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14MAT11

**First Semester B.E. Degree Examination, June/July 2017**  
**Engineering Mathematics – I**

Time: 3 hrs.

Max. Marks:100

**Note: Answer any FIVE full questions, selecting at least ONE question from each part.**

**Module-1**

- 1 a. Find the  $n^{\text{th}}$  derivative of  $y = \sin^2 x \sin h^2 x + \log_{10} (x^2 - 3x + 2)$ . (07 Marks)
  - b. Find the pedal equation for the curve  $r = a + b \cos \theta$ . (06 Marks)
  - c. Obtain radius of curvature for the parametric curve,  $x = a(t - \sin t)$   $y = a(1 - \cos t)$ . (07 Marks)
- 2 a. If  $y = \tan^{-1} x$ , prove that  $(1 + x^2)y_{n+2} + 2(n + 1)xy_{n+1} + n(n + 1)y_n = 0$ . Hence obtain  $y_n(0)$ . (07 Marks)
  - b. Find the angle of intersection between the curves  $r = 2 \sin \theta$  ;  $r = 2(\sin \theta + \cos \theta)$ . (06 Marks)
  - c. Find the radius of curvature for the polar curve  $r^2 = a^2 \cos 2 \theta$ . (07 Marks)

**Module-2**

- 3 a. Evaluate :  $\lim_{x \rightarrow 0} (\cos x)^{\cot^2 x}$ . (06 Marks)
  - b. Determine Maclarin's series for the function for  $f(x) = \log (1 + \cos x)$  upto term containing  $x^4$ . (07 Marks)
  - c. If  $u = f(2x - 3y, 3y - 4z, 4z - 2x)$  then obtain the value of  $\frac{1}{2} \frac{\partial u}{\partial x} + \frac{1}{3} \frac{\partial u}{\partial y} + \frac{1}{4} \frac{\partial u}{\partial z}$ . (07 Marks)
- 4 a. Find total derivative of  $u$  with respect to  $t$  where  $u = \tan^{-1} x/y$ ,  $x = e^t - e^{-t}$ ,  $y = e^t + e^{-t}$ . (06 Marks)
  - b. If  $u = \frac{x}{y-z}$ ,  $v = \frac{y}{z-x}$ ,  $w = \frac{z}{x-y}$ , find the Jacobian  $\frac{\partial(u, v, w)}{\partial(x, y, z)}$ . Determine whether  $u$ ,  $v$  and  $w$  are functionally dependent. (07 Marks)
  - c. If  $x$   $y$   $z$  be the angles of a triangle, show that the maximum value of  $\sin x \sin y \sin z$  is  $\frac{3\sqrt{3}}{8}$ . (07 Marks)

**Module-3**

- 5 a. A particle moves along  $x = t^3 - 4t$ ,  $y = t^2 + 4t$ ,  $z = 8t^2 - 3t^3$ , where 't' denotes time. Find the magnitudes of velocity and acceleration at time  $t = 2$ . (07 Marks)
- b. Assuming the validity of differentiation under integral sign prove that  $\int_0^{\infty} e^{-x^2} \cos \alpha x dx = \frac{\sqrt{\pi}}{2} e^{-\alpha^2/4}$ . (07 Marks)
- c. Trace the curve  $x^{2/3} + y^{2/3} = a^{2/3}$ , using general rules of tracing the curve. (06 Marks)





- 6 a. If  $\vec{F} = \text{grad}(x^3 + y^3 + z^3 - 3xyz)$  find  $\text{curl } \vec{F}$ . Is  $\vec{F}$  irrotational? (07 Marks)
- b. Prove that if  $\vec{F}$  is a vector point function  $\text{div}(\text{curl } \vec{F}) = 0$ . (07 Marks)
- c. If  $\vec{r}$  is a position vector of a point in space obtain  $\text{div } \vec{r}$  and  $\text{curl } \vec{r}$ . (06 Marks)

#### Module-4

- 7 a. Solve  $\frac{dy}{dx} + x \sin 2y = x^3 \cos^2 y$ . (07 Marks)
- b. Obtain the reduction formula for  $\int_0^{\pi/2} \cos^n x \, dx$ , where 'n' is a positive integer. (07 Marks)
- c. A body originally at  $80^\circ\text{C}$  cools down to  $60^\circ\text{C}$  in 20 minutes, the temperature of air being  $40^\circ\text{C}$ . What will be the temperature of the body after 40 minutes from the original? (06 Marks)
- 8 a. Show that family  $\frac{x^2}{a^2 + \lambda} + \frac{y^2}{b^2 + \lambda} = 1$  with  $\lambda$  as a parameter is self orthogonal. (07 Marks)
- b. Evaluate:  $\int_0^{2a} x^3 \sqrt{2ax - x^2} \, dx$ . (07 Marks)
- c. Solve:  $(y^2 e^{xy^2} + 4x^3) dx + (2xy e^{xy^2} + 3y^2) dy = 0$ . (06 Marks)

#### Module-5

- 9 a. Solve by gauss elimination method:  
 $2x - 3y + 4z = 7$   
 $5x - 2y + 2z = 7$   
 $6x - 3y + 10z = 23$ . (07 Marks)
- b. Reduce the quadratic form:  $3x_1^2 + 3x_2^2 + 3x_3^2 + 2x_1x_2 + 2x_1x_3 - 2x_2x_3$  into canonical form by orthogonal transformation. (07 Marks)
- c. Find the largest eigen value and corresponding eigen vector by Rayleigh's power method performing five iterations, with  $x^{(0)} = [1, 1, 1]^T$  for  $A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ . (06 Marks)
- 10 a. Solve by LU decomposition method:  
 $10x + y + z = 12$   
 $2x + 10y + z = 13$   
 $2x + 2y + 10z = 14$ . (07 Marks)
- b. Diagonalize the matrix  $A = \begin{bmatrix} -1 & 3 \\ -2 & 4 \end{bmatrix}$ . Hence find  $A^4$ . (07 Marks)
- c. Solve by Gauss Seidel iteration method:  
 $20x + y - 2z = 17$   
 $3x + 20y - z = -18$   
 $2x - 3y + 20z = 25$   
Perform 3 iterations. (06 Marks)

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