarrow (Q \rightarrow S)$, $\neg R \vee P$ and Q. 5

EITHER

4. (A) Show that, $(\exists x)\ M(x)$ follows logically from the premises : $(x)\ (H(x) \rightarrow M(x))$ and $(\exists x)\ H(x)$. 5

   (B) Define free and bound variables with suitable example. 5

OR

   (C) Define Universal quantifier and Existential quantifier with suitable example. 5

   (D) Prove that, $(\exists x)\ (P(x) \wedge Q(x)) \Rightarrow (\exists x)\ P(x) \wedge (\exists x)\ Q(x)$. 5

5. (A) Show that :

   $P \uparrow Q \Leftrightarrow \neg(P \wedge Q).$ 2½

   (B) Define the terms :

   (i) Conjunctive Normal form.

   (ii) Disjunctive Normal form. 2½

   (C) Demonstrate that R is a valid inference from the premises, $P \rightarrow Q$, $Q \rightarrow R$ and P. 2½

   (D) Symbolize the statement, "All men are giants". 2½

TKN/KS/16/5953

Bachelor of Computer Application (B.C.A.)
Semester—I (C.B.S.) Examination
DISCRETE MATHEMATICS—I
Paper—IV

Time—Three Hours] [Maximum Marks—50

N.B. :— All questions are compulsory and carry equal marks.

EITHER

1. (A) Show that :

$P \to (Q \to P) \Leftrightarrow \neg P (P \to Q)$. 5

(B) Construct the truth table for $(Q \wedge (P \to Q)) \to P$. 5

OR

(C) Given the truth value of P and Q as T and those of R and S as F, find the truth values of :

$(\neg (P \wedge Q) \vee \neg R) \vee ((Q \to \neg P) \to (R \vee \neg S))$. 5

(D) Show that :

$(\neg P \wedge (\neg Q \wedge R)) \vee (Q \wedge R) \vee (P \vee R) \Leftrightarrow R$. 5

EITHER

2. (A) Obtain the conjunctive normal form of :

$\neg (P \vee Q) — (P \wedge Q)$. 5

(B) Obtain the principal disjunctive normal form of :

$$P \to ((P \to Q) \wedge \neg(\neg Q \vee \neg P)).$$ 5

OR

(C) Obtain the principal conjunctive normal form of :

$$(\neg P \vee \neg Q) \to (P \rightleftharpoons \neg Q).$$ 5

(D) Obtain the principal disjunctive normal form of $\neg P \vee Q$. 5

EITHER

3. (A) Determine whether the conclusion C follows logically from premises H_1 and H_2 :

$$H_1 : P \to Q, \quad H_2 : \neg(P \wedge Q) \qquad C : \neg P$$ 5

(B) Show that $R \vee S$ follows logically from the premises $C \vee D$, $(C \vee D) \to \neg H$, $\neg H \to (A \wedge \neg B)$, and $(A \wedge \neg B) \to (R \vee S)$. 5

OR

(C) Show that :

$$\neg Q, P \to Q \Rightarrow \neg P.$$ 5

(D) Show that $S \vee R$ is tautologically implied by : $(P \vee Q) \wedge (P \to R) \wedge (Q \to S)$. 5

EITHER

4. (A) Explain the following with respect to predicate calculus with one example of each :

(i) Predicate formula

(ii) Free and bound variables

(iii) Universe of discourse

(iv) Statement function. 5

(B) Show that :

$$(x)(P(x) \to Q(x)) \wedge (x)(Q(x) \to R(x)) \Rightarrow (x)(P(x) \to R(x))$$ 5

OR

(C) Show that :

$$(x)(H(x) \to M(x)) \wedge H(s) \Rightarrow M(s).$$ 5

(D) Show that $\neg P(a, b)$ follows logically from $(x)(y)(P(x, y) \to W(x, y))$ and $\neg W(a, b)$. 5

5. (A) Write the duds of :

(i) $(P \vee Q) \wedge R$

(ii) $\neg(P \vee Q) \wedge (P \vee \neg(Q \wedge \neg S))$. 2½

(B) Obtain the product-of-sums canonical forms of :

$$(P \wedge Q \wedge R) \vee (\neg P \wedge R \wedge Q) \vee (\neg P \wedge \neg Q \wedge \neg R).$$ 2½

(C) What are the rules of inference ? 2½

(D) Symbolize the expression ''All the world loves a lover''. 2½