

CBCS Scheme

15MAT11

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First Semester B.E. Degree Examination, Dec.2016/Jan.2017 Engineering Mathematics - I

Max. Marks: 80

Time: 3 hrs.

Note: Answer FIVE full questions, choosing one full question from each module.

Module-1

- 1 a. If $y = e^{-3x} \cos^3 x$, find y_n . (06 Marks)
- b. Find the angle between the curves

$$r = \frac{a}{1 + \cos \theta} \text{ and } r = \frac{b}{1 - \cos \theta}.$$
 (05 Marks)
- c. Find the radius of curvature of the curve $x^4 + y^4 = 2$ at the point (1, 1). (05 Marks)

OR

- 2 a. If $x = \tan(\log y)$, find the value of $(1+x^2)y_{n+1} + (2nx-1)y_n + (n)(n-1)y_{n-1}$. (06 Marks)
- b. Find the Pedal equation of $\frac{2a}{r} = 1 + \cos \theta$. (05 Marks)
- c. Find the radius of curvature of the curve $r^n = a^n \cos n\theta$. (05 Marks)

Module-2

- 3 a. Explain $\log(\cos x)$ about the point $x = \frac{\pi}{3}$ upto 3rd degree terms using Taylor's series. (06 Marks)
- b. Evaluate $\lim_{x \rightarrow 0} \left(\frac{\tan x}{x} \right)^{1/x^2}$. (05 Marks)
- c. State Euler's theorem and use it to find $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y}$ when $u = \tan^{-1} \left(\frac{x^2 + y^2}{x + y} \right)$. (05 Marks)

OR

- 4 a. Expand $\frac{e^x}{1+e^x}$ using Maclaurin's series upto and including 3rd degree terms. (06 Marks)
- b. Find $\frac{du}{dt}$ when $u = x^3 y^2 + x^2 y^3$ with $x = at^2$, $y = 2at$. Use Partial derivatives. (05 Marks)
- c. If $u = \frac{x_2 x_3}{x_1}$, $v = \frac{x_1 x_3}{x_2}$, $w = \frac{x_1 x_2}{x_3}$, find the value of Jacobian $J \left(\frac{u, v, w}{x_1, x_2, x_3} \right)$. (05 Marks)

Module-3

- 5 a. A particle moves on the curve $x = 2t^2$, $y = t^2 - 4t$, $z = 3t - 5$, where t is the time find the components of velocity and acceleration at time $t = 1$ in the direction of $i - 3j + 2k$. (06 Marks)
- b. Find the divergence and curl of the vector $\vec{V} = (xyz)i + (3x^2y)j + (xz^2 - y^2z)k$ at the point (2, -1, 1). (05 Marks)
- c. A vector field is given by $\vec{A} = (x^2 + xy^2)i + (y^2 + x^2y)j$, show that the field is irrotational and find the scalar potential. (05 Marks)



15MAT11

OR

- 6 a. Find grad ϕ when $\phi = 3x^2y - y^3z^2$ at the point $(1, -2, -1)$. (06 Marks)
 b. Find a for which $f = (x + 3y)i + (y - 2z)j + (x + az)k$ is solenoidal. (05 Marks)
 c. Prove that $\text{Div}(\text{curl } \vec{V}) = 0$. (05 Marks)

Module-4

- 7 a. Obtain the reduction formula of $\int \sin^m x \cos^n x \, dx$. (06 Marks)
 b. Evaluate $\int_0^{2a} x\sqrt{2ax - x^2} \, dx$. (05 Marks)
 c. Solve $(2x \log x - xy) \, dy + 2y \, dx = 0$. (05 Marks)

OR

- 8 a. Obtain the reduction formula of $\int \cos^n x \, dx$. (06 Marks)
 b. Obtain the Orthogonal trajectory of the family of curves $r^n \cos n\theta = a^n$. Hence solve it. (05 Marks)
 c. A body originally at 80°C cools down at 60°C in 20 minutes, the temperature of the air being 40°C . What will be the temperature of the body after 40 minutes from the original? (05 Marks)

Module-5

- 9 a. Find the rank of the matrix

$$A = \begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$$

(06 Marks)

- b. Solve by Gauss – Jordan method the system of linear equations
 $2x + y + z = 10$, $3x + 2y + 3z = 18$, $x + 4y + 9z = 16$. (05 Marks)
 c. Find the largest eigen value and the corresponding Eigen vector by power method given that

$$A = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}. \text{ (Use } [1 \ 0 \ 0]^T \text{ as the initial vector). (Apply 4 iterations). (05 Marks)}$$

OR

- 10 a. Use Gauss – Seidel method to solve the equations
 $20x + y - 2z = 17$
 $3x + 20y - z = 18$
 $2x - 3y + 20z = 25$. Carry out 2 iterations with $x_0 = y_0 = z_0 = 0$. (06 Marks)

- b. Reduce the matrix $A = \begin{bmatrix} -1 & 2 & -2 \\ 1 & 2 & 1 \\ -1 & -1 & 0 \end{bmatrix}$ to the diagonal form. (05 Marks)

- c. Reduce the quadratic form $3x^2 + 5y^2 + 3z^2 - 2yz + 2zx - 2xy$ to the canonical form. (05 Marks)

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