



KERALA AGRICULTURAL UNIVERSITY
B. Tech. (Agrl. Engg.) 2024 Admission
IV Semester Final Examination – July 2026

BES 2210

Engineering Mathematics – II (3+0)

Marks: 50
Time: 2 hours

I

Fill in the blanks

(10x1=10)

1. If $\nabla \cdot \vec{F} = 0$ then the vector field $\vec{F}$ is called
2. Newton's forward interpolation formula is used when the value of x is near the of the table.
3. Stokes' theorem relates a line integral to a integral.

State True or False

4. Laplace transform converts differentiation into algebraic operations.
5. At a discontinuity, Fourier series converges to the average of left and right limits.
6. If u is harmonic, then its harmonic conjugate always exists globally.
7. Every continuous function of a complex variable is analytic.

Answer the following

8. Define the curl of a vector field.
9. Define Linearity property of Laplace transform.
10. State the necessary condition for $f(z)$ to be analytic.

II

Write short notes on ANY FIVE of the following

(5x2=10)

1. Find the total work done in moving a particle in a force field given by $\vec{F} = 3xy\hat{i} - 5z\hat{j} + 10x\hat{k}$ along the curve $x = t^2 + 1, y = 2t^2, z = t^3$ from $t = 1$ to $t = 2$.
2. Write Euler's formulae for a_0, a_n and b_n for a function defined in $(-\pi, \pi)$.
3. Derive the first derivative formula

$$f'(x_0) \approx \frac{f(x_0 + h) - f(x_0)}{h}$$

4. Evaluate $\mathcal{L}\{t \sin at\}$.
5. Show that $\nabla f(x, y, z)$ is both an irrotational and solenoidal vector, if $f(x, y, z)$ satisfies $\nabla^2 f(x, y, z) = 0$.
6. If the real part of an analytic function is constant in a domain, prove that the function is constant in that domain.
7. Let the polynomial

$$p(x) = \alpha + \beta(x + 2) + \gamma(x + 2)(x + 1) + \delta(x + 2)(x + 1)x$$

Interpolate the data

x	-2	-1	0	1
$f(x)$	2	-1	8	5

Find the value of $\alpha + 2\beta + 5\gamma - 7\delta$.

III

Answer ANY FIVE of the following

(5x4=20)

1. Obtain the Fourier series, in the interval $\left[-\frac{1}{2}, \frac{1}{2}\right]$, of the function f given by

$$f(x) = \begin{cases} x - [x] - \frac{1}{2}, & \text{when } x \text{ is not an integer} \\ 0, & \text{otherwise} \end{cases}$$

where $[x]$ is the greatest integer $\leq x$.

2. Find the value of $\int_{0.4}^{1.6} \frac{x}{\sinh x} dx$, taking five sub-intervals, by Trapezoidal rule, correct to five significant figures.
3. Let E be the shift operator and let Δ and ∇ denote the forward and backward difference operators, respectively. Then
 - (i) Prove that $\Delta = E - 1$ and $\nabla = 1 - E^{-1}$.
 - (ii) Express Δ^2 in terms of E .
4. Show that $\nabla^2(\ln r) = \frac{1}{r^2}$, where $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ and $r = |\vec{r}|$.
5. Solve using Laplace transform $y'' + 3y' + 2y = 2u(t - 2)$, $y(0) = 0$, $y'(0) = 0$, where u is unit step function.
6. If $f(z) = u + iv$ is an analytic function, then show that u and v are both harmonic functions.
7. Prove that

$$\vec{F} = (y^2 \cos x + z^3)\hat{i} + (2y \sin x - 4)\hat{j} + (3xz^2 + 2)\hat{k}$$
 is a conservative force field.

IV

Write an essay on ANY ONE of the following

(1x10=10)

1. Verify the Gauss divergence theorem for vector function

$$\vec{F}(x, y, z) = (2x - z, x^2y, -xz^2)$$
 taken over the region bounded by $0 \leq x, y, z \leq 1$.
2. Apply fourth-order Runge-Kutta method to compute $y(0.3)$ for

$$\frac{dy}{dx} = x^2 + y, \quad y(0) = 1,$$
 taking $h=0.1$.
