

Roll No

MCIT-101

M.E./M.Tech. I Semester

Examination, December 2016

Mathematical Foundation for Information Technology

Time : Three Hours

Maximum Marks: 70

- Note : i) Attempt any five questions out of eight.
ii) All questions carry equal marks.

1. a) Write short note on channel mutual information capacity.
b) Explain Shannon's concept of information and Shannon's measures of information.
2. a) Write short notes on:
i) Block codes
ii) Information capacity theorem
iii) Hamming codes
b) What is parity check codes and produce an example of parity check polynomial.
3. a) What are fuzzy sets. Compare it with classical set.
b) Let $X = \{47, 48, 49, 50, 51\}$ and A and B are two fuzzy sets given by
$$A = \left\{ \frac{0.3}{47}, \frac{0.4}{48}, \frac{0.7}{49}, \frac{0.8}{50}, \frac{1}{51} \right\}$$
 and
$$B = \left\{ \frac{1}{47}, \frac{0}{48}, \frac{0.8}{49}, \frac{0.6}{50}, \frac{0.3}{51} \right\}$$
. Find $A \cup B$ and $A \cap B$.
4. a) If $A = \{(1, 0.2), (2, 0.5), (3, 0.8), (4, 1), (5, 0.7), (6, 0.3)\}$ be a fuzzy set then find the α -cut for $\alpha = 0.2, 0.5, 0.8$ and strong α -cut for $\alpha = 0.8$.

MCIT-101

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[2]

- b) Let A, B be fuzzy sets defined on universal set X. Prove that $|A| + |B| = |A \cup B| + |A \cap B|$
5. a) Determine the DFT of the sequence
$$x(n) = \begin{cases} \frac{1}{4}, & 0 \leq n \leq 2 \\ 0, & \text{otherwise} \end{cases}$$

b) Explain wavelet transform and distinguish it from Fourier transform.
6. a) Find the inverse DFT of $X(k) = \{1, 2, 3, 4\}$.
b) State and prove Parseval's theorem for DFT.
7. a) A bag contains 3 white and 2 black balls, and another bag contains 5 white and 3 black balls. If a bag is selected at random and a ball is drawn from it, find the probability that it is white.
b) If $f(x) = cx^2$, $0 < x < 1$, find the value of c and determine the probability that $\frac{1}{3} < x < \frac{1}{2}$.
8. a) The probability function of a random variable x is given by
$$P(X = x) = \begin{cases} k & \text{if } x = 0 \\ 2k & \text{if } x = 1 \\ 3k & \text{if } x = 2 \\ 0 & \text{otherwise} \end{cases}$$

Then
i) Find the values of k
ii) Evaluate $P(x < 2)$, $P(x \leq 2)$, $p(0 < x < 2)$.
b) The probability density function of a random variable X is given by
 $f(x) = 6(x - x^2)$, $0 \leq x \leq 1$.
Find mean and variance of probability distribution of X.

MCIT-101
