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BEY–018

B. SC. (APPLIED SCIENCE–ENERGY) (BSCAEY)

Term-End Examination

June, 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.

1. (a) If : 2

$$A = \begin{bmatrix} 2 & 4 & 5 \\ -3 & 6 & 7 \\ 1 & 8 & 9 \end{bmatrix} \text{ and } B = \begin{bmatrix} 2 \\ 3 \\ 1 \end{bmatrix},$$

find AB.

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(b) Find the constant λ, so that the vectors : 2

$$\vec{a} = 2\hat{i} - \hat{j} + \hat{k},$$

$$\vec{b} = \hat{i} + 2\hat{j} - 3\hat{k}$$

and $\vec{c} = 3\hat{i} + \lambda\hat{j} + 5\hat{k}$

are coplanar.

(c) Find the general solution of : 2

$$y'' + 8y' + 16y = 0$$

(d) Solve : 2

$$\frac{dy}{dx} = \frac{y}{x} + x \sin \frac{y}{x}$$

(e) Find the area of a parallelogram whose adjacent sides are $\hat{i} - 2\hat{j} + 3\hat{k}$ and $2\hat{i} + \hat{j} - 4\hat{k}$. 2

2. Find A^{-1}, where $A = \begin{bmatrix} 4 & 2 & 3 \\ 0 & -1 & -2 \\ 5 & -3 & 6 \end{bmatrix}$. 10

3. (a) A particle is moving in a straight line according to the following relation between distance (s) and time (t) : 5

$$s = t^3 - 9t^2 + 3t + 1$$

s is measured is metres and t is seconds. When the velocity is – 24 m/s, find the acceleration.

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(b) Given $y_1 = e^{-x}$ is one solution, find the second linearly independent solution of : 5

$$y'' + 2y' + y = 0$$

4. (a) Find $\frac{dy}{dx}$, where $x^3 + y^2 + \sin xy = 0$. 4

(b) Use method of Laplace transform to solve the initial value problem (IVP) : 6

$$y'' - y' - 2y = 0,$$

$$y(0) = 1,$$

$$y'(0) = 0.$$

5. (a) Prove that : 5

$$\vec{a} \times \left(\vec{b} \times \vec{c}\right) + \vec{b} \times \left(\vec{c} \times \vec{a}\right) + \vec{c} \times \left(\vec{a} \times \vec{b}\right) = 0$$

(b) If the sum of two unit vectors is a unit vector, prove that the magnitude of their difference is $\sqrt{3}$. 5

6. (a) If $u = e^{xyz}$, find the value of : 6

$$\frac{\partial^3 u}{\partial x \, \partial y \, \partial z}$$

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(b) Expand the polynomial :

$$x^5 - 2x^4 + x^3 - x^2 + 2x - 1$$

in powers of $(x-1)$. 4

7. (a) Draw the graph of the curve $y = \cos^2 x$. 5

(b) Check whether the mean value theorem is applicable to the function $y = 1 - x^{2/3}$ over the interval $[-1,1]$. If yes, find the value of c. 5

8. (a) Without expanding prove that : 6

$$\begin{vmatrix} ab & 1 & c(a+b) \\ bc & 1 & a(b+c) \\ ca & 1 & b(c+a) \end{vmatrix} = 0$$

(b) Find the values of 'a' for which the vectors $3\hat{j} + 2\hat{j} + a\hat{k}$ and $\hat{i} + a\hat{j} + 3\hat{k}$ are (i) perpendicular and (ii) parallel. 4

9. (a) Find the differential equation satisfied by the two parameter family of functions $c_1 x + c_2 x^2$. 4

(b) Use the method of variation of parameter to obtain a particular solution of : 6

$$y''' - 2y'' - y' + 2y = e^{4x}$$

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