

PURBANCHAL UNIVERSITY

2026

B.E./Civil/Computer/Electrical/ECA/Electrical/Geomatic/Biomedical/Third Semester/Final
Time: 03:00 hrs.

Full Marks: 60 / Pass Marks: 24

BSH3008: Mathematics-III

Candidates are required to give their answers in their own words as far as practicable. The figures in the margin indicate full marks.

Group A

Attempt ALL questions.

10×2=20

1. Show that the matrix is Hermitian.

$$A = \begin{pmatrix} 1 & 2+3i & 4-i \\ 2-3i & 4 & 3+i \\ 4+i & 3-i & 2 \end{pmatrix}$$

2. Find the inverse transform of $y_1 = 5x_1 - 3x_2$, $y_2 = -3x_1 + 2x_2$
3. If the eigen values of a 3×3 matrix A are 2, 3 and 5, then find the trace of A, eigen values of matrix A^{-1} , A^2 , and A^T .
4. Find modal matrix of $A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$.
5. Find the Laplace transform of function $f(t) = \sin t \cosh t$.
6. Let $L[f(t)] = \frac{1}{(s+2)(s+3)}$, then find the function $f(t)$.
7. Using Laplace transform evaluate the value of integral $\int_0^{\infty} e^{-3t} t \cos 4t \, dt$.
8. Evaluate $\int_C \vec{F} \cdot d\vec{r}$ for a force field $\vec{F} = 3xy\vec{i} - y^2\vec{j}$ and C being a path given by the curve $y = 2x^2$ in xy-plane from (0,0) to (1,2).
9. Show that the function $f(x) = x^2 \sin x$ is odd function and $g(x) = x \sin x$ is even function.
10. Find the Fourier coefficient b_n in the Fourier series expansion of function $f(x) = x$ in (0,2).

Contd. ...

(2)

Group B

Attempt ALL questions.

10×4=40

11. Show that:

$$\begin{vmatrix} b^2 + c^2 & ab & ac \\ ab & c^2 + a^2 & bc \\ ca & cb & a^2 + b^2 \end{vmatrix} = 4a^2b^2c^2.$$

12. Find the rank of the matrix by reducing to row echelon form:

$$A = \begin{pmatrix} 4 & 1 & 2 & 1 \\ 1 & 2 & -1 & 3 \\ 3 & -1 & 1 & 2 \\ 1 & 2 & 0 & 1 \end{pmatrix}$$

OR

Find the Eigen vectors of the matrix:

$$A = \begin{pmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{pmatrix}$$

13. Find the inverse Laplace transform of $F(s) : \frac{s^2}{(s+1)(s+2)(s+3)}$

14. Solve the initial value problem using Laplace transform technique:

$$y''(t) - 5y'(t) + 6y(t) = 0, \quad y(0) = 0, y'(0) = 0$$

OR

Define unit step function $u(t-a)$ and find its Laplace transform. Finally show that:

$$L[u(t-a)f(t)] = e^{-as} L[f(t+a)]$$

15. Find the total work done in moving particle in the field

$$\vec{F} = (3x-4y+2z)\vec{i} + (4x+2y-3z^2)\vec{j} + (2zx-4y^2+z^3)\vec{k} \text{ along with one round of the ellipse } \frac{x^2}{16} + \frac{y^2}{9} = 1, z=0.$$

16. Using Green's theorem find the area of $x^{2/3} + y^{2/3} = a^{2/3}$.

Contd. ...

(3)

17. Using Gauss Divergence theorem, evaluate the surface integral $\iint_S \vec{F} \cdot \vec{n} \, ds$ where $\vec{F} = 2x \vec{i} + 3y \vec{j} + z \vec{k}$ and S is the surface of sphere $x^2 + y^2 + z^2 = 1$.

OR

Verify Stoke's theorem for the function $\vec{F} = 2y \vec{i} + 3x \vec{j} - z^2 \vec{k}$ and S is the upper half of the sphere $x^2 + y^2 + z^2 = 9$ and C is its boundary.

18. Find the flux $\iint_S \vec{F} \cdot \hat{n} \, ds$ where $\vec{F} = 6z \vec{i} - \vec{j} + y \vec{k}$ and S is the surface of plane $2x+3y+6z=12$ in the first octant.
19. Find the Fourier series of the function $f(x) = x-x^2$ in the interval $[-\pi, \pi]$.
20. Solve the following linear programming problem using Big-M method.

Maximize, $Z = 2x + y$

Subject to: $x + y \leq 10$, $-x + y \geq 2$, $x, y \geq 0$

≡