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B.Tech. Civil (Construction Management) /  
B.Tech. Civil (Water Resources Engineering) /  
B.Tech. (Aerospace Engineering) /  
BTCLEVI / BTMEVI / BTELVI / BTECVI / BTCSVI

Term-End Examination

June, 2019

ET-101(B) : MATHEMATICS - II  
(PROBABILITY AND STATISTICS)

Time : 3 hours

Maximum Marks : 70

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- Note : (i) All questions are compulsory.  
(ii) Use of scientific calculator is allowed.  
(iii) Use statistical tables wherever necessary.
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1. Answer any six of the following : 6x5=30
- (a) What is the probability of setting a total of 7 or 11 when a pair of fair dice are tossed ?
- (b) A continuous random variable  $X$  that can assume values between  $x=1$  and  $x=3$  has a density function given by  $f(x) = \frac{1}{2}$ .
- (i) Show that the area under the curve is equal to 1
- (ii) Find  $P(2 < X < 2.5)$
- (iii) Find  $P(X \leq 1.6)$
- (c) Two cards are drawn in succession from a deck without replacement. What is the probability that both cards are greater than 2 and less than 8 ?

- (d) In a high school graduating class of 100 students, 54 studied mathematics, 69 studied history, and 35 studied both mathematics and history. If one of these students is selected at random, find the probability that
- (i) the students took mathematics or history.
  - (ii) the student did not take either of these subjects.
  - (iii) the student took history but not mathematics.
- (e) One bag contains 4 white balls and 3 black balls and a second bag contains 3 white and 5 black balls. One ball is drawn from the first bag and placed unseen in the second bag. What is the probability that a ball now drawn from the second bag is black ?
- (f) The probability that a doctor correctly diagnoses a particular illness is 0.7. Given that the doctor makes an incorrect diagnosis, the probability that the patient enters a law suit is 0.9. What is the probability that the doctor makes an incorrect diagnosis and the patient sues ?
- (g) In a certain assembly plant, three machines,  $B_1$ ,  $B_2$  and  $B_3$ , make 30%, 45% and 25%, respectively of the products. It is known from past experience that 2%, 3% and 2% of the products made by each other, respectively are defective. Now, suppose that a finished product is randomly selected. What is the probability that it is defective ?

- (h) The proportion of people who respond to a certain mail-order solicitation is a continuous random variable  $X$  that has the density function

$$f(x) = \begin{cases} \frac{2(x+2)}{5}, & 0 < x < 1 \\ 0 & \text{elsewhere} \end{cases}$$

show that  $P(0 < X < 1) = 1$ .

2. Answer any two of the following : 2x10=20

- (a) It is known that 60% of mice inoculated with a serum are protected from a certain disease. If 5 mice are inoculated, find the probability that
- (i) none contracts the disease
  - (ii) fewer than 2 contract the disease
  - (iii) more than 3 contract the disease
- (b) During a laboratory experiment the average number of radioactive particles passing through a counter in 1 millisecond is 4. What is the probability that 6 particles enter the counter in a given millisecond ?
- (c) Given a random variable  $X$  having a normal distribution with  $\mu = 50$  and  $\sigma = 10$ , find the probability that  $X$  assume a value between 45 and 62.

3. Answer any two of the following : 2x10=20

- (a) The probability that a patient recovers from a delicate heart operation is 0.9. Of the next 100 patients having this operation, what is the probability that
- (i) between 84 and 95 inclusive survive ?
  - (ii) fewer than 86 survive ?

- (b) A chemical engineer claims that the population mean yield of a certain batch process is 500 grams per milliliter of raw material. To check this claim he samples 25 batches each month. If the computed t-value falls between  $-t_{0.05}$  and  $t_{0.05}$ , he is satisfied with his claim. What conclusion should he draw from a sample that has a mean  $\bar{x} = 518$  grams per milliliter and a sample standard deviation  $s = 40$  grams? Assume the distribution of yields to be approximately normal.
- (c) A random sample of size 25 from a normal population has the mean  $\bar{x} = 47.5$  and standard deviation  $\sigma = 8.4$ . Does this information refute the claim that the mean of the population is  $\mu = 42.1$ .
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