

**In-Class Test #1 - Module Vector Calculus**  
**Engineering Mathematics for Advanced Studies**  
IIT Dharwad  
Autumn 2019

---

Time - 25 minutes

Maximum score - 20

Rule for absentee - Minimum 30% penalty, discuss reasons absense in person to get a chance for re-test.

Note:

1. Considering the time allotted for the quiz, to be on the safer side, student may want to first go through all questions and identify the ones that would not take much time to answer. Answer these first and then work on the relatively tedious questions.
  2. Ensure to clearly write question number before the answer the question.
  3. Worked out solutions on suppliments are must for some problems.
  4. Please ensure to write Question number in a box as a heading to the upcoming answer on suppliments e.g.
  5. 

|            |
|------------|
| Question 1 |
|------------|
- 

1. If  $u, v, w$  are vectors in  $\mathbb{R}^3$  and  $k$  and  $l$  are scalars state True/False: (mark 2)
  - (a)  $u \times v = v \times u$  \_\_\_\_\_
  - (b)  $u \cdot (v \times w) = v \cdot (u \times w)$  \_\_\_\_\_
  - (c)  $w \cdot (v \times u) = -w \cdot (u \times v)$  \_\_\_\_\_
  - (d)  $w \cdot (v \times u) = v \cdot (u \times w)$  \_\_\_\_\_
  - (e)  $\|v + w\| = \|v\| + \|w\|$  \_\_\_\_\_
  - (f)  $u \cdot v = v \cdot u$  \_\_\_\_\_
2. Two soap bubbles are coalescing together. One is having radius of 3cm with center at (0,0,0) and other having radius of 2cm and center (2,3,1). If  $r = ui + vj + wk$  denotes locus of all the points in 3D space can you provide what is expected type of geometry of that shared locii? Can you identify  $u(x, y, z)$ ,  $v(x, y, z)$ , and  $w(x, y, z)$ ? (mark 3)
3. Write the vector form of a line L through the point  $P = (2, 3, 5)$  and parallel to the vector  $v = (4, -1, 6)$  (mark 2)
4. If a farm produces 10 units of produce per unit area. How much crop produce is expected from a farm whose four corner points are given as -  $A(2, 2), B(6, 3), C(7, 5), D(4, 6)$  (mark 4)
5. For a curve  $r(t) = a\cos(t)\hat{i} + b\sin(t)\hat{j} + c(t)\hat{k}$  (mark 6)
  - (a) What is the geometry expected?
  - (b) What is the unit vector along tangent direction at  $t=2$
  - (c) What is the length traversed from  $t=1$  to  $t=2$  along the curve

6. If vector  $p$  such that ,  $p = r'(t)$  where  $r$  is position vector which of the following is appropriate for any vector  $a$  true/false: (mark 3)

- (a)  $a \cdot p$  is component along  $p$  \_\_\_\_\_
- (b)  $p(t)$  is a unit vector always \_\_\_\_\_
- (c) if  $q(t)$  is unit vector along  $p(t)$ ,  $q \cdot q' = 0$  \_\_\_\_\_