

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^{th} derivative of
 A) trigonometric function B) exponential function C) product of two algebraic functions D) product of two functions
 (ii) The n^{th} derivative of 5^x is : A) $\log 5, 5^n$ B) $(\log 5)^n 5^x$ C) $e^{(\log 5)x}$ D) $(\log 5)^n e^{5x \log 5}$
 (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 ϕ be the angle between the tangent and radius vector at any point on the curve $r = R(\theta)$, then $\sin \phi$ equals to
 A) $\frac{dr}{ds}$ B) $r \frac{d\theta}{ds}$ C) $r \frac{dr}{ds}$ D) $r \frac{dr}{d\theta}$
 (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) ∞^{∞}
 (iv) $\lim_{x \rightarrow \infty} (a^{1/x} - 1)x$ is of the following form : A) $0 \times \infty$ B) $\infty - \infty$ C) ∞^{∞} 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) ρ 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 $V = x^2 + y^2 + z^2$ 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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