DIPLOMA FIRST SEMESTER EXAMINATION 2026 (JUT)

ENGINEERING MATHEMATICS

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Time: 3 Hours **Full Mar**

General Instructions:

- Question No. 1 is **Compulsory** (7 x 2 = 14 Marks).
- Answer any **FOUR** questions from Q.2 to Q.7.
- Figures in the right-hand margin indicate full marks for that question.

Q1. Select the correct option for the following: 7 ×

1.1 If two rows of a determinant are identical, then the value of the determinant is:

(a) 1
(b) 0
(c) -1
(d) Any constant

1.2 The slope of the straight line represented by $y = mx + c$ is:

(a) c
(b) x
(c) m
(d) -m

1.3 The value of $\sin^2\theta + \cos^2\theta$ is always:

(a) 0
(b) 1
(c) $\sin 2\theta$
(d) $\cos 2\theta$

1.4 The derivative of x^n with respect to x is:

(a) nx^n
(b) nx^{n-1}
(c) $x^{n+1}/(n+1)$
(d) 1

1.5 The integration $\int \frac{1}{x} dx$ equals:

(a) $\log x + c$
(b) $e^x + c$
(c) $x^2/2$
(d) 1

1.6 Two lines with slopes m_1 and m_2 are perpendicular if:

(a) $m_1 = m_2$
(b) $m_1 \cdot m_2 = -1$
(c) $m_1 + m_2 = 0$
(d) $m_1 \cdot m_2 = 1$

1.7 The order of a matrix with 3 rows and 2 columns is:

(a) 2x3
(b) 3x2
(c) 3x3
(d) 1x6

Q2. (A) If $A = \begin{bmatrix} 2 & 3 \\ 1 & -4 \end{bmatrix}$, show that $A^2 + 2A - 11I = 0$.

(B) Resolve into **Partial Fractions**: $\frac{x^2+1}{(x-1)(x-2)}$.

Q3. (A) Prove using properties of determinants:

$$\begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^2 & b^2 & c^2 \end{vmatrix} = (a-b)(b-c)(c-a)$$

(B) Find the **Eigenvalues** of the matrix $A = \begin{bmatrix} 3 & 2 \\ 2 & 3 \end{bmatrix}$.

Q4. (A) Find the distance between parallel lines $3x + 4y - 9 = 0$ and $3x + 4y + 1 = 0$.

(B) Find the equation of a line perpendicular to $x - 2y + 3 = 0$ and passing through (1, -2).

Q5. (A) Prove that: $\frac{\sin 2\theta}{1+\cos 2\theta} = \tan\theta$.

(B) Prove that $\sin 20^\circ \sin 40^\circ \sin 60^\circ \sin 80^\circ = 3/16$.

Q6. (A) If $y = a\cos(\log x) + b\sin(\log x)$, prove that $x^2 y_2 + x y_1 + y = 0$.

(B) Evaluate: $\int x^2 e^x dx$ using **Integration by Parts**.

Q7. Answer any FOUR of the following: **4 × 3.**

(a) Find the area bounded by the circle $x^2 + y^2 = a^2$.

(b) Find the equation of Tangent to the curve $y = x^2 - 4x + 3$ at (4, 3).

(c) Evaluate the value of $\sin 150^\circ + \cos 300^\circ$.

(d) Find x if the matrix $\begin{bmatrix} x & 2 \\ 8 & x \end{bmatrix}$ is singular.

(e) Write the formula for the angle between two lines having slopes m_1 and m_2.