

Code No: R161203

R16
SET - 1
I B. Tech II Semester Regular/Supplementary Examinations, April/May - 2018
MATHEMATICS-III

(Com. to CE,CSE,IT,AE,AME,EIE,EEE,ME,ECE,Metal E,Min E,E Com E,Agri E,Chem E,PCE,PE)

Time: 3 hours

Max. Marks: 70

 Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)

 2. Answer **ALL** the question in **Part-A**

 3. Answer any **FOUR** Questions from **Part-B**
PART -A

1. a) Write the working procedure to reduce the given matrix into Echelon form. (2M)
- b) Find the Eigen value of the matrix $A = \begin{bmatrix} 4 & 2 \\ 1 & 5 \end{bmatrix}$. (2M)
- c) Find the point of the curve $r = a(1 + \cos \theta)$ where tangent coincide with the radius vector. (2M)
- d) Evaluate $\int_1^2 \int_3^4 (xy + e^y) dx dy$ (2M)
- e) Show that $\Gamma(n+1) = n\Gamma(n)$ for $n > 0$ (2M)
- f) Find grad ϕ where $\phi = x^3 + y^3 + 3xyz$ at $(1,1,-2)$ (2M)
- g) Find the work done in moving particle in the force field $\vec{F} = 3x^2 \vec{i} + \vec{j} + z\vec{k}$ along the straight line $(0, 0, 0)$ to $(2, 1, 3)$. (2M)

PART -B

2. a) Reduce the matrix $A = \begin{bmatrix} 3 & -2 & 0 & -1 \\ 0 & 2 & 2 & 1 \\ 1 & -2 & -3 & 2 \\ 0 & 1 & 2 & 1 \end{bmatrix}$ in to normal form hence find the rank. (7M)
- b) If consistent, solve the system of equations. (7M)

$$\begin{aligned} x + y + z + t &= 4 \\ x - z + 2t &= 2 \\ y + z - 3t &= -1 \\ x + 2y - z + t &= 3. \end{aligned}$$
3. a) Determine the diagonal matrix orthogonally similar to the matrix. (7M)

$$A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$$
- b) Find the Nature, index and signature of the quadratic form (7M)

$$10x^2 + 2y^2 + 5z^2 - 4xy - 10xz + 6yz$$

Code No: R161203

R16
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4. a) By change of order of integration evaluate $\int_0^a \int_x^a (x^2 + y^2) dy dx$ (7M)
- b) Evaluate $\int_0^{\pi/2} \int_0^{a \sin \theta} \int_0^{(a^2 - r^2)/a} r dr d\theta dz$ (7M)
5. a) Evaluate $\int_0^\infty 3^{-4x^2} dx$ (7M)
- b) Show that $\int_0^\infty \sin x^2 dx = \int_0^\infty \cos x^2 dx = \frac{1}{2} \sqrt{\frac{\pi}{2}}$ (7M)
6. a) Show that $\vec{f} = r^n (\vec{a} \times \vec{r})$ is solenoidal where $\vec{a} = a_1 \vec{i} + a_2 \vec{j} + a_3 \vec{k}$ and $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ (7M)
- b) Prove that $\nabla \left(r \nabla \left(\frac{1}{r^3} \right) \right) = \frac{3}{r^4}$ (7M)
7. a) Verify stoke's theorem for $\vec{F} = y\vec{i} + z\vec{j} + x\vec{k}$ for the upper part of the sphere $x^2 + y^2 + z^2 = 1$. (7M)
- b) Verify Green's theorem in the plane for $\oint_c (xy + y^2) dx + x^2 dy$. Where c is the closed curve of the region bounded by $y=x$ & $y=x^2$ (7M)

Code No: R161203

R16
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 2. Answer **ALL** the question in **Part-A**

 3. Answer any **FOUR** Questions from **Part-B**

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**PART -A**

1. a) Write the working procedure to reduce the given matrix into Normal form. (2M)
- b) Write quadratic form  $x^2 + 3y^2 + 3z^2 - 2yz$  (2M)
- c) Write the tangents at the origin of the curve  $a^2y^2 = x^2(a^2 - x^2)$ . (2M)
- d) Evaluate  $\int_0^1 \int_0^1 \int_0^1 dx dy dz$  (2M)
- e) Prove that  $\beta(m, n) = \int_0^{\frac{\pi}{2}} \sin^{2m-1} \theta \cos^{2n-1} \theta d\theta$  (2M)
- f) Find the maximum value of the directional derivative of  $\phi = 2x^2 - y - z^4$  at  $(2, -1, 1)$  (2M)
- g) Write Stoke's theorem. (2M)

**PART -B**

2. a) For what value of k the matrix  $A = \begin{bmatrix} 4 & 4 & -3 & 1 \\ 1 & 1 & -1 & 0 \\ k & 2 & 2 & 2 \\ 9 & 9 & k & 3 \end{bmatrix}$  has rank 3. (7M)

$$8x - 3y + 2z = 20$$

- b) Solve the following system of equations  $4x + 11y - z = 33$  by using. (7M)

$$6x + 3y + 12z = 35$$

Gauss – Seidel method.

