



Reg. No. : .....

Name : .....

IV Semester B.Sc. Degree (CBCSS – Reg./Sup./Imp.) Examination, May 2018  
(2014 Admn. Onwards)

COMPLEMENTARY COURSE IN MATHEMATICS  
4C04 MAT-PH : Mathematics for Physics and Electronics – IV

Time : 3 Hours

Max. Marks : 40

**Instruction :** Use of Non programmable scientific calculator may be permitted.

SECTION – A

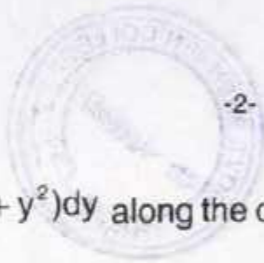
All the first 4 questions are compulsory. They carry 1 mark each.

1. Find  $\text{div } \vec{r}$ ,  $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ .
2. State Stoke's theorem.
3. Define backward difference operator.
4. Give the iteration formula for modified Euler Method. (4×1=4)

SECTION – B

Answer any 7 questions from among the questions 5 to 13. These questions carry 2 marks each.

5. Find the arclength of circle of radius a.
6. Find the directional derivative of  $F(x, y) = e^{xy}$  at  $(-2, 0)$  in the direction of the unit vector that makes an angle of  $\frac{\pi}{3}$  with the positive X-axis.
7. Show that  $