

# end sem set 2

All questions are compulsory, Q13 is a bonus question, it will be checked only when all the other questions are attempted

\* Required

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1

Q1 Find the acute angle  $\theta$  between the curves  $y^2 = 4x$  and  $y = e^{-\frac{x}{2}}$

(3 marks)

a)  $\theta = 0$

b)  $\theta = \frac{\pi}{8}$

c)  $\theta = \frac{\pi}{4}$

d)  $\theta = \frac{3\pi}{4}$

e)  $\theta = \frac{\pi}{2}$

f)  $\theta = \pi$

☐ A

☐ B

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☐ E

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2

**Q2** Find the points on the curve  $y = x^3 - x^2 - x + 3$ , where the tangents are parallel to x-axis (3 marks)

a)  $(1, 2)$

b)  $(-1, -2)$

c)  $(1, 3)$

d)  $(-\frac{1}{3}, \frac{70}{27})$

e)  $(\frac{1}{3}, -\frac{70}{27})$

f) None of these

☐ A☐ B☐ C☐ D☐ E☐ F

3

**Q3** The shortest distance between the lines  $x - y = 0 = 2x + z$  and  $x + y - 2 = 0 = 3x - y + z - 1$  is (3 marks)

a)  $\frac{1}{\sqrt{3}}$

b)  $\frac{1}{2\sqrt{3}}$

c)  $\frac{1}{2}$

d) 1

e) 2

f) None of these

☐ A☐ B☐ C☐ D☐ E☐ F

4

Q4 Find the curvature  $\kappa$  for the space curves

$$r(t) = (\cos^3 t)\vec{i} + (\sin^3 t)\vec{j}, \quad 0 < t < \frac{\pi}{2}$$

(3 marks)

a)  $\kappa = \frac{1}{\cos t \sin t}$

b)  $\kappa = \frac{1}{2 \cos t \sin t}$

c)  $\kappa = \frac{1}{3 \cos t \sin t}$

d)  $\kappa = \frac{1}{\cos t \tan t}$

e)  $\kappa = \frac{1}{2 \sin t \tan t}$

f) None of these

☐ A☐ B☐ C☐ D☐ E☐ F

5

Q5 Find the maximum rate of change of the function at the indicated point

$$f(x, y) = \sqrt{x^2 + y^4} \quad \text{at } (-2, 3)$$

(3 marks)

a) 5.86

b) 7.3

c) 9.25

d) 10.03

e) 11.7

f) None of these

☐ A☐ B☐ C☐ D☐ E☐ F

6

**Q6** Find the maximum or minimum values of the function  $f(x, y) = 2xy$  subject to the constraint  $x^2 + y^2 = 1$

(3 marks)

a) maximum of  $f(x, y)$  is 1 at  $\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ b) maximum of  $f(x, y)$  is 1 at  $\left(-\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right)$ c) maximum of  $f(x, y)$  is 1 at  $\left(-\frac{1}{\sqrt{3}}, -\frac{1}{\sqrt{3}}\right)$ d) minimum of  $f(x, y)$  is -1 at  $\left(-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}\right)$ e) minimum of  $f(x, y)$  is -1 at  $\left(\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right)$ f) minimum of  $f(x, y)$  is -1 at  $\left(\frac{1}{\sqrt{3}}, -\frac{1}{\sqrt{3}}\right)$ ☐ A☐ B☐ C☐ D☐ E☐ F

7

**Q7** Determine the area of the region bounded by the given set of curves

$$y = 4x + 3, y = 6 - x - 2x^2, x = -4 \text{ and } x = 2$$

(3 marks)

a)  $\frac{43}{2}$ b)  $\frac{97}{6}$ c)  $\frac{143}{6}$ d)  $\frac{243}{12}$ e)  $\frac{343}{12}$ 

f) None of these

☐ A☐ B☐ C☐ D☐ E☐ F

8

Q8 Find the centre of mass of the region  $x^2 + y^2 \leq R^2, y \geq 0$  with the given mass density  $\delta(x, y) = y$   
(3 marks)

a)  $\left(-\frac{3R}{16}, -\frac{3\pi R}{16}\right)$

b)  $\left(\frac{3R}{16}, \frac{3\pi R}{16}\right)$

c)  $\left(-\frac{5R}{8}, \frac{5\pi R}{8}\right)$

d)  $\left(-\frac{5R}{8}, -\frac{5\pi R}{8}\right)$

e)  $\left(-\frac{7R}{16}, \frac{5\pi R}{16}\right)$

f)  $\left(\frac{7R}{16}, -\frac{5\pi R}{16}\right)$

☐ A☐ B☐ C☐ D☐ E☐ F

9

Q9 Compute

$$I = \oint_C (y^4 - 2y)dx - (6x - 4xy^3)dy, \quad \text{where } C \text{ is shown below}$$

(4 marks)



a)  $I = 0$

b)  $I = -6$

c)  $I = -11$

d)  $I = 18$

e)  $I = -76$

f)  $I = -96$

☐ A☐ B☐ C☐ D☐ E☐ F

10

**Q10** Evaluate the surface integral  $\iint_S F \cdot n \, dA$ , where  $F = 6z\vec{i} + 6\vec{j} + 3y\vec{k}$  and  $S$  is the portion of the plane  $2x + 3y + 4z = 12$ , which is in the first octant

(4 marks)

2

a) 28

b) 138

c) 148

d) 208

e) 373

f) 379

☐ A☐ B☐ C☐ D☐ E☐ F

11

**Q11** Find the volume of the solid in the first octant bounded by the paraboloid  $z = 36 - 4x^2 - 9y^2$   
(4 marks)

- a)  $2\pi$                       b)  $3\pi$                       c)  $9\pi$   
d)  $19\pi$                       e)  $27\pi$                       f)  $31\pi$

☐ A☐ B☐ C☐ D☐ E☐ F

12

**Q12** Evaluate  $\iint_S (\text{Curl } F \cdot N) dS$  for the vector field  $F(x, y, z) = z\vec{i} + 3x\vec{j} + 2z\vec{k}$  and surface S is  $z = 1 - x^2 - 2y^2, z \geq 0$ , C is boundary circle  $x^2 + y^2 = 1$  and S is oriented in the positive z- direction  
(4 marks)

- a) 0                      b)  $\pi$                       c)  $3\pi$   
d)  $\frac{5\pi}{2}$                       e)  $\frac{7\pi}{2}$                       f) None of these

☐ A☐ B☐ C☐ D☐ E☐ F



13

**Q13**(Bonus question) Evaluate  $I = \iint_R (x + y) dA$  where R is the trapezoidal region with vertices given by  $(0, 0)$ ,  $(5, 0)$ ,  $(\frac{5}{2}, \frac{5}{2})$  and  $(\frac{5}{2}, -\frac{5}{2})$  using the transformation  $x = 2u + 3v$  and  $y = 2u - 3v$

(4 marks)

a)  $\frac{25}{4}$

b)  $\frac{75}{8}$

c)  $\frac{121}{16}$

d)  $\frac{125}{4}$

e)  $\frac{225}{4}$

f) None of these

☐ A☐ B☐ C☐ D☐ E☐ F

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