3. a) Determine the characteristic roots and the corresponding characteristic vectors of the matrix. (7M)

$$A = \begin{bmatrix} 3 & 10 & 5 \\ -2 & -3 & -4 \\ 3 & 5 & 7 \end{bmatrix}$$

- b) Find the Nature, index and signature of the quadratic form (7M)

$$4x^2 + 3y^2 + z^2 - 8xy + 4xz - 6yz$$

Code No: R161203

**R16****SET - 2**

4. a) Trace the curve  $r^2 = a^2 \cos 2\theta$  (7M)
- b) Evaluate  $\int \int (x^2 + y^2) dx dy$  over the area bounded by the Ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  (7M)
5. a) Evaluate  $\int_0^\infty a^{-bx^2} dx$   $b > 0, a > 1$  (7M)
- b) Show that  $\int_0^1 x^m (\log x)^n dx = \frac{(-1)^n n!}{(m+1)^{n+1}}$  (7M)
6. a) Find the constants 'a' and 'b' such that the surfaces  $5x^2 - 2yz - 9x = 0$  and  $ax^2y + bz^3 = 4$  cuts orthogonally at (1, -1, 2) (7M)
- b) Show that the vector  $(x^2 - yz)\bar{i} + (y^2 - zx)\bar{j} + (z^2 - xy)\bar{k}$  is irrotational and find its scalar potential. (7M)
7. a) If  $\vec{f} = (3x^2 - 2z)\bar{i} - 4xy\bar{j} - 5x\bar{k}$  Evaluate  $\int_v \text{Cur } \vec{F} dv$ , where v is volume bounded by the planes  $x = 0; y = 0; z = 0$  and  $3x + 2y + 3z = 6$ . (7M)
- b) Evaluate  $\oint_c \cos y dx + x(1 - \sin y) dy$  over a closed curve c given by  $x^2 + y^2 = 1; z = 0$  using Green's theorem. (7M)

Code No: R161203

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Time: 3 hours

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 2. Answer **ALL** the question in **Part-A**

 3. Answer any **FOUR** Questions from **Part-B**
**PART -A**

1. a) Write the working procedure to find the inverse of the given matrix by Jordan method. (2M)
- b) Find the Eigen value of Adj A if the 'λ' is the Eigen value of A. (2M)
- c) Write the symmetry of the curve  $y^2 (2a - x) = x^3$  (2M)
- d) Evaluate  $\int_0^3 \int_{-x}^x xy \, dx \, dy$  (2M)
- e) Find the value of  $\beta\left(\frac{1}{2}, \frac{1}{2}\right)$  (2M)
- f) Find the angle between the surfaces  $x^2 + y^2 + z^2 = 9$  and  $z = x^2 + y^2 - 3$  at the point (2, -1, 2). (2M)
- g) Write the physical interpretation of Gauss divergence theorem. (2M)

**PART -B**

2. a) Reduce the matrix to Echelon form and find its rank  $\begin{bmatrix} 2 & -1 & 3 & 4 \\ 0 & 3 & 4 & 1 \\ 2 & 3 & 7 & 5 \\ 2 & 5 & 11 & 6 \end{bmatrix}$  (7M)
- b) Solve the equations  $10x + y + z = 12$ ,  $2x + 10y + z = 13$ ,  $x + y + 5z = 7$  by Gauss – Jordan method. (7M)
3. a) Find the Natural frequencies and normal modes of vibrating system for which mass  $M = \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix}$  and stiffness  $K = \begin{bmatrix} 2 & 1 \\ 1 & 3 \end{bmatrix}$  (7M)
- b) Verify Cayley-Hamilton theorem for the matrix  $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$ . Hence find  $A^{-1}$  (7M)

