



KERALA AGRICULTURAL UNIVERSITY  
B.Tech.(Agrl. Engg.) 2023 Admission  
I Semester Final Examination- February 2024

Sacs.1101

Engineering Mathematics - I (2+1)

Marks:50  
Time: 2 hours

**I Fill in the blanks** (10x1=10)

1. The maximum value of  $\sin x + \cos x$  is \_\_\_\_\_.
2.  $\lim_{x \rightarrow 0} x^x$  is equal to \_\_\_\_\_.
3.  $\frac{\partial(u,v)}{\partial(x,y)} \times \frac{\partial(x,y)}{\partial(u,v)} =$  \_\_\_\_\_.
4. Gradient of a constant is \_\_\_\_\_.
5.  $\text{div}(\phi \mathbf{f}) =$  \_\_\_\_\_.
6.  $\lim_{x \rightarrow 0} (1+x)^{\frac{1}{x}}$  is equal to \_\_\_\_\_.

**Answer the following**

7. Which theorem can be used to expand  $\log x$  in powers of  $x - 1$ ?
  8. Find the least value of the function  $f(x) = 3x^4 - 2x^3 - 6x^2 + 6x + 1$  in the interval  $[0,2]$ .
  9. Define curl of a continuously differentiable vector point function  $\mathbf{f}$ .
- State True or False**
10.  $\nabla \times \mathbf{f}$  is a scalar.

**II Write short notes on ANY FIVE of the following** (5x2=10)

1. Find the first order partial derivatives of  $e^{ax} \sin by$ .
2. If  $x = r \cos \theta$ ,  $y = r \sin \theta$ , then find  $\frac{\partial(r,\theta)}{\partial(x,y)}$ .
3. State Gauss's divergence theorem.
4. Find the asymptote of the spiral  $r = \frac{a}{\theta}$ .
5. Find  $\text{grad } r^m$ , where  $r$  is the distance of any point from the origin.
6. Evaluate  $\lim_{x \rightarrow 0} \frac{x e^x - \log(1+x)}{x^2}$ .
7. If  $u = x \log xy$ , where  $x^3 + y^3 + 3xy = 1$ , find  $\frac{du}{dx}$ .

**III Answer ANY FIVE of the following** (5x4=20)

1. Expand  $\log(1+x)$  using Maclaurin's series.
2. The loop of the curve  $2ay^2 = x(x-a)^2$  revolves about X-axis, find the volume of the solid so generated.
3. Expand the function  $\sin^{-1} \frac{2x}{1+x^2}$  in series form.
4. Find the values of  $a$  and  $b$  such that  $\lim_{x \rightarrow 0} \frac{x(a+b \cos x) - c \sin x}{x^5} = 1$ .

5. If  $u = \sin^{-1} \frac{x+2y+3z}{x^8+y^8+z^8}$ , find the value of  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z}$ .
6. If  $y_1 = \frac{x_2 x_3}{x_1}$ ,  $y_2 = \frac{x_3 x_1}{x_2}$ ,  $y_3 = \frac{x_1 x_2}{x_3}$ , find the Jacobian of  $y_1, y_2, y_3$  with respect to  $x_1, x_2, x_3$ .
7. Evaluate  $\iint_R x^2 dx dy$ , where  $R$  is the region in the first quadrant bounded by the lines  $x = y$ ,  $y = 0$ ,  $x = 8$  and the curve  $xy = 16$ .

**IV Write an essay on ANY ONE of the following (1x10=10)**

1. Find the volume of the solid obtained by the revolution of the cissoid  $y^2(2a - x) = x^3$  about its asymptote.
2. Transform the equation  $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$  into polar coordinates.

\*\*\*\*\*