# I B.Tech I Semester Regular Examinations, February 2013 MATHEMATICS-I <br> ( Common to Civil Engineering, Electrical \& Electronics Engineering, Mechanical Engineering, Electronics \& Communication Engineering, Computer Science \& Engineering, Chemical Engineering, Electronics \& Instrumentation Engineering, Bio-Medical Engineering, Information Technology, Electronics \& Computer Engineering, Aeronautical Engineering, Bio-Technology, Automobile Engineering, Mining and Petroliem Technology) 

Time: 3 hours
Max Marks: 75
Answer any FIVE Questions
All Questions carry equal marks

1. (a) Solve $d y+(2 y \operatorname{Cot} x+\operatorname{Sin} 2 x) d x=0$
(b) Find the orthogonal trajectory of the family of curves $2 x y+y^{2}-x^{2}=a$, where ' $a$ ' is a parameter
$[8+7]$
2. (a) Explain the procedure to find Complete solution of second order non homogeneous differential equation with constant coefficients.
(b) Solve $\left(D^{2}-4\right) y=x \operatorname{Sin} \lambda x$
3. (a) Find the dimensions of a open rectangular tank of maximum capacity whose surface area is 54 square feet.
(b) In a right angled triangle ABC with $\angle B=90^{\circ}$, find the maximum of $\cos \mathrm{A} \cos \mathrm{B}$ cosC.
4. (a) Trace the curve $r=4 \theta$.
(b) Trace the curve $\mathrm{r}=\frac{1}{4}+2 \sin \theta$.
5. (a) Find the cost of plating of the front portion of the parabolic reflector of an automobile head light of 12 cm diameter and 4 cm deep if the cost of plating is Rs. 2.00 per Sq . cm.
(b) Find the volume of the right circular cone of height ' h ' and base radius ' r '.
6. (a) Evaluate $\iiint_{v} d x d y d z$ where V is the finite region of space formed by the planes $\mathrm{x}=0, \mathrm{y}=0, z=0 \& 2 x+3 y+4 z=12$.
(b) Evaluate $\iint_{R} y$ dxdy where R is the region bounded by the Parabolas $y^{2}=$ $4 x$ and $\mathrm{x}^{2}=4 y$.
7. (a) Find the directional derivative of $\mathrm{xyz}^{2}+\mathrm{xz}$ at $(1,1,1)$ in a direction of the normal to the surface $3 x^{2} y+y=z$ at $(0,1,1)$.
(b) Show that the vector $\left(x^{2}-y z\right) i-\left(y^{2}-z x\right) j+\left(z^{2}-x y\right) k$ is irrotational and find its scalar potential.
8. (a) If $\mathrm{f}=4 \mathrm{xzi}-\mathrm{y}^{2} \mathrm{j}+\mathrm{yzk}$, evaluate $\int_{s} f . N d s$ where S is the surface of the cube bounded by $\mathrm{x}=0, \mathrm{x}=\mathrm{a}, \mathrm{y}=0, \mathrm{y}=\mathrm{a}, \mathrm{z}=0, \mathrm{z}=\mathrm{a}$.
(b) Evaluate by Green's theorem, $\oint_{c}(y-\operatorname{Sin} x) d x+\operatorname{Cos} x$ dy where $C$ is the triangle enclosed by the lines $\mathrm{x}=0, \mathrm{x}=\frac{\pi}{2}, \pi \mathrm{y}=2 \mathrm{x}$.
$[8+7]$

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1. (a)Solve $(x y \operatorname{Sin} x y+\operatorname{Cos} x y) y d x+(x y \operatorname{Sin} x y-\operatorname{Cos} x y) x d y=0$
(b) Radium decomposes at a rate proportional to the amount present. If $5 \%$ of the original amount disappears in 50 years, how much will remain after 100 years.
2. (a) Solve $\left(D^{2}+9\right) y=\sec 3 x$
(b) Solve $\frac{d^{2} y}{d x^{2}}+4 y=x \operatorname{Cos} x$
3. (a) Find Taylor's series expansion of the $\mathrm{f}(\mathrm{x}, \mathrm{y})=\cos x$ about $\mathrm{x}=\frac{\pi}{3}$ and hence find the approximate value of $\cos 35^{\circ}$.
(b) If $\mathrm{x}=u \sqrt{1-r^{2}}, \mathrm{y}=v \sqrt{1-r^{2}}, \mathrm{Z}=w \sqrt{1-r^{2}}$ such that $x^{2}+y^{2}+z^{2}=r^{2}$ then find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$.
4. (a) Trace the curver ${ }^{2}=a^{2} \cos 2 \theta$.
(b) Trace the curve $\mathrm{x}=\mathrm{a}(\theta+\sin \theta), \mathrm{y}=\mathrm{a}(1+\cos \theta)$.
5. (a) A man walks along the curve $20 y=3\left(4 x^{2}-20 x+9\right)$ between the points, Where $\mathrm{x}=\frac{1}{2}$ and $x=\frac{9}{2}$ find the distance covered by the man?
(b) Find the surface area of the solid generated by the revolution of the astroid $x^{2 / 3}+y^{2 / 3}=a^{2 / 3}$ about the x -axis.
6. (a) Evaluate $\int_{0}^{4} \int_{y^{2} / 4}^{y} \frac{y}{x^{2}+y^{2}} \mathrm{dx} d y$.
(b) Evaluate $\int_{0}^{1} \int_{0}^{\sqrt{1-x^{2}}} \int_{0}^{\sqrt{1-x^{2}-y^{2}}} x y z \quad \mathrm{~d} z \mathrm{dy} \mathrm{dx}$.
7. (a)If $\mathrm{V}=\mathrm{e}^{x y z}(\mathrm{i}+\mathrm{j}+\mathrm{k})$, find curl V .
(b) Find the constants a and b so that the surface $\mathrm{ax}^{2}$-byz $=(\mathrm{a}+2) \mathrm{x}$ will be orthogonal to the surface $4 x^{2} y+z^{3}=4$ at the point $(1,-1,2)$
8. (a)Let C be the curve $\mathrm{x}=1-\mathrm{y}^{2}$ from $(0,-1)$ to $(0,1)$. Evaluate $\oint_{c} y^{3} d x+x^{2} d y$
(b) Use Gauss divergence theorem to evaluate $\iint_{S}\left(y z^{2} i+z x^{2} j+2 z^{2} k\right) \cdot N d s$, where S is the surface bounded by the xy-plane and the upper half of the sphere $x^{2}+y^{2}+z^{2}=a^{2}$ above the this plane.

