



Roll No.....

COURSE CODE: MA 201

Time: 3 hours

Max. Marks: 100

COURSE TITLE: Engineering Mathematics II

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

- i. The rank of matrix $A = \begin{bmatrix} 3 & -1 & 2 \\ -6 & 2 & 4 \\ -3 & 1 & 2 \end{bmatrix}$;
(a) 1 (b) 2 (c) 3 (d) None of these
- ii. The integrating factor for differential equation $\frac{dy}{dx} - \frac{y}{1+x} = (1+x)$ is
(a) $\frac{1}{1+x}$ (b) $\frac{x}{1+x}$ (c) $(1+x)x$ (d) $(1+x)$
- iii. The differential equation $\frac{d^2y}{dx^2} + x^2 \frac{dy}{dx} + x^3y = e^x$ is a
(a) linear differential equation of first degree (b) non-linear differential equation of first degree (c) linear differential equation of second degree (d) non-linear differential equation of second degree
- iv. The general solution of $\frac{\partial^2 z}{\partial x \partial y} = xy^2$ is
(a) $z = \frac{x^2y^2}{4} + f(y) + \varphi(x)$ (b) $z = \frac{x^3y^2}{6} + f(y) + \varphi(x)$ (c) $z = \frac{xy^3}{4} + f(y) + \varphi(x)$
(d) $z = \frac{x^2y^3}{6} + f(y) + \varphi(x)$
- v. The dimension of the vector space V_4 is
(a) 1 (b) 2 (c) 3 (d) 4
- vi. The homogenous part of the differential equation $\frac{d^2y}{dx^2} + p \frac{dy}{dx} + qy = r$ has real distinct roots if
(a) $p^2 - 4q > 0$ (b) $p^2 - 4q < 0$ (c) $p^2 - 4q = 0$ (d) $p^2 - 4q = r$
- vii. LP theory states that the optimal solution to any problem will lie at;
(a) the origin (b) corner point of feasible region (c) Highest point of feasible region (d) None of these
- viii. Let A be a 3×3 matrix with rank 2; then $AX=0$ has
(a) only the trivial solution $X=0$ (b) it has one independent solution (c) it has two independent solutions (d) it has three independent solutions
- ix. In the feasible region of LPP, which are the basic variables

Max. $Z = x_1 + x_2 + x_3 + x_4 + x_5$

subject to $x_1 + x_2 - 2x_3 + x_4 = 10$

$4x_1 + x_2 + x_3 + x_5 - x_6 = 20$

and $x_1 \geq 0, x_2 \geq 0, x_3 \geq 0, x_4 \geq 0, x_5 \geq 0, x_6 \geq 0$

(a) x_1 and x_2 (b) x_3 and x_4 (c) x_4 and x_5 (d) none of these

x The boundary conditions for one dimensional heat flow when the ends $x=0$ and $x=l$ are insulated are

(a) $u_x(0, t) = 0, u_x(l, t) = 0 \forall t$ (b) $u_t(l, t) = 0, u_x(0, t) = 0 \forall t$ (c) $u(0, t) = u(x, 0) = 0 \forall t$ (d) None of these

Q.2 Short answer type questions (4 questions @ 2.5 marks) 10

Q.2A Solve $(1 + x^2)dy = (1 + y^2)dx$

Q.2B Prove that the set $(1, x, 1 + x + x^2)$ is linearly independent set of vectors in the vector space of all polynomials over the real number field.

Q.2C Write the properties of vector space. Also, define unit vector space.

Q.2D Solve $z = px + qy + 2\sqrt{pq}$, where p and q have their usual meanings.

Q.3A Show using a matrix that the set of vectors 05

$X = [1, 2, -3, 4], Y = [3, -1, 2, 1], Z = [1, -5, 8, -7]$ is linearly dependent.

Q.3B Let W be the set of all polynomials of degree not exceeding 'n' in an indeterminate x , over field F . Then, W is a subspace of the vector space $F[x]$ of all polynomial over F . 05

Q.4A Solve $(1 + y^2)dx = (\tan^{-1}y - x)dy$ 05

Q.4B Solve PDE: $p^2 - q^2 = x - y$ 05

Q.5A Find the eigen values and eigen vectors of the given matrix 05

$$A = \begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$$

Q.5B If $V_3(R)$ is a vector space then show that $S = \{(0, 1, -1), (1, 1, 0), (1, 0, 2)\}$ is a basis of V_3 and hence find coordinates of vector $(1, 0, -1)$ with respect to this basis. 05

Q.6A Solve $(3x^2y^4 + 2xy)dx + (2x^3y^3 - x^2)dy = 0$ 05

Q.7A Apply method of variation of parameter to solve $(D^2 + 2D + 1)y = e^{-x} \log x$ 05

Q.7B Explain rank of matrix. Verify Cayley-Hamilton theorem for the matrix 10

$A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$. Hence compute A^{-1} .

OR

Q.7B Find the general solution of $(D^2 + a^2)y = \sec ax$ 10

- 8A In a metal shop two articles A and B are produced. Both articles pass through the three phases stamping, forming and painting. The available information is given as: 10

Process	Processing time (min)	
	Product A	Product B
Stamping	2	4
Forming	3	1
Painting	2	1.6

The profit margins on products A and B are Rs. 6 and Rs. 9, respectively. The time available per week on each process is 50 hrs. (3000 minutes). How many products of type A and type B should be produced so as to maximize profit? Give the mathematical formulation of the problem. Find also the maximum profit.

- Q.9A Use simplex method to solve the following LPP 10

$$\text{Max } Z = 30x + 20y$$

$$\text{Subject to } 3x + y \leq 1500$$

$$x + y \leq 3000$$

$$\text{and } x, y \geq 0$$

- Q.9B A tightly stretched string with fixed end points $x=0$ and $x=l$ is initially in a position given by $u = u_0 \sin^3\left(\frac{\pi x}{l}\right)$. If it is released from rest from this position, find the displacement $u(x,t)$. 10

OR

- Q.9B Find the solution in series of $y'' + xy' + x^2y = 0$ about $x=0$. 10

