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Question Paper Code : 11632

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

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Third Semester

Electrical and Electronics Engineering

MA3303 — PROBABILITY AND COMPLEX FUNCTIONS

(Regulations 2021)

Time : Three hours Maximum : 100 marks

(Use of Statistical tables are permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

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1. If A and B are two events such that $P(A \mid B) = 0.4$, $P(B) = 0.8$, $P(A) = 0.5$, are the events A and B independent?

2. Let the random variable X have a continuous uniform distribution on the interval $0 \le x \le 15$. Determine the mean and variance of X.

3. Random variables X and Y have joint PDF

$$f_{X,Y}(x, y) = \begin{cases} \frac{1}{2}; & -1 \le x \le 1, -1 \le y \le 1, \\ 0, & \text{otherwise} \end{cases}$$ then find $f_X(x)$.

4. State the central limit theorem.

5. For what values of a, b, c the function $f(z) = (x - 2cy) + i(bx - cy)$ is analytic.

6. Find the fixed points of $w = \dfrac{1+z}{1-z}$.

7. State the Cauchy's integral formula.

8. Find the residue of $f(z) = \dfrac{\sin z}{z^3}$ at $z = 0$.

9. Find the Wronskian of $y'' + 9y = \sin 2x$

10. Find the particular integral of $(D^2 + D + 1)y = x$.

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PART B — (5 × 16 = 80 marks)

11. (a) (i) State and prove Baye's theorem. (6)

(ii) A factory has three machines, A, B and C, producing parts. Machine A produces 50% of the parts, Machine B produces 30%, and Machine C produces 20%. The defect rates for each machine are : A (2%), B(3%), and C (5%). If a randomly selected part is defective, what is the probability that it was produced by Machine A? (10)

Or

(b) (i) The number of telephone calls that arrive at a phone exchange is often modelled as a Poisson random variable. Assume that on the average there are 15 calls per hour. (6)

(1) What is the probability that there are exactly 5 calls in one hour?

(2) What is the probability that there are 3 or less calls in two hours?

(3) What is the probability that there are exactly 5 calls in 30 minutes?

(ii) The IQ level X, of a randomly selected individual is often supposed to follow a Gaussian distribution with mean 100 and standard deviation 15. (10)

(1) Find the probability that an individual has an IQ level is below 140

(2) Find the probability that an individual has an IQ level is above 150

(3) Find the probability that an individual has an IQ level is below 120 and 130

(4) Find the value of x, such that $P(X < x) = 0.99$.

12. (a) Random variables X and Y have the joint PMF

$$P_{X,Y} = (x, y) = \begin{cases} kxy; & x = 1, 2, 3;\ y = 1, 2, 3, \\ 0 & otherwise \end{cases}$$

(i) What is the value of the constant k?

(ii) What is $P[Y \geq X]$ and $P[x \leq 2]$?

(iii) Find the correlation coefficient $\rho_{X,Y}$.

Or

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(b) Random variables X and Y have the joint PDF

$$f(x, y) = \begin{cases} k(1-e^{x}) \quad (1-e^{y});\ x>0;\ y>0, \\ 0 \qquad\qquad\qquad otherwise \end{cases}$$

Then find

(i) value of k

(ii) $f_x(x, y)$ and $f_y(x, y)$

(iii) $P[X+Y<3]$

(iv) $P[1<X<3, 1<Y<2]$

(v) Are X and Y independent?

13. (a) (i) Derive the Cauchy-Riemann equations for $f(z)$ to be analytic. (8)

(ii) Determine a so that the given function $u(x, y) = \cos ax \cosh 2y$ is harmonic and find its harmonic conjugate. Also construct an analytic function $f(z) = u(x, y) + iv(x, y)$. (8)

Or

(b) (i) Find the linear fractional transformation that maps $z_1 = 0, z_2 = 1, z_3 = \infty$ onto $w_1 = -1, w_2 = -i, w_3 = 1$ respectively. (8)

(ii) Show that the transformation $w = \frac{1}{z}$ transforms all circles and straight lines in the z-plane into circles or straight lines in the w-plane. (8)

14. (a) State and prove Cauchy residue theorem. Apply it evaluate $\oint_C \frac{(z-23)\,dz}{z^2-4z-5}$, where C the circle $|z-2-i| = 3.3$ counter clockwise.

(8+8=16)

Or

(b) (i) Evaluate $\oint_C \frac{z\,dz}{z^2+4z+3}$, where C is the circle with center -1 and radius 2. (8)

(ii) Find all the Laurent series for the function $f(z) = \frac{-2z+3}{z^2-3z+2}$ about $z_0 = 0$ and discuss about the region of convergence. (8)

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15. (a) (i) Solve the differential equation $(x^2D^2 - 2xD - 4)\,y = x^2 + 2\log x$. (8)

(ii) Solve the differential equation $(D^2 + 1)\,y = x\sin x$, by the method of variation of parameters. (8)

Or

(b) (i) Solve $(D^2 + 4)\,y = 5e^x \cos x$ using Method of undermined co-efficient. (8)

(ii) Solve $\frac{dx}{dt} + 2y = 5e^t$, $\frac{dy}{dt} - 2x = 5e^t$, given that $x = -1$ and $y = 3$ at $t = 0$. (8)

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