2E1022

Roll No. : ____________

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B. Tech. I Year (Sem. II) (Main / Back) Examination, July - 2011
Common to All Branches of Engineering
202 : Engineering Mathematics-II

Time : 3 Hours] [Total Marks : 80
[Min. Passing Marks : 24

Attempt overall ***five questions****, selecting* ***one question*** *from* ***each unit. All*** *questions carry* ***equal*** *marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.)*

Use of following supporting material is permitted during examination.
(Mentioned in form No. 205)

1.____Nil____ 2.____Nil____

UNIT - I

1 (a) A variable plane passes through a fixed point (a, b, c) and cuts the coordinate axes at A, B and C. Show that the locus of the centre of the sphere OABC is $\frac{a}{x}+\frac{b}{y}+\frac{c}{z}=2$. 8

(b) Find the equation of the right circular cone, which passes through the point $(1,1,1)$, has its vertex $(1,0,1)$ and whose axis is equally inclined to the coordinate axes. 8

OR

1 (a) Find the equation of the sphere inscribed in the tetrahedron whose faces are
$x=0, y=0, z=0$ and $2x+6y+3z=14$. 8

(b) Find the equation of a right circular cylinder whose guiding curve is the circle
$x^2+y^2+z^2=9,\ x+y+z=3$ 8

UNIT - II

2 (a) Find the rank of the matrix

$$\begin{bmatrix} 1 & 0 & 1 & 1 \\ 1 & 1 & -2 & 0 \\ 3 & 1 & 0 & 2 \\ 0 & 1 & -3 & -1 \end{bmatrix},$$

and also reduce it to its normal form. 8

(b) Find the eigen values and eigen vectors of the matrix

$$A = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$$

8

OR

2 (a) Find the characteristic equation of the matrix

$$A = \begin{bmatrix} 1 & 3 & 7 \\ 4 & 2 & 3 \\ 1 & 2 & 1 \end{bmatrix}.$$

Show that this equation is satisfied by the matrix A and hence obtain the inverse of A. 8

(b) Investigate for consistency, the given equations and if possible, find the solution also :

$$4x - 2y + 6z = 8$$
$$x + y - 3z = -1$$
$$15x - 3y + 9z = 21$$

8

UNIT - III

3 (a) If $\vec{A} = (x + 2y + az)\hat{i} + (bx - 3y - z)\hat{j} + (4x + cy + 2z)\hat{k}$, find a, b, c so that $\vec{A}$ is irrotational. Also find the scalar potential of $\vec{A}$. 8

(b) Evaluate $\iint_S \vec{F} \cdot \hat{n}\, ds$

where $\vec{F} = (x+y^2)\hat{i} - 2x\hat{j} + 2yz\hat{k}$ and S is the surface of the plane $2x+y+2z=6$ in the first octant.

8

OR

3 (a) Prove that

$$\nabla^2 f(r) = f''(r) + \frac{2}{r} f'(r)$$

where $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$.

8

(b) Verify Stoke's theorem for

$\vec{F} = (x^2 + y - 4)\hat{i} + 3xy\hat{j} + (2xy + z^2)\hat{k}$ over the surface of hemisphere $x^2 + y^2 + z^2 = 16$ above the x-y plane.

8

UNIT - IV

4 (a) A point moves in a plane curve so that its tangential acceleration is constant and the magnitudes of the velocity and the normal acceleration are in constant ratio. Show that the intrinsic equation of the path has the form

$$S = A\psi^2 + B\psi + C$$

8

(b) If the resistance to the motion of a railway train vary as its mass and the square of its velocity and the engine works at constant H.P. Show that the full speed will never be attained and that the distance traversed from rest when half of the full speed is attained is $\frac{1}{3\mu} \log \frac{8}{7}$, where μ is the resistance per unit mass per unit velocity.

8

OR

4 (a) If the angular velocity w of a particle about the origin is constant and the rate of change of acceleration is directed wholly along the radius vector, prove that $\frac{d^2r}{dt^2} = \frac{1}{3} w^2 \cdot r$.

8

(b) A body is projected vertically upwards with a velocity U against a resistance proportional to the square of the velocity. If V is the terminal velocity of the body and m its mass, show that, when the body has fallen back to the point of projection, the loss of kinetic energy is $\frac{1}{2} m \frac{U^4}{U^2 + V^2}$.

8

UNIT - V

5 (a) Solve in series :

$$x(1-x)\frac{d^2y}{dx^2} - 3x\frac{dy}{dx} - y = 0$$

8

(b) Find the complete integral of

$$\left(x^2 - y^2\right)pq - \left(p^2 - q^2\right)xy = 1.$$

8

OR

5 (a) Solve :

$$x\left(y^2 + z\right)p - y\left(x^2 + z\right)q = \left(x^2 - y^2\right)z$$

6

(b) Solve :

$$x^2 y^3 p^2 q = z^3$$

5

(c) Solve completely :

$$Z = px + qy + c\sqrt{1 + p^2 + q^2}.$$

5