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1. (a) Solve $x \frac{d y}{d x}+y=x^{3} y^{6}$
(b) Find the orthogonal trajectory of the family of curves $r^{2}=a \operatorname{Cos} 2 \theta$, where ' $a$ ' is a parameter [7+8]
2. (a) Solve $\left(D^{2}-3 D+2\right) y=e^{x}$
(b) Solve $\left(D^{4}-a^{4}\right) y=0$
3. (a) Calculate the approximate value of $\sqrt{10}$ to four decimal places using Taylor's theorem.
(b) Find 3 positive numbers whose sum is 600 and whose product is maximum.
4. (a) Trace the curve $r=\frac{3 a \sin \theta \cos \theta}{\sin ^{3} \theta+\cos ^{3} \theta}$
(b) Trace the curver $=\tan \theta$.
5. (a) Find the length of the arc of the semi-cubical parabola $a y^{2}=x^{3}$ from the vertex to the ordinate $x=5 a$.
(b) Find the area of the surface of revolution generated by revolving one arc of the curve $y=\sin x$ about the $x$-axis .
$[8+7]$
6. (a) Evaluate $\iint \frac{r d r d \theta}{\sqrt[a^{2}+r^{2}]{ }}$ over one loop of the lemniscates $r^{2}=a^{2} \cos 2 \theta$.
(b) Evaluate the integral $\int_{0}^{a} \int_{0}^{\sqrt[a^{2}-x^{2}]{ }}\left(1-x^{2}-y^{2}\right)^{1 / 2} d x d y$ by changing into polar coordinates and hence evaluate it.
7. (a) Prove that $\bar{F}=r^{2} \bar{r}$ is conservative and find the scalar potential.
(b) Show If $\theta$ is the acute angle between the surfaces $x y^{2} z=3 x+z^{2}$ and $3 x^{2}-y^{2}+2 z$ $=1$ at the point $(1,-2,1)$, show that $\cos \theta=\frac{3}{7 \sqrt{6}}$.
8. Verify Green's theorem for $\oint_{c}\left(x y+y^{2}\right) d x+x^{2} d y$ where C is a bounded by $\mathrm{y}=\mathrm{x}$ and $y=x^{2}$.

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2. (a) Explain the procedure to find Complete solution of second order non homogeneous differential equation with constant coefficients.
(b) Solve $\left(D^{2}-4\right) y=x \operatorname{Sin} \lambda x$
3. (a) If $\mathrm{U}=f\left(\frac{y-x}{x y}, \frac{z-x}{x z}\right)$,P.T. $x^{2} \frac{\partial f}{\partial x}+y^{2} \frac{\partial f}{\partial y}+z^{2} \frac{\partial f}{\partial z}=0$.
(b) Expand $u=x^{y}$ in powers of ( $\mathrm{x}-1$ ) and ( $\mathrm{y}-1$ ) up to third degree terms. [8+7]
4. (a) Trace the curve $r=\cos 4 \theta$.
(b) Trace the curve $y^{2}(1-x)=x^{2}(1+x)$..
5. (a) Find the surface area generated by rotating the arc of the catenary $y=a \cosh$ $\frac{x}{a}$ from $\mathrm{X}=0$ to a about the x -axis.
(b) Find the volume of the solid generated by revolving about the x -axis of the loop of the curve $y^{2}=x^{2} \frac{(a+x)}{a-x}$.
6. (a) Evaluate $\iint r d r d \theta$ over the region bounded by the cardioid $\mathrm{r}=\mathrm{a}(1+\cos \theta)$ and out side the circle $\mathrm{r}=\mathrm{a}$.
(b) By Transforming into cylindrical coordinates evaluate the integral $\iiint z\left(x^{2}+\right.$ $y^{2}+z^{2}$ ) dxdydz taken over the volume of the cylinder $x^{2}+y^{2}=a^{2}$ intercepted by the plus $\mathrm{z}=\mathrm{o}$ and $\mathrm{z}=\mathrm{h}$.
[8+7]
7. (a) Find div f and curl f where $f=\operatorname{grad}\left(x^{3}+y^{3}+z^{3}-3 x y z\right)$
(b) Find the angle of intersection at $(4,-3,2)$ of spheres $x^{2}+y^{2}+z^{2}=29$ and $x^{2}$ $+y^{2}+z^{2}+4 x-6 y-8 z-47=0$
$[8+7]$
8. Verify Stokes theorem for $\mathrm{F}=(\mathrm{y}-\mathrm{z}+2) \mathrm{i}+(\mathrm{yz}+4) \mathrm{j}$-xzk where S is the surface of the cube $\mathrm{x}=0, \mathrm{y}=0, \mathrm{z}=0, \mathrm{x}=2, \mathrm{y}=2, \mathrm{z}=2$ above the xy -plane
