SNS COLLEGE OF ENGINEERING, COIMBATORE-641 107
DEPARTMENT OF MATHEMATICS

MA 8251 ENGINEERING MATHEMATICS-II
QUESTION BANK- Unit –II
Vector calculus
Part-A

		Unit	Reg	year
1.	Find the unit normal vector to the surface $x^3 + y^2 - z$ at (1,1,2).	2	13	Apr/May 17
2.	Find the unit normal vector of the surface $x^2 + y^2 - z = 1$ at (1, 1,1).	2	8	Apr /May 17
3.	Find the unit vector normal to the surface $x^2 + y^2 = z$ at (1, -2, 5)	2	13	May/ June 14
4.	Find the unit normal vector to $xy=z^2$ at (1,1,-1).	2	13	Nov /Dec 16
5.	Using Greens theorem in the plane,find the area of the circle $x^2 + y^2 = a^2$	2	13	Apr/May 17
6.	Using Greens theorem evaluate $\int_C (xdy - ydx)$ where C is the circle $x^2+y^2=1$ in the xy plane	2	13	Nov /Dec 16
7.	Prove that $Grad\,(1/r) = \frac{-\vec{r}}{r^3}$.	2	13	Dec/Jan 16
8.	Prove that Curl(gradφ) = 0	2	13	May/ June 14
9.	Evaluate $\nabla^2 \log r$.	2	13	May/June 16
10	Find $\nabla(\nabla.((x^2 - yz)\vec{i} + (y^2 - xz)\vec{j} + (z^2 - xy)\vec{k}))$ at the point (1,-1,2).	2	8	Nov/Dec 14
11	Find $Curl\vec{F}$ if $\vec{F} = xy\vec{i} + yz\vec{j} + zx\vec{k}$	2	13	Nov /Dec 14
12	Evaluate $\int_c (yz\vec{i} + xz\vec{j} + xy\vec{k}).\vec{dr}$ where C is the boundary of the surface S.	2	13	Dec/Jan 16
13	Evaluate the integral $\int_c \vec{F}.d\vec{r}$ if $\vec{F}=xy^2\vec{i}+(x^2+y^2)\vec{j}$ and C is the curve given by $y=x^2-4$ from (2,0) to (4,12).	2	13	Noc /Dec 17
14	What is the greatest rate of $\phi = xyz^2$ at (1,0,3) .	2	8	Apr /May 17
15	The temperature of points in space is given by $T(x, y, z) = x^2 + y^2 - z$. A mosquito located (1 ,1, 2)desires to fly in such a direction that it will get warm as soon as possible. In what direction should it move?	2	8	Dec/Jan 16
16	If $\vec{F}=(x+3y)\vec{i}+(y-2z)\vec{j}+(x+2kz)\vec{k}$ has divergence zero, find the unknown value of k.	2	13	Nov/Dec 17
17	State Green's theorem in a plane	2	8,13	Noc /Dec 14,Dec/Jan 16
18	State Stokes' theorem	2	8,13	Noc /Dec 14,May/Jun16

Part-B

1	Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and	2	13	Nov /Dec 16,Apr/May

	$z^2 = x^2 + y^2 - 3$ at the point (2,-1,2).			17
2	Find the angle between the normals to the surfaces $x^2 = yz$ at the points(1,1,1) and (2,4,1).	2	13	Nov /Dec 14
3	Prove that div(grad r^n) =n(n+1) r^{n-2} Prove that curl(grad ϕ)=0	2	8	Apr /May 17
4	Prove $\nabla^2(r^n) = n(n+1)r^{n-2}$ and deduce that $\frac{1}{r}$ satisfies Laplace equation	2	8	DEC /JAN 16
5	Find the value of n such that the vector $r^n\vec{r}$ is both solenoidal and irrotational.	2	13	May/ June 14
6	Prove that $Curl Curl \vec{F} = grad\ div \vec{F} - \nabla^2 \vec{F}$.	2	13	May/June 16
7	Prove that $div(\phi\vec{F}) = \phi div\vec{F} + \nabla\phi.\vec{F}$. Also ,determine the value of n for which $r^n\vec{R}$ is solenoidal,where $\vec{R} = x\vec{i} + y\vec{j} + z\vec{K}$ and $r = \lvert\vec{R}\rvert$.	2	8	Nov/Dec 14
8	A fluid motion is given by $\vec{V} = (y+z)\vec{i} + (z+x)\vec{j} + (x+y)\vec{k}$. Is this motion is irrotational and is possible for an incompressible fluid?	2	13	Dec/Jan 16
9	If $\nabla\varphi = 2xyz^3\vec{i} + x^2z^3\vec{j} + 3x^2yz^2\vec{k}$. find $\varphi(x,y,z)$ given that $\varphi(1,-2,2) = 4$	2	13	May/June 16
10	Find the constants a,b,c so that $\vec{F} = (x+2y+az)\vec{i} + (bx-3y-z)\vec{j} - (4x+cy+2z)\vec{k}$ is irrotational.For those values of a,b,c.Find its scalar potential .	2	13	Apr/May 17
11	Show that $\vec{F} = 2xyz^3\vec{i} + x^2z^3\vec{j} + 3x^2yz^2\vec{k}$ is irrotational . Find the scalar potential ϕ and F= grad ϕ	2	8	Apr /May 17
12	Show that $\vec{F} = (y^2 + 2xz^2)\vec{i} + (2xy - z)\vec{j} + (2x^2z - y + 2z)\vec{k}$ is irrotational and hence find its scalar potential	2	8	Nov/Dec 14,DEC /JAN 16
13	Prove that $\vec{F}=(x^2-y^2+x)\vec{i}-(2xy+y)\vec{j}$ is a conservative field and find the scalar potential of $\vec{F}$.	2	13	Noc /Dec 17
14	Prove that $\vec{F} = (x^2 - y^2 + x)\vec{i} - (2xy + y)\vec{j}$ is irrotational and hence find its scalar potential.	2	13	Nov /Dec 14
15	Prove that $\vec{F} = (y^2\cos x + z^3)\vec{i} + (2y\sin x - 4)\vec{j} + 3xz^2\vec{k}$ is irrotational and find its scalar potential.	2	13	Nov /Dec 16
16	Verify Green's theorem for $\vec{F} = (x^2 + y^2)\vec{i} - 2xy\vec{j}$ taken around the rectangle bounded by the lines x = ±a, y=0 and y=b.	2	13	Dec/Jan 16
17	Using Green's theorem in a plane $\int_C [x^2(1+y)dx + (x^3 + y^3)dy]$ where C is the square formed by $x = \pm 1$ and $y = \pm 1$.	2	13	May/June 16
18	Appply Green's theorem to evaluate $\int_c (xy-x^2)dx + x^2y\, dy$ along the closed curve C formed by y=0, x=1 and y=x.	2	13	Noc /Dec 17
19	Using Greens theorem, evaluate $\int_C [(3x^2 - 8y^2)dx + (4y - 6xy)dy]$ where C is the boundary of the triangle formed by the lines x=0,y=0, x+y=1 in the xy plane.	2	13	Nov /Dec 14
20	Verify Stoke's theorem for $\vec{F} = (x^2 - y^2)\vec{i} + 2xy\vec{j}$,where S is the rectangle	2	13	May/ June

