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Question Paper Code : 23539

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Fourth Semester

Civil Engineering

MA 1253/MA 1259 — PROBABILITY AND STATISTICS

(Common to Production Engineering, Automobile Engineering, Mechanical Engineering, Information Technology, Textile Technology, Textile Technology (Textile Chemistry) and Textile Technology (Fashion Technology))

(Also common to Sixth Semester – Civil Engineering)

(Regulation 2004/2007)

(Common to B.E. (Part-Time) Third Semester, Mechanical Engineering – Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A random variable X is distributed at random between the values 0 and 1 so that its probability density function is : $f(x) = kx^2(1 - x^3)$, where k is a constant. Find the value of k. Using this value of k, find its mean and variance.

2. Mention the properties of moment generating function.

3. State under what conditions the binomial distribution can be approximated to the normal distribution.

4. Define Weinbul distribution.

5. Mention the properties of regression coefficients.

6. State central limit theorem.

7. Write a note on student's t-distribution and point out its uses.

8. Define chi-square test for goodness of fit.

9. State the basic assumption in the analysis of variance.

10. Define Latin square design.

PART B — (5 × 16 = 80 marks)

11. (a) (i) State and prove Baye's theorem. (8)

(ii) A factory produces a certain type of outputs by three types of machines. The respective daily production figures are Machine I : 3,000 units; Machine II : 2,500 units; Machine III : 4,500 units. Past experience shows that 1 percent of the output produced by Machine I is defective. The corresponding fractions of defectives for the other two machines are 1.2 percent and 2 percent respectively. An item is drawn at random from the day's production run and is found to be defective. What is probability that it comes from the output of Machine I, Machine II, Machine III? (8)

Or

(b) (i) Explain the concepts of random variable, independent random variables, marginal and conditional probability distributions. (8)

(ii) A random variable X has the following probability function :

Values of X, x :	0	1	2	3	4	5	6	7
$P(x)$:	0	K	2K	2K	3K	K^2	$2K^2$	$7K^2+K$

Find K and evaluate $P(X \geq 6)$, $P(X < 6)$ and $P(O < X < 5)$. If $P(X \leq a) > \frac{1}{2}$, find the minimum value of 'a' and determine the distribution function of X. (8)

12. (a) Define the binomial distribution with parameters p and n, and give a situation in real life where the distribution is likely to be realized. Obtain the moment generating function of the binomial distribution and obtain the mean, variance, skewness and kurtosis of the distribution. (16)

Or

(b) (i) Explain normal distribution. State the important properties of normal distribution. (8)

(ii) In a distribution exactly normal 10.03% of the items are under 25 kilogram weight and 89.97% of the items are under 70 kilogram weight. What are the mean and standard deviation of the distribution? (8)

13. (a) (i) Explain Karl Pearson's co-efficient of correlation. State its properties. (8)

(ii) Calculate the correlation co-efficient for the following data relating to the heights (in inches) of fathers (X) and other sons (Y).

X :	65	66	67	67	68	69	70	72
Y :	67	68	65	68	72	72	69	71

Also obtain the two regression lines. (8)

Or

(b) (i) Explain the concept of transformation of n-dimensional random variables. (8)

(ii) The random variables X and Y are independent and their probability density functions are given by

$$f(x)=\frac{1}{\pi}\cdot\frac{1}{\sqrt{1-x^2}},\ |x|<1 \text{ and } g(y)=y\exp\left(-\frac{1}{2}y^2\right),\ y>0.$$

Find the joint probability density function of Z and W, where $Z = XY$ and $W = X$. Deduce the probability density function of Z. (8)

14. (a) (i) Explain briefly the test of significance for difference of proportions. (8)

(ii) Before an increase in excise duty on tea, 800 persons out of a sample of 1,000 persons were found to be tea drinkers. After an increase in duty, 800 people were tea drinkers in a sample of 1,200 people. Using standard error of proportion, state whether there is a significant decrease in the consumption of tea after the increase in excise duty? (8)

Or

(b) (i) Define F-distribution and mention the applications of F-distribution. Also state its properties. (8)

(ii) Two random samples gave the following results.

Sample	Size	Sample mean	Sum of squares of deviations from the mean
1	10	15	90
2	12	14	108

Test whether the samples come from the same normal population at 5% level of significance. (Given $F_{0.05}(9, 11) = 2.90$). (8)

15. (a) (i) State the mathematical model used in analysis of variance in a two way classification. Explain the hypothesis to be used. Discuss the advantages of this method over one-way classification if any. (8)

(ii) A trucking company wishes to test the average life of each of the four brands of tyres. The company uses all brands on randomly selected trucks. The recores showing the lines (thousands of miles) of tyres are as given in the adjoining table.

Brand I	Brand II	Brand III	Brand IV
20	19	21	15
23	15	19	17
18	17	20	16
17	20	17	18
	16	16	

Test the hypothesis that the average life for each brand of tyres is the same. Assume $\alpha = 0.01$ $\left(F_{3,14}(0.01) = 5.56\right)$. (8)

Or

(b) (i) Explain the basic principles of experimentation. Explain how far these principles are met with in the Latin square design. (8)

(ii) A company wants to purchase cars for its own use. He has to select the make of the car out of the four makes. A, B, C and D available in the market. For this he tries five cars of each make by assigning the cars to four drivers to run on four different routes. For this, he chooses a Latin square design. The efficiency of cars is measured in terms of time in hours. The layout and time consumed is given below.

Routers	Drivers			
	1	2	3	4
1	18 (C)	12 (D)	16 (A)	20 (B)
2	26 (D)	34 (A)	25 (B)	31 (C)
3	15 (B)	22 (C)	10 (D)	28 (A)
4	30 (A)	20 (B)	15 (C)	9 (D)

Analyse the experimental data and draw conclusions.
$\left(F_{.05}(3,5) = 5.41\right)$. (8).