

B. Sc. DEGREE (C.B.C.S.S.) EXAMINATION, OCTOBER 2016
SEMESTER III – COMPLEMENTARY COURSE (MATHEMATICS)
MT3CPC03B – VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND
ANALYTICAL GEOMETRY
(Common for Physics and Chemistry)

Time: Three Hours

Maximum Marks: 80

PART A**Short answer questions****I. Answer all questions. Each question carries 1 marks**

1. What is the curvature of a straight line?
2. Define potential function for the field F.
3. Define Clairaut's equations.
4. Solve $p^2 - 2p - 3 = 0$.
5. Write an equivalent polar point of P (2, $\pi/6$).
6. Find the directrix of the parabola $y^2 = 10x$.

(6 x 1 = 6)

PART B**Brief answer questions****II. Answer any seven questions. Each question carries 2 marks**

7. Find the directional derivative of $f = x^2 + y^2$ at P(1,1) in the direction of $\vec{a} = 2\mathbf{i} - 4\mathbf{j}$.
8. Find T and N for the circular motion $\vec{r}(t) = \cos 2t \mathbf{i} - \sin 2t \mathbf{j}$.
9. Find the work done by $F = 3y\mathbf{i} + 2xz\mathbf{j} + 4zk\mathbf{k}$ over the curve $r(t) = t\mathbf{i} + tj + tk$, $0 \leq t \leq 1$, from (0,0,0) to (1,1,1).
10. State Greens theorem in normal and tangential form.
11. Find a parametrization of a sphere with radius a units.
12. Check whether $x^2y^3 dx + x^3y^2 dy = 0$ is exact or not?
13. Solve $y = px - \log p$
14. Solve $(2x - 1)dx + (3y + 7)dy = 0$.
15. Identify the conic $x^2 + 4x + y^2 = 12$.
16. Describe the motion of a particle whose position P(x,y) at time t is given by $x = \sec t, y = \tan t$, $-\pi/2 < t < \pi/2$.

(7 x 2 = 14)

PART C**Descriptive Short essay questions****III. Answer any five questions. Each question carries 6 marks**

17. Find the point on the curve $\vec{r}(t) = 5\sin t \mathbf{i} + 5\cos t \mathbf{j} + 12t \mathbf{k}$ at a distance 26π units along the curve from the origin in the direction of increasing arc length.
18. Find the parametric equation for the line that is tangent to the curve $\vec{r}(t) = \sin t \mathbf{i} + (t^2 - \cos t) \mathbf{j} + e^t \mathbf{k}$ at $t = 0$.
19. Find the surface area of a sphere of radius a.

20. Show that $F = (e^x \cos y + yz)\mathbf{i} + (xz - e^x \sin y)\mathbf{j} + (xy + z)\mathbf{k}$ is conservative and find the potential function.
21. Solve $y + px = p^2 x^4$
22. Solve $\frac{dy}{dx} + \frac{1}{x}y = 3y^3$
23. A wheel of radius a rolls along a horizontal straight line. Find the parametric equations for the path traced by a point on the wheel's circumference.
24. Find the foci, vertices and center of the ellipse $(x - 4)^2/16 + (y - 3)^2/9 = 1$
- (5 x 6 = 30)**

PART D

Long essay type questions

IV. Answer any two questions. Each question carries 15 marks

25. Find the binormal vector, curvature and torsion for the helix $\vec{r}(t) = a\cos t\mathbf{i} + a\sin t\mathbf{j} + btk$,
 $a, b \geq 0, a^2 + b^2 \neq 0$.
26. Verify both forms of Greens theorem for $F = (x - y)\mathbf{i} + x\mathbf{j}$ and the region R bounded by the unit circle .
27. A) Solve $x \frac{dy}{dx} + y = \frac{1}{x}$ B) Solve $(10 - 6y + e^{-3x})dx - 2dy = 0$
28. A) Find the center and vertices of the conic in polar form whose equation is $r = \frac{25}{10 - 5\cos\theta}$.
 B) Find a polar equation in the form $r\cos(\theta - \theta_0) = r_0$, for the line $\sqrt{3}x - y = 1$.
- (2 x 15 = 30)**