	in the xy-plane formed by the lines x=0 ,x=a,y=0 and y=b.			14,Apr/May 17
21	Using Stoke's theorem to evaluate $\int_c \vec{F} d\vec{r}$ where $\vec{F} = (\sin x - y)\vec{i} - \cos x \vec{j}$ and C is the boundary of the triangle whose vertices are $(0,0), \left(\frac{\pi}{2}, 0\right) and \left(\frac{\pi}{2}, 1\right)$	2	8	DEC /JAN 16
22	Verify Stoke's theorem for $\vec{F} = (x^2 + y^2)\vec{i} + 2xy\vec{j}$ where S is the rectangle in the xy-plane formed by the lines x=0,x=a,y=0,y=b.	2	8	Nov/Dec 14
23	Verify Divergence theorem for $\vec{F} = 4xz\vec{i} - y^2\vec{j} + yz\vec{k}$ taken over the cube bounded by the planes x=0,x=a,y=0,y=a,z=0,z=a.	2	13	Nov /Dec 16,Apr/May 17
24	Verify Gauss divergence theorem for $\vec{F} = y\vec{i} + x\vec{j} + z^2\vec{k}$ for the cylindrical region given by $x^2 + y^2 = a^2$, z=0, z=h.	2	8	Apr /May 17
25	Verify Gauss divergence theorem for $\vec{F} = x^2\vec{i} + y^2\vec{j} + z^2\vec{k}$, wher S is the surface of the cuboid formed by the planes $x = 0, x = a, y = 0, y = b, z = 0, z = c$	2	8	Nov/Dec 14,DEC /JAN 16
26	Verify Gauss divergence theorem for $\vec{F} = (x^2 - yz)\vec{i} + (y^2 - xz)\vec{j} + (z^2 - xy)\vec{k}$.and S is the surface of the rectangular parallelepiped bounded by $x = 0, x = a, y = 0, y = b, z = 0 and z = c$.	2	13	Dec/Jan 16
27	Verify Gauss divergence Theorem for $\vec{F} = x^2\vec{i} + y^2\vec{j} + z^2\vec{k}$ taken over the cube bounded by the planes x= 0, x = 1, y = 0, y = 1, z = 0, z = 1	2	13	May/ June 14
28	Evaluate $\iint_S \vec{f}.\hat{n} dS$ where $\vec{F} = z\vec{i} + x\vec{j} - 3y^2 z\vec{k}$ and S is the surface of the cylinder $x^2+y^2 = 16$ included in the first octant between z=0 and z=5.	2	13	Noc /Dec 17
29	Evaluate $\iint \vec{F}.\hat{n}$ dS using Gauss divergence theorem for $\vec{F} = x^2\vec{i} + y^2\vec{j} + z^2\vec{k}$ taken over the cube bounded by the planes x=0, y=0, z=0, x=1, y=1, z=1.	2	13	Noc /Dec 17
30	Find the work done in moving particle in the force field $\vec{F} = 3x^2\vec{i} + (2xz - y)\vec{j} + z\vec{k}$ along the curve defined by $x^2 = 4y$, $3x^2 = 8z$ from x=0 to x=2.	2	8	Apr /May 17
31	Find the values of constants a,b,c so that the maximum value of the directional derivative of $\varphi = axy^2 + byz + cz^2x^3$ at (1,2,-1) has a magnitude 64 in the direction parallel to z-axis.	2	13	Dec/Jan 16
32	Find the directional derivative of $\phi = 4xz^2 + x^2yz$ at(1,-2,1) in the direction of $2\vec{i} + 3\vec{j} + 4\vec{k}$	2	13	Nov /Dec 16
33	Find 'a' and 'b' so that the surfaces $ax^3 - by^2z = (a+3)x^2$ and $4x^2y - z^3 = 11$ cut orthogonally at (2, -1, -3)	2	13	May/June 16
34	Find the values of constants a,b,c so that the maximum value of the directional derivative of $\varphi = axy^2 + byz + cz^2x^3$ at (1,2,-1) has a magnitude 64 in the direction parallel to z-axis.	2	13	Dec/Jan 16