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BTECH
(SEM III) THEORY EXAMINATION 2022-23
MATHEMATICS-V

Time: 3 Hours ***Total Marks: 100***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 10 = 20**

(a) State (without proof) the convolution theorem of the Fourier transform.

(b) Write the formula for Fourier sine and cosine transforms.

(c) A random variable X has the following probability distribution:

x	0	1	2	3	4
$p(x)$	c	$2c$	$2c$	c^2	$5c^2$

Find the value of c.

(d) Write the probability density function of normal distribution with parameters μ(mean) and σ^2(variance).

(e) Prove that $\Delta tan^{-1}x = tan^{-1}\left(\frac{h}{1+hx+x^2}\right)$, the interval of difference being h.

(f) Write the Lagrange's interpolation formula for unequal intervals.

(g) What do you mean by level of significance?

(h) Write the formulae for mean and variance of $F-$distribution with (υ_1, υ_2) degrees of freedom.

(i) Write the principles of an experimental design.

(j) Write two advantages of completely randomized design (CRD).

SECTION B

2. Attempt any *three* of the following: **10x3=30**

(a) Find Fourier transform of $f(x) = \begin{cases} x, & |x| \le a \\ 0, & |x| > a \end{cases}$, where $a > 0$.

(b) In a book of 600 pages, there are 60 typographical errors. Assuming Poisson law for the error per pages, find the probability that a randomly chosen 4 pages will contain no error.

(c) Find by the Regula-Falsi method the real root of the equation $x^3 - x^2 - 2 = 0$.

(d) The heights (in cm) of 8 males participating in an athletic championship are found to be as below:
175, 168, 165, 170, 167, 160, 173, 168
Is the average height is greater than 165cm? Test at 5% level of significance.

(e) Distinguish $np-$chart and $p-$chart. The data of defectives of 10 samples of size 100 each is given below:

Sample No.	1	2	3	4	5	6	7	8	9	10
Number of defectives	3	4	7	11	3	2	1	5	12	8

Construct $np-$chart and discuss your findings.

SECTION C

3. Attempt any *one* part of the following: **10x1=10**

(a) Using Z- transform solve the following difference equation:

$$y_{n+2} + 5y_{n+1} + 4y_n = 2^n, \qquad y_0 = 1, y_1 = -4.$$

(b) Find the Fourier integral representation of the function

$$f(x) = \begin{cases} 0, & x < 0 \\ 1, & 0 \le x \le 1 \\ 0, & x > 0 \end{cases}$$

Hence, show that $\int_0^\infty \frac{\sin\left(\frac{x}{2}\right)}{x} dx = \frac{\pi}{2}$.

4. Attempt any *one* part of the following: 10x1=10

(a) Find mean and variance of binomial distribution.

(b) The probability density function of a continuous random variable $X$is given by

$$f(x) = \begin{cases} 0, & x < 0 \\ kx, & 0 \le x \le 2 \\ (4-x)k, & 2 \le x \le 4 \\ 0, & x > 4 \end{cases}$$

Find the value of k and hence find $P(X > 2.5)$.

5. Attempt any *one* part of the following: 10x1=10

(a) Using Newton-Raphson method to find a root of $x^2 - 5x + 2 = 0$, correct to five decimal places.

(b) Construct the forward difference table for the following data and find $f(6)$:

x	0	1	2	3
$y = f(x)$	-3	6	8	12

6. Attempt any *one* part of the following: 10x1=10

(a) Discuss the mathematical model and related assumptions in one way analysis of variance. Also write the null hypothesis in this analysis.

(b) Fit a Poisson distribution for the following data and test the goodness of fit at 5% level of significance:

x:	0	1	2	3	4	5
$f(x)$:	110	170	130	60	23	7

7. Attempt any *one* part of the following: 10x1=10

(a) Discuss the statistical analysis of randomized block design (RBD) for one observation per experimental unit.

(b) The following are the figures of defectives in 22 lots each containing 2000 rubber belts:
425, 430, 216, 341, 225, 322, 280, 306, 337, 305, 356, 402, 216, 264, 126, 409, 193, 326, 280, 389, 451, 420.
Draw control chart for fraction defective and comment on the state of the control of the process.