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MCS-013

MCA (Revised) / BCA (Revised)

Term-End Examination

08018

June, 2016

MCS-013 : DISCRETE MATHEMATICS

Time : 2 hours *Maximum Marks : 50*

Note : *Question number 1 is **compulsory**. Attempt any **three** questions from the rest.*

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1. (a) Using the principle of mathematical induction prove that

$$5 + 10 + 15 + \dots + 5n = \frac{5n(n+1)}{2}. \qquad 3$$

(b) Let A and B be the $n \times n$ matrices and I be the identity matrix of order $n \times n$.

Check the validity of the following statements and give justification : *4*

(i) $\exists B \; \forall A \qquad A + B = I$

(ii) $\exists B \; \forall A \qquad A + B = A$

(c) Let $f : \beta^2 \rightarrow \beta$ be a function defined as

$f(0, 0) = 1$, $f(0, 1) = 0$, $f(1, 0) = 0$ and $f(1, 1) = 1$.

Find the Boolean expression specifying the function f. *3*

(d) Let f be a permutation function defined as follows :

$$f(1) = 2, f(2) = 4, f(3) = 1, f(4) = 3$$

Find the inverse of f i.e., f^{-1}. *2*

(e) Make a table to recursively calculate P_n^k, where n is the total number, k is the number of partitions, using the following conditions : *3*

$$7 \geq n \geq 1 \text{ and } 1 \leq k < 7.$$

(f) An urn contains 15 balls, of which eight are red and seven are black. In how many ways can 5 balls be chosen such that two are red and three are black ? *3*

(g) In how many ways can 7 people be seated around a circular table ? *2*

2. (a) Show that $\sim (p \rightarrow q) \rightarrow p$ is a tautology. *2*

(b) Prove : *3*

$$\sim (\forall x\, P(x)) \equiv \exists\, x \sim P(x)$$

(c) Give the direct proof of the statement "The sum of two odd integers is always even". *3*

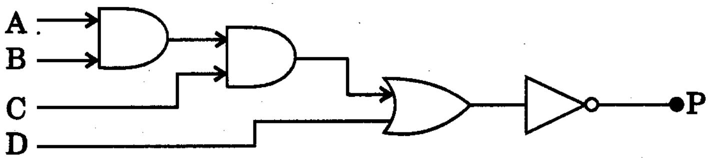
(d) Explain the Identity Laws of Boolean algebra. *2*

3. (a) Reduce the following Boolean expressions to simpler form : *5*

(i) $X(x_1, x_2, x_3) = (x_1 \wedge x_2 \wedge x_3) \vee (x_1 \wedge x_2) \vee (x_2 \wedge x_3)$

(ii) $X(x_1, x_2, x_3) = (x_1 \wedge x_3) \vee x_3 \vee x_2$

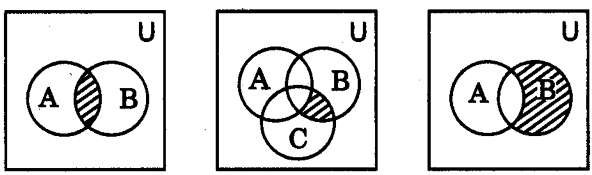
(b) Find the Boolean expression for the following circuit : 3



(c) Make the circuit corresponding to the following Boolean expression : 2

$$x_1' \vee (x_2 \wedge x_3)' \vee (x_2 \wedge x_3 \wedge x_1)$$

4. (a) Write the set expressions for the following Venn diagrams : 3



(b) What is an equivalence relation ? Let A = {1, 2, 3, 4} be a set and R be an equivalence relation on A such that A/R = {{1, 2}, {3, 4}}. Write R. 3

(c) Let f and g be the two functions such that $f(x) = x^2$ and $g(x) = 2x$. Define fof, fog, gof and gog. 2

(d) Find the number of distinguishable words that can be framed from the letters of 'MISSISSIPPI'. 2

5. (a) Prove : 3

$$^{n+1}C_r = {}^nC_{r-1} + {}^nC_r$$

(b) Use pigeonhole principle to show that if 7 colours are used to paint 50 bicycles, then at least 8 bicycles will have the same colour. 2

(c) In how many ways can 10 students be grouped into 2 groups ? 3

(d) Obtain the truth value of the disjunction of 'Sun moves around the Earth' and '2 > 3'. 2