

**First Semester B.E. Degree Examination, January 2013**  
**Engineering Mathematics – I**

Time: 3 hrs.

Max. Marks: 100

- Notes:** 1. Answer any FIVE full questions, choosing at least two from each part.  
 2. Answer all objective type questions only in OMR sheet page 5 of the answer booklet.  
 3. Answer to objective type questions on sheets other than OMR will not be valued.

**PART – A**

1. a. Choose the correct answers for the following :  
 (i) The Leibnitz theorem is the formula to find the  $n^{\text{th}}$  derivative of  
 A) trigonometric function B) exponential function C) product of two algebraic functions D) product of two functions  
 (ii) The  $n^{\text{th}}$  derivative of  $5^x$  is : A)  $\log 5, 5^n$  B)  $(\log 5)^n 5^x$  C)  $e^{(\log 5)x}$  D)  $(\log 5)^n e^{(\log 5)x}$   
 (iii) The value of 'c' of the Cauchy mean value theorem for  $f(x) = e^x$ ,  $g(x) = e^x$  in  $(3, 7)$  is : A) 5 B) 3 C) 0 D) 4  
 (iv) The generalized series of Maclaurin's series expansion is  
 A) Taylor series B) Exponential series C) Logarithmic series D) Trigonometric series (04 Marks)
- b. Verify Rolle's theorem for the function  $f(x) = x^2(1-x)^2$  in  $0 \leq x \leq 1$  and also find the value of c. (04 Marks)
- c. If  $\sin^{-1} y = 2 \log(x+1)$ , prove that  $(x+1)^2 y_{n+2} + (2n+1)(x+1)y_{n+1} + (n^2+4)y_n = 0$ . (06 Marks)
- d. Expand by using Maclaurin's series, the function  $\log(1+\sin x)$  upto fifth degree terms. (06 Marks)
2. a. Choose the correct answers for the following :  
 (i) The curve  $r = \frac{a}{1-\cos\theta}$  intersect orthogonally with the following curve : A)  $r = \frac{b}{1-\sin\theta}$  B)  $r = \frac{a}{1+\sin\theta}$  C)  $r = \frac{b}{1+\sin\theta}$  D)  $r = \frac{d}{\cos\theta}$   
 (ii) If  $\phi$  be the angle between the tangent and radius vector at any point on the curve  $r = R(\theta)$ , then  $\sin \phi$  equals to  
 A)  $\frac{dr}{d\theta}$  B)  $r \frac{d\theta}{dr}$  C)  $r \frac{dr}{d\theta}$  D)  $r \frac{d\theta}{dr}$   
 (iii) L Hospital's Rule can be applied to the limits of the form : A)  $0/0$  B)  $0 \times \infty$  C)  $\infty - \infty$  D)  $\infty^{\infty}$   
 (iv)  $\lim_{x \rightarrow \infty} (a^{1/x} - 1)x$  is of the following form : A)  $0 \times \infty$  B)  $\infty - \infty$  C)  $\infty^{\infty}$  D)  $0^0$  (04 Marks)
- b. Evaluate  $\lim_{x \rightarrow 0} (\tan x)^{\cot x}$ . (04 Marks)
- c. Find the radius of curvature for the curve  $x^2 y = a(x^2 + y^2)$  at the point  $(-2a, 2a)$ . (06 Marks)
- d. Find the Pedal equation for the curve  $r(1 - \cos \theta) = 2a$ . (06 Marks)
3. a. Choose the correct answers for the following :  
 (i) If  $f(x, y) = \frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{x^2 + y^2}$ , then  $x \frac{\partial f}{\partial x} + y \frac{\partial f}{\partial y}$  is : A) 0 B) 9 C) 0 D)  $-3f$   
 (ii) If  $x = \rho \cos \theta$ ,  $y = \rho \sin \theta$ ,  $z = z$  then  $\frac{\partial(x, y, z)}{\partial(\rho, \theta, z)}$  : A)  $\rho$  B) 1 C) 0 D) 0  
 (iii) If an error of 1% is made in measuring its base and height, the percentage error in the area of a triangle is  
 A) 0.2% B) 0.02% C) 1% D) 2%  
 (iv) One of the necessary and sufficient condition for a function to have a maximum value is  
 A)  $AC - B^2 > 0$ ,  $A < 0$  B)  $AC - B^2 = 0$ ,  $A = 0$  C)  $AC - B^2 < 0$ ,  $A > 0$  D)  $AC - B^2 > 0$ ,  $A > 0$  (04 Marks)
- b. If  $V = e^{\theta} \cos(a \log r)$ , prove that  $\frac{\partial^2 V}{\partial r^2} + \frac{1}{r} \frac{\partial V}{\partial r} + \frac{1}{r^2} \frac{\partial^2 V}{\partial \theta^2} = 0$ . (06 Marks)
- c. Examine the function  $f(x, y) = 1 + \sin(x^2 + y^2)$  for extremum values. (05 Marks)
- d. In calculating the volume of right circular cone, errors of 2% and 1% are made in height and radius of the base respectively. Find the percentage error in the volume. (05 Marks)
4. a. Choose the correct answers for the following :  
 (i) If  $\vec{F} = \nabla \phi$ , then the curl  $\vec{F}$  : A) solenoidal B) irrotational C) rotational D) none of these  
 (ii) If  $V = x^2 + y^2 + 3$  then grad V is : A)  $2xi + 2yj$  B)  $2x + 2y$  C)  $2xi + 2yj + k$  D)  $xi + yj$   
 (iii) The value of 'a' of the vector  $\vec{F} = (x + 3y)i + (x - 2z)j + (x + az)k$ , which is solenoidal : A) -2 B) -1 C) 0 D) 3  
 (iv) If  $R = x^2 y + y^2 z + z^2 x$ , then Laplacian of R is : A)  $x + y + z$  B)  $x - y - z$  C)  $2(x + y + z)$  D)  $2(x - y + z)$  (04 Marks)
- b. Find  $\text{div } \vec{F}$  and  $\text{curl } \vec{F}$ , where  $\vec{F} = \nabla(x^2 + y^2 + z^2 - 3xyz)$ . (06 Marks)
- c. Prove that  $\text{curl}(\phi \vec{u}) = \phi \text{curl } \vec{u} + \text{grad } \phi \times \vec{u}$ . (06 Marks)
- d. Show that the cylindrical system is orthogonal. (04 Marks)

**PART – B**

5. a. Choose the correct answers for the following :  
 (i) The value of  $\int_0^{\pi} \cos x \sin^m x \, dx$  is : A)  $1/99$  B)  $1/100$  C)  $\pi/100$  D)  $99/100$



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