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# DMI-ST. EUGENE UNIVERSITY

ZAMBIA

DEGREE EXAMINATION – DECEMBER 2024

Semester: IV 055 MA 42 PROBABILITY & QUEUING THEORY

Time: 3:00 Hours

Max. Marks: 100

Answer any FIVE Questions (5 x 20 = 100 Marks)

- When a die is thrown, 'X' denotes the number that turns up. Find  $E(X)$ ,  $E(X^2)$  and  $Var(X)$ . (10 Marks)
  - Given the *p. d. f* of a continuous random variable  $X$  follows  $f(x) = \begin{cases} 6x(1-x), & 0 < x < 1 \\ 0 & \text{otherwise} \end{cases}$ , find *c. d. f* for  $X$ . (10 Marks)
- Four coins are tossed simultaneously. What is the probability of getting (i) 2 heads (ii) at least 2 heads (iii) at most 2 heads? (10 Marks)
  - If  $X$  is a Poisson variate such that  $P(X = 1) = \frac{3}{10}$  and  $P(X = 2) = \frac{1}{5}$ , find the  $P(X = 0)$  and  $P(X = 3)$ . (10 Marks)
- Find the moment generating function of Normal distribution. (10 Marks)
  - A sample of size 13 gave an estimated population variance of 3.0, while another sample of size 15 gave an estimate of 2.5. Could both samples be from populations with the same variance? (10 Marks)
- The life time in hrs of a component is a random variable  $X$  which follows weibull distribution with  $\alpha=0.1, \beta=0.5$ , find
    - Mean lifetime.
    - Probability that such a component will last more than 300 hrs. (10 Marks)
  - A Xerox machine has a time to failure that is log normal with a shape parameter  $S=0.56$  and a scale parameter  $t_M=40$ hrs. repair is normally distributed with mean=3 hrs and  $\sigma=2$ hrs. Find

the steady state availability of the machine. **(10 Marks)**

5. a) Explain the characteristics of Queuing process. **(10 Marks)**  
b) In a heavy machine job the overhead crane is 75% utilized. Time study observations gave the average service time as 10.5 minutes with a standard deviation of 8.8 minutes. What is the average calling rate for the services of the crane, and what is the average delay in getting service? If the average service time is cut to 8.0 minutes with the SD of 6 minutes. How much reduction will occur an average in the delay of getting served? **(10 Marks)**
6. a) A continuous *R.V*  $X$  has the *p.d.f*  $f(x)$  given by  $f(x) = ce^{-|x|}$ ,  $-\infty < x < \infty$ . Find the value of  $c$  and moment generating function of  $X$ . **(10 Marks)**

Find the moment generating function of a *RV*  $X$  having the density function  $f(x) =$

b) 
$$\begin{cases} \frac{x}{2}, & 0 \leq x \leq 2 \\ 0 & \text{otherwise} \end{cases} .$$

Using the generating function, find the first four moments about origin. **(10 Marks)**

7. a) An experiment succeeds twice as many times as it fails. Find the probability that in 5 trials there will be at least one success. **(10 Marks)**  
b) If  $X$  is uniformly distributed over  $(-\alpha, \alpha)$ ,  $\alpha < 0$ , find  $\alpha$  so that
- (i)  $P(X > 1) = \frac{1}{3}$
- (ii)  $P(|X| < 1) = P(|X| > 1)$  **(10 Marks)**