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BEY–018

B. SC. (APPLIED SCIENCE–ENERGY)

(BSCAEY)

Term-End Examination

December, 2025

BEY-018 : LINEAR ALGEBRA AND CALCULUS

Time : 3 Hours *Maximum Marks : 70*

Note : *(i) Question No. **1** is compulsory.*

*(ii) Attempt any **six** questions from the remaining question nos. **2** to **9**.*

(iii) Use of scientific calculator (non-programmable) is allowed in exam.

(iv) Symbols have their usual meanings.

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1. (a) If $A = \begin{bmatrix} 2 & 3 \\ 5 & 4 \end{bmatrix}$, show that $\frac{1}{2}(A + A')$ is symmetric and $\frac{1}{2}(A - A')$ is skew-symmetric. 2

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(b) Show that the vectors $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} + 2\hat{j} - 3\hat{k}$ and $3\hat{i} - 4\hat{j} + 5\hat{k}$ are coplanar vectors. 2

(c) Expand $y = \sin x$ about $x = 0$ using Maclaurin's formula upto 2 terms. 2

(d) Evaluate : 2

$$\lim_{\substack{x \to 1 \\ y \to 2}} \frac{2x^2 + y^2}{2xy}.$$

(e) Solve : 2

$$\frac{dx}{x} = \tan y \cdot dy$$

2. (a) Find the coordinates of the point, where the tangent is parallel to the x-axis for the curve : 5

$$y^3 = x^2(2 - x).$$

(b) Find the points of maximum and minimum for the function : 5

$$f(x) = x^5 - 5x^4 + 5x^3 - 1$$

3. Solve the following system of equations : 10

$$3x + 6y - 4z = 3$$
$$3x - z = 0$$
$$12x - 6y - z = -3$$

4. (a) Solve the differential equation : 5

$$x^2 y'' + 4xy' + 2y = 0, \quad x > 0$$

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(b) Solve : 5

$$y'' + 2y' = 4 \sin 2x .$$

5. (a) Find the volume of the tetrahedron whose three sides are given by : 5

$$2\hat{i} - 3\hat{j} + 4\hat{k},$$

$$\hat{i} + 2\hat{j} - \hat{k}$$

and $3\hat{i} - \hat{j} + 2\hat{k}$.

(b) A particle is acted upon by constant forces $-3\hat{i} + 2\hat{j} + 5\hat{k}$ and $2\hat{i} + \hat{j} - 3\hat{k}$ and is displaced from the point $(2, -1, -3)$ to the point $(4, -3, 7)$. Find the total work done by the forces. 5

6. (a) Prove that :

$$(\vec{a} \times \vec{b}) \times \vec{c} = \vec{a} \times (\vec{b} \times \vec{c})$$

if and only if $\vec{a}$ and $\vec{c}$ are collinear vectors. 6

(b) Check the applicability of the Rolle's theorem in the function :

$$f(x) = x^2 + 4, \quad x \in [-2, 2]$$

Find 'c' in case it is applicable. 4

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7. (a) Find $\frac{\partial u}{\partial r}$ and $\frac{\partial u}{\partial \theta}$, if : 6

$$u = e^{r\cos\theta} \cdot \cos(r\sin\theta).$$

(b) If $x = r\cos\theta, y = r\sin\theta, z = z$, then find : 4

$$\frac{\partial(x, y, z)}{\partial(r, \theta, z)}$$

8. (a) Prove that : 6

$$\begin{vmatrix} 1 & x & x^2 \\ 1 & y & y^2 \\ 1 & z & z^2 \end{vmatrix} = (x-y)(y-z)(z-x)$$

(b) Show by vector method that the diagonals of a rhombus are at right angles. 4

9. (a) Solve : 5

$$\frac{d^2y}{dx^2} + 6\frac{dy}{dx} + 9y = 5e^{3x}$$

(b) Solve : 5

$$(x+1)\frac{dy}{dx} - y = e^x(x+1)^2$$

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