Code No: R161203

**R16****SET - 3**

4. a) Find the volume of region bounded by the surface  $z = x^2 + y^2$  and  $z = 2x$ . (7M)
- b) Evaluate  $\int_0^a \int_0^{\sqrt{a^2-x^2}} \sqrt{x^2 + y^2} dy dx$  by changing in to polar co-ordinates. (7M)
5. a) Show that  $\int_a^b (x-a)^{m-1} (b-x)^{n-1} dx = (b-a)^{m+n-1} \beta(m,n)$   $m > 0, n > 0$  (7M)
- b) Evaluate  $\int_0^1 (x \log x)^4 dx$  (7M)
6. a) Find the directional derivative of  $\phi = xyz$  at  $(1, -1, 1)$  along the direction which makes equal angles with the positive direction of  $x, y, z$  axes (7M)
- b) Prove that  $\text{div } \text{curl } \vec{f} = 0$  (7M)
7. a) Verify Green's theorem for  $\int_c (3x^2 - 8y^2) dx + (4y - 6xy) dy$  where  $c$  is the boundary of the region enclosed by the lines  $x = 0, y = 0, x + y = 1$ . (7M)
- b) Find the flux of vector function  $\vec{F} = (x - 2z)\vec{i} + (x + 3y)\vec{j} + (5x + y)\vec{k}$  through the upper side of the triangle ABC with vertices  $(1, 0, 0), (0, 1, 0), (0, 0, 1)$ . (7M)

Code No: R161203

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Time: 3 hours

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 2. Answer **ALL** the question in **Part-A**

 3. Answer any **FOUR** Questions from **Part-B**
**PART -A**

1. a) Find the Rank of the matrix  $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$  (2M)
- b) Prove the AB and BA has same Eigen values. (2M)
- c) Write the Asymptote of the curve  $y = \frac{x^2 + 1}{x^2 - 1}$  (2M)
- d) Evaluate  $\int_0^3 \int_1^2 xy(x+y) dx dy$  (2M)
- e) Show that  $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$  (2M)
- f) Show that  $\nabla(r^2) = 2\vec{r}$  (2M)
- g) Write Green's theorem. (2M)

**PART -B**

2. a) Reduce the matrix  $A = \begin{bmatrix} 1 & 2 & 3 & -2 \\ 2 & -2 & 1 & 3 \\ 3 & 0 & 4 & 1 \end{bmatrix}$  into PAQ form and hence find the rank of the matrix. (7M)
- b) Solve the equations  $x + y + z = 8,$   
 $2x + 3y + 2z = 19$  by Gauss – Elimination method. (7M)  
 $4x + 2y + 3z = 23$
3. a) Diagonalize the matrix  $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 3 & 1 \\ 0 & 0 & 1 \end{bmatrix}$  if possible. (7M)
- b) Find the Nature, index and signature of the quadratic form  $3x^2 + 5y^2 + 3z^2 - 2xy + 2xz - 2yz$  by orthogonal reduction. (7M)

Code No: R161203

**R16**
**SET - 4**

4. a) Trace the curve  $x = a \cos t + \frac{a}{2} \log \tan^2 t/2$ ,  $y = a \sin t$  (7M)
- b) Find the area between the circles  $r = a \cos \theta$  and  $r = 2a \cos \theta$ . (7M)
5. a) Prove that  $\int_0^1 \frac{x^{m-1}(1-x)^{n-1}}{(a+bx)^{m+n}} dx = \frac{\beta(m,n)}{(a+b)^m a^n}$  (7M)
- b) Evaluate  $\int_0^\infty e^{-x^6} x^4 dx$  (7M)
6. a) Find the directional derivative of the function  $e^{2x} \cos yz$  at the origin in the direction to the tangent to the curve  $x = a \sin t$ ,  $y = a \cos t$ ,  $z = at$  at  $t = \frac{\pi}{4}$  (7M)
- b) Show that  $\text{curl curl } \vec{f} = \nabla \times (\nabla \times \vec{f}) = \nabla (\nabla \cdot \vec{f}) - (\nabla \cdot \nabla) \vec{f}$  if  $\vec{f}(x, y, z)$  is vector point function. (7M)
7. a) Verify Gauss Divergence theorem for  $\vec{F} = (x^2 - yz)\vec{i} + (y^2 - zx)\vec{j} + (z^2 - xy)\vec{k}$  taken over the rectangular parallelepiped  $0 \leq x \leq a$ ;  $0 \leq y \leq b$ ;  $0 \leq z \leq c$ . (7M)
- b) Evaluate  $\iint_s (\nabla \times \vec{F}) \cdot \vec{n} ds$  where  $\vec{F} = (x^2 + y - 4)\vec{i} + 3xy\vec{j} + (2xy + z^2)\vec{k}$  and  $s$  in the surface of the paraboloid  $z = 4 - x^2 - y^2$  above the  $xy$  plane. (7M)