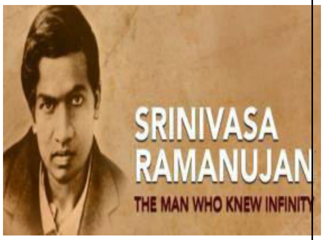
	SRM Institute of Science and Technology Kattankulathur **DEPARTMENT OF MEATHEMATICS** **18MAB102T ADVANCED CALCULUS &COMPLEX ANALYSIS** **UNIT - II Vector Calculus** **Tutorial Sheet - 1**	

Sl.No.	Questions	Answer
	Part - A	
1	**Find the directional derivative of** $\phi = 2xy + 5yz + zx$ **at the point (1, 2, 3) in the direction of** $3\vec{i} - 5\vec{j} + 4\vec{k}$	$\nabla\phi.\hat{n} = -2\sqrt{2}$
2	**Find the angle of intersection at the point (2, -1, 2) of the surfaces** $x^2 + y^2 + z^2 = 9$ **and** $z = x^2 + y^2 - 3$	$\theta = \cos^{-1}\left[\frac{-8}{3\sqrt{21}}\right]$
3	**Find the angle between the normals to the surface** $xy = z^2$ **at the points (-2, -2, 2) and (1, 9, -3).**	$\theta = \cos^{-1}\left[\frac{-11}{\sqrt{177}}\right]$
4	**The temperature of points in space is given by T(x, y, z) =** $x^2 + y^2 - z$**. A mosquito located at (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?**	$\nabla T = 2\vec{i} + 2\vec{j} - \vec{k}$
5	**If** $\vec{F} = (x + y + 1)\vec{i} + \vec{j} - (x + y)\vec{k}$ **show that** $\vec{F}.curl\,\vec{F} = 0$	$\vec{F}.\,curl\,\vec{F} = 0$
	Part - B	
6	**i) Prove that** $\vec{F} = (2x + yz)\vec{i} + (4y + xz)\vec{j} - (6z - xy)\vec{k}$ **is solenoidal as well as irrotational. Also find the scalar potential of** $\vec{F}$**.** **ii) Find the unit normal to the surface** $x^4 - 3xyz + z^2 + 1 = 0$ **at the point (1, 1,1).**	$i)\ \phi = x^2 + 2y^2 - 3z^2 + xyz + k$ $ii)\ \frac{1}{\sqrt{11}}(\vec{i} - 3\vec{j} - \vec{k})$
7	**Prove that** $div(r^n\vec{r}) = (n+3)r^n$ **. Deduce that** $r^n\vec{r}$ **is solenoidal if and only if n = - 3.**	
8	**i) If** $\vec{A}$ **and** $\vec{B}$ **are irrotational, prove that** $\vec{A}\times\vec{B}$ **is solenoidal.** **ii) Show that the vector** $\vec{F} = (6xy + z^3)\vec{i} + (3x^2 - z)\vec{j} + (3xz^2 - y)\vec{k}$ **is irrotational and find its scalar potential.**	$i)\ \nabla.(\vec{A}\times\vec{B}) = 0$ $ii)\ \phi = xz^3 - yz + 3x^2y + k$
9	**If** $\nabla\phi = (y^2 - 2xyz^3)\vec{i} + (3 + 2xy - x^2z^3)\vec{j} + (6z^3 - 3x^2yz^2)\vec{k}$**, find** ϕ**.**	$\phi = xy^2 - x^2yz^3 + 3y + \frac{3}{2}z^4 + k$
10	**Find the values of 'a' and 'b' so that the surfaces** $ax^3 - by^2z = (a+3)x^2$ **and** $4x^2y - z^3 = 11$ **may cut orthogonally at (2, -1, -3).**	$a = -2.33, b = 7.11$

Co-Ordinators : Dr. Sundarammal Kesavan, Dr.V.Srinivasan, Dr.N.Parvathi , Dr.N.Balaji