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Total No. of printed pages = 6

MA 131302

Roll No. of candidate

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2017

B.Tech. 3rd Semester End-Term Examination

Computer Science Engineering

DISCRETE MATHEMATICS

Full Marks – 100

Time – Three hours

The figures in the margin indicate full marks
for the questions.

Answer Q.No. 1 and any *six* from the rest.

1. Choose the correct option of the following :

(10 × 1 = 10)

(a) If $A = \{\phi, \{\phi\}\}$, then the power set of A is

(i) A

(ii) $\{\phi, \{\phi\}, A\}$

(iii) $\{\phi, \{\phi\}, \{\{\phi\}\}, A\}$

(iv) none of these

[Turn over

- (b) Let R be a symmetric and transitive relation on a set A . Then
- (i) R is reflexive and hence an equivalence relation
 - (ii) R is reflexive and hence a partial order relation
 - (iii) R is not reflexive and hence not an equivalence relation
 - (iv) None of these
- (c) The number of binary relations on a set with n elements is
- (i) n^2 (ii) 2^n
 - (iii) 2^{n^2} (iv) none of these
- (d) The subset of a countable set is
- (i) countable (ii) uncountable
 - (iii) finite (iv) none of these
- (e) If $f : A \rightarrow B$ is bijective then, $f \circ f^{-1}$ is
- (i) f (ii) f^{-1}
 - (iii) I_A (iv) none of these

- (f) The set $G = \{1, -1\}$ is a group under
- (i) addition
 - (ii) addition modulo
 - (iii) multiplication
 - (iv) none of these
- (g) The contrapositive of $p \rightarrow q$ is
- (i) $p \rightarrow \sim q$ (ii) $\sim q \rightarrow p$
 - (iii) $\sim q \rightarrow \sim p$ (iv) none of these
- (h) gcd of 21 and 85 is
- (i) 2 (ii) 3
 - (iii) 5 (iv) none of these
- (i) Every finite subset of a lattice has
- (i) a lub and a glb
 - (ii) many lubs and a glb
 - (iii) many lubs and many glbs
 - (iv) none of these
- (j) The generating function of the sequence $1, -1, 1, -1, 1, -1, \dots$ is
- (i) $\frac{1}{1-x}$ (ii) $\frac{1}{1+x}$
 - (iii) $\frac{1}{1-x^2}$ (iv) none of these

2. (a) Prove that $A - (A \cap B) = A - B$. (3)
- (b) Define a countable set. Show that the set z of all integers is countable. (2 + 3)
- (c) The function $f: R \rightarrow R$ and $g: R \rightarrow R$ are defined by $f(x) = 2x + 3$ and $g(x) = \frac{x-3}{2}$. Show that, f and g are inverse of each other. (4)
- (d) If $A_n = \left[0, \frac{1}{n}\right]$ be an interval from 0 to $\frac{1}{n}$, $n \in N$, then find $\bigcap A_n$ and $\bigcup A_n$ for all $n \in N$. (3)
3. (a) Prove by induction that $n^n < 2^{n^2}$. (5)
- (b) Use Euclidean algorithm to find gcd (7469, 2464). (4)
- (c) Show that, the relation of congruence modulo m , defined on the set z of integers by $a \equiv b \pmod{m}$ is an equivalence relation. Is 3 congruent to (-5) modulo 4? (5 + 1)
4. (a) Define a poset. When a poset becomes totally ordered? Give an example of a poset which is not totally ordered. (2 + 1 + 2)
- (b) Prove that a nonempty subset H of a group G is a subgroup of G if and only if $a, b \in H \rightarrow ab^{-1} \in H$ for all $a, b \in H$. (5)
- (c) Are the sets R, Q, Z with natural ordering \simeq lattices? Give one example to show that every lattice is not a chain. (3 + 2)

5. (a) Show that $p \vee \sim p$ is a tautology and $p \wedge \sim p$ is a contradiction. (2 + 2)
- (b) Write the converse, inverse and contrapositive of the statement, "If it is raining then I stay at home". (3)
- (c) When a group is said to be cyclic? Give two examples of cyclic groups. (3)
- (d) Draw Hasse diagram of the poset (X, \leq) where, $X = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ and $x \leq y$ if x divides y . (5)
6. (a) Write in symbolic form and then negate the following statements :
- (i) If I am ill, then I cannot go to college.
- (ii) $-4 < x \leq 2$.
- (iii) If it is cold, then he wears a coat but no sweater. (3 × 2 = 6)
- (b) Obtain pdnf of $q \vee (p \vee \sim q)$. (5)
- (c) How many bit strings of length seven either begin with two zeros or end with three ones? (4)
7. (a) Define a ring. Give two examples of commutative rings. (3 + 2)
- (b) Show that the generating function of the Fibonacci sequence $\{F_n\}, n \geq 0$ defined by $F_0 = 1, F_1 = 1, F_n = F_{n-1} + F_{n-2}$ for $n \geq 2$ is
$$\frac{x}{1 - x - x^2}$$
 (5)
- (c) Test the validity of the argument :
- If it rains, Tapas will be sick.
- If did not rain. Therefore Tapas is not sick. (5)

8. (a) Express the following statements using quantifiers : (6)
- (i) Every number divisible by an even number is even.
 - (ii) Some housewives are politicians.
 - (iii) Not every one is mortal.
 - (iv) Every one is immortal.
- (b) Solve $a_r - 3a_{r-1} + 2a_{r-2} = 0$ given $a_0 = 2, a_1 = 3$ using generating functions. (7)
- (c) When a group is said to be simple? Give one example of a simple group. (2)
9. (a) Find the solution of the recurrence relation $F_n = F_{n-1} + F_{n-2}$ for $n \geq 2$ and $F_0 = F_1 = 1$. (7)
- (b) Find the number of nonnegative integral solution of $n_1 + n_2 + n_3 + n_4 = 20$. (3)
- (c) There are 5 letters to be put in 5 addressed envelopes. In how many ways this can be done such that all letters go to wrong address. (5)
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