# CBCS Scheme

**15MAT11**

USN

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

Time: 3 hrs. Max. Marks: 80

**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 $r = \dfrac{a}{1+\cos\theta}$ and $r = \dfrac{b}{1-\cos\theta}$. **(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 $\dfrac{2a}{r} = 1 + \cos\theta$. **(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 $x = \dfrac{\pi}{3}$ upto 3rd degree terms using Taylor's series. **(06 Marks)**

b. Evaluate $\underset{x\to 0}{\text{Limit}}\left(\dfrac{\tan x}{x}\right)^{1/x^2}$. **(05 Marks)**

c. State Euler's theorem and use it to find $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y}$ when $u = \tan^{-1}\left(\dfrac{x^2+y^2}{x+y}\right)$. **(05 Marks)**

**OR**

4 a. Expand $\dfrac{e^x}{1+e^x}$ using Maclaurin's series upto and including 3rd degree terms. **(06 Marks)**

b. Find $\dfrac{du}{dt}$ when $u = x^3y^2 + x^2y^3$ with $x = at^2$, $y = 2at$. Use Partial derivatives. **(05 Marks)**

c. If $u = \dfrac{x_2x_3}{x_1}$, $v = \dfrac{x_1x_3}{x_2}$, $w = \dfrac{x_1x_2}{x_3}$, find the value of Jacobian $J\left(\dfrac{u, v, w}{x_1, x_2, x_3}\right)$. **(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)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. 2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

**OR**

6 a. Find grad $\phi$ 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 Div(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 $80^0$C cools down at $60^0$C in 20 minutes, the temperature of the air being $40^0$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 $A = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$. (Use $[1\ 0\ 0]^T$ as the initial vector). (Apply 4 iterations). **(05 Marks)**

**OR**

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

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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