

**M.Tech Odd Semester (CBCS) Exam.,
December—2016**

COMPUTER SCIENCE AND ENGINEERING

(1st Semester)

Course No. : MCSECF-01

**(Mathematical Foundation for
Computer Science)**

Full Marks : 50

Pass Marks : 15

Time : 2 hours

Note : 1. Answer any **five** questions.

2. Begin each answer in a new page.

3. Answer parts of a question at a place.

4. Assume reasonable data wherever required.

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

1. (a) What is the reflexive closure of a non-negative integer N and ' ' relation? 5
- (b) In equation $y = x^3 - 2x^2$, which property holds on function? 5

2. (a) Prove that the identity element of a subgroup is the same as that of group. 5

- (b) Prove that intersection of any two subgroups of a group is a subgroup of the group. 5

3. (a) Prove the validity of the following sequent : 5

$$(q \vee r) \vdash (p \wedge q) \vee (p \wedge r)$$

- (b) Find a proposition with three variables p, q and r that is true when exactly one of the three variables is true and false otherwise. 5

4. (a) Translate each of these statements into logical expression using predicate and logical connection : $2\frac{1}{2} + 2\frac{1}{2} = 5$

(i) Some trigonometric functions are continuous. Some continuous functions are periodic. Therefore, some trigonometric functions are periodic.

(ii) Some scientists are not engineers. Some astronauts are not engineers. Hence, some scientists are not astronauts.

- (b) Prove the validity of the sequent $(p(x) \vee Q(x)), x p(x) \vdash x Q(x)$ 5

(3)

5. (a) Find the running time of the following program : 5
- ```
temp = 1;
repeat;
 for i = 1 to n
 temp = temp + 1;
 n = n/2;
until n = 1
```
- (b) Find the upper bound for  $f(n) = n^2 - 1$ . 5
6. (a) Prove that the length of a hamiltonian path in a connected graph of  $n$  vertices is  $n-1$ . 5
- (b) What is vertex connectivity? Show that if vertex connectivity = 1, then it is called a separable graph. 5
7. (a) Construct NFA to DFA for regular expression  $(a|b)abb$ . 5
- (b) Convert the following regular grammar into regular expression : 5
- ```
S = 0B|1A|
A = 0S
B = 1S
```

(4)

8. (a) Consider the CFG :
- ```
S → aX
X → aX|bX|
```
- What is the language this CFG generates? 5
- (b) Design a PDA for the language  $L = \{a^n b^{2n} : n \geq 0\}$ . 5

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