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

Question Paper Code : X 85766

M.E./M.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
First Semester
Control and Instrumentation Engineering
MA 5155 – APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS
(Common to M.E. Electrical Drives and Embedded Control/M.E. Embedded System Technologies/M.E. Instrumentation Engineering/M.E. Power Electronics and Drives/M.E. Power Systems Engineering)
(Regulations 2017)

Time : Three Hours Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Determine a canonical basis for $A = \begin{bmatrix} 3 & 5 \\ -2 & -4 \end{bmatrix}$.

2. Explain the terms chain and length of the chain.

3. Find the extremals of the following functional $\int_{x_0}^{x_1} \left[y'^2 - y^2 + 2xy \right] dx$.

4. Find the extremals of the functional $\int_{x_0}^{x_1} \left[\frac{1 + y^2}{y'^2} \right] dx$.

5. Derive the moment generating function of uniform distribution.

6. From a pack of cards, a card is drawn at random. What is the probability of drawing a black card or a green card ?

7. Define basic feasible solution in linear programming problem.

8. Determine an initial basic feasible solution for the following transportation problem by using North-West corner rule.

	D_1	D_2	D_3	D_4	
O_1	6	4	1	5	14
O_2	8	9	2	7	16
O_3	4	3	6	2	5
	6	10	15	4	35

9. Explain the power signal with an example.

10. Write down the properties of the eigenvalues of a regular Sturm-Liouville system.

PART – B **(5×13=65 Marks)**

11. a) Construct a QR factorization for the matrix $A = \begin{bmatrix} -4 & 2 & 2 \\ 3 & -3 & 3 \\ 6 & 6 & 0 \end{bmatrix}$. **(13)**

(OR)

b) Determine the number of generalized eigenvectors of each rank corresponding to $\lambda = 4$ that will appear in a canonical basis for $A = \begin{bmatrix} 4 & 2 & 1 & 0 & 0 & 0 \\ 0 & 4 & -1 & 0 & 0 & 0 \\ 0 & 0 & 4 & 0 & 0 & 0 \\ 0 & 0 & 0 & 4 & 2 & 0 \\ 0 & 0 & 0 & 0 & 4 & 0 \\ 0 & 0 & 0 & 0 & 0 & 7 \end{bmatrix}$. **(13)**

12. a) Show that the functional $\int_0^{\pi/2} \left[2xy + \left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2 \right] dt$ such that $x(0) = 0$, $x(\pi/2) = -1$, $y(0) = 0$, $y(\pi/2) = 1$ is stationary for $x = -\sin t$, $y = \sin t$. **(13)**

(OR)

b) Find the extremals of the functional $\int_0^1 \left[2xy - y^2 - y'^2 \right] dx$ given that $y(0) = 0$, $y(1) = 0$ by using Rayleigh-Ritz method. **(13)**

13. a) i) Let X be a discrete random variable with probability mass function $p(x) = \frac{1}{k^x}$, x = 1, 2, ... (k = constant). Find the moment generating function, mean and variance. **(7)**

ii) A machine produces a certain item with a defectiveness of 1%. By applying Poisson approximation find the probability that a sample of 100 items selected at random from the total output will contain not more than one defective item. **(6)**

(OR)

b) i) If X is a normal variate with $\mu = 30$ and $\sigma = 5$. Find (i) $P(26 \leq X \leq 40)$ and (ii) $P[|X - 30| > 5]$. **(7)**

ii) A candidate applying for driving licence has the probability of 0.8 in passing the road test in a given trial. What is the probability that he will pass the test, (a) on the fourth trial (b) in less than four trials ? **(6)**

14. a) Use Big-M method to solve the following LPP.

Minimize $Z = 2x_1 + x_2$ Subject to the constraints

$3x_1 + x_2 = 3$; $4x_1 + 3x_2 \geq 6$; $x_1 + 2x_2 \leq 3$, $x_1, x_2 \geq 0$. **(13)**

(OR)

b) Obtain an initial basic feasible solution to the following transportation problem by using Vogel's approximation method (VAM). (13)

Stores

Warehouse	I	II	III	IV	Availability
A	5	1	3	3	34
B	3	3	5	4	15
C	6	4	4	3	12
D	4	–1	4	2	19
Requirement	21	25	17	17	80

15. a) Calculate the average power of the periodic signal (Period T = 2) ; $f(t) = 2 \cos 5\pi t + \sin 6\pi t$,

i) Using a time domain analysis. **(7)**

ii) Using a frequency domain analysis. **(6)**

(OR)

b) Find the eigenvalues and eigenfunctions of $y'' + \lambda y = 0, < x < p$, $y(0) = 0$, $y(p) = 0$. **(13)**

PART – C **(1×15=15 Marks)**

16. a) Use Two-phase simplex method to solve the following LPP.

Maximize $Z = 2x_1 + x_2 + x_3$ subject to the constraints

$4x_1 + 6x_2 + 3x_3 \leq 8,$

$3x_1 - 6x_2 - 4x_3 \leq 1$

$2x_1 + 3x_2 - 5x_3 \geq 4$ where $x_1, x_2, x_3 \geq 0.$ **(15)**

(OR)

b) Solve the following system of equations by using least square method.

$x_3 + 2x_4 = 1$; $x_1 + 2x_2 + 2x_3 + 3x_4 = 2.$ **(15)**
