Reg. No. : | | | | | | | | | | |

Question Paper Code: 51025

M.E. DEGREE EXAMINATION, MAY 2018

First Semester

Structural Engineering

15PMA125 - APPLIED MATHEMATICS FOR STRUCTURAL ENGINEERING

(Regulation 2015)

Duration: Three hours — Maximum: 100 Marks

Answer ALL Questions

PART A - (5 x 1 = 5 Marks)

1. $F(e^{-x^2/2}) =$

   (a) $e^{s^2/2}$ (b) $e^{-x^2/2}$ (c) $e^{-s^2/2}$ (d) $e^{x^2/2}$

2. For one point Gaussian Quadrature the sampling point is at ______________

   (a) $\xi = 0$ (b) $\xi = 2$ (c) $\xi = 3$ (d) $\xi = 1$

3. Suppose 'f' is independent of 'y' then the solution of Euler's equation is _______________

   (a) $\frac{\partial F}{\partial y'} = c$ (b) $\frac{\partial F}{\partial y} = c$ (c) $\frac{\partial F}{\partial x} = c$ (d) $\frac{\partial F}{\partial x'} = c$

4. To find the smallest eigen values of the matrix then use

   (a) Faddeev-Leverrier Method (b) Power method
   (c) Rayley-Ritz method (d) Approximation Method

5. Angle between the regression lines are parallel then _________________

   (a) $\theta = 0$ (b) $\theta = \frac{\pi}{2}$ (c) $\theta = \frac{\pi}{4}$ (d) $\theta = \pi$

PART - B (5 x 3 = 15 Marks)

6. Define laplace transform of unit step function and find its Laplace transform.

7. Define Rayleigh quotient of a Hermitian matrix.

8. If y is independent of y, then give the reduced form of the Euler's equation.

9. Find the largest eigen value of $\begin{bmatrix} 4 & 1 \\ 1 & 3 \end{bmatrix}$ by Power method.

10. What are maximum likelihood estimators?

PART - C (5 x 16 = 80 Marks)

11. (a) A string is stretched and fixed between two fixed points (0, 0) and (l, 0). Motion is initiated by displacing the string in the form u = $\sin\left(\frac{\pi x}{l}\right)$ and released from rest at time t=0.Find the displacement of any point on the string at any time t. (16)

Or

(b) Solve the following IBVP using the Laplace transform technique

PDE : $u_t = u_{xx}, \quad 0 < x < 1, \quad t > 0$

BCs : $u(0, t) = 1,\ u(1, t) = 1,\ t > 0$

ICs : $u(x, 0) = 1 + \sin \pi x,\ 0 < x < 1.$ (16)

12. (a) (i) By relaxation method, solve $12x + y + z = 31,\ 2x + 8y - z = 24,\ 3x + 4y + 10z = 58$. (8)

(ii) Solve the equation by Choleski method $4x + 6y + 8z = 0,\ 6x + 34y + 52z = -160,\ 8x + 52y + 129z = -452$. (8)

Or

(b) (i) Evaluate $\int_1^2 \frac{dx}{1 + x^3}$ by Gaussian three point formula. (8)

(ii) Evaluate $\int_1^2 \int_1^2 \frac{dxdy}{x + y}$ by Gaussian quadrature formula. (8)

13. (a) (i) By applying Ritz method, find the extremal of $I[y(x)] = \int_0^1 (y'^2 + y^2)dx$ with $y(0) = 0, y(1) = 1$. (8)

(ii) Find the plane curve of a fixed perimeter and maximum area. (8)

Or

(b) Show that the curve which extremizes the functional $I = \int_0^{\frac{\pi}{4}} (y''^2 - y^2 + x^2)dx$ under the conditions $y(0) = 0$, $y'(0) = 1$, $y(\frac{\pi}{4}) = y'(\frac{\pi}{4}) = \frac{1}{\sqrt{2}}$. (16)

14. (a) Find the resolvent of the matrix $A = \begin{pmatrix} -2 & -2 & -4 \\ 2 & 3 & 2 \\ 3 & 2 & 5 \end{pmatrix}$ by Faddeev-Leverrier method. (16)

Or

(b) Use Faddeev-Leverrier method to find the characteristic polynomial and inverse of the matrix $A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & 1 \\ 1 & -1 & 2 \end{bmatrix}$. (16)

15. (a) (i) Fit a parabola $y = a + bx + cx^2$ to the following data by the method of least squares

X :	2	4	6	8	10
Y :	3.07	12.85	31.47	57.38	91.29

(8)

(ii) Estimate α and β for the distribution defined by

$f(x; \alpha, \beta) = \frac{\beta^\alpha}{I(x)} x^{\alpha-1} e^{-\beta x}$, $0 \le x \le \infty$ by the method of moments. (8)

Or

(b) Find the maximum likelihood estimate for the parameter λ of a Poisson distribution on the basis of a sample of size n. Also find its variance. Show that the sample mean $\bar{x}$ is sufficient for estimating the parameter λ of the Poisson distribution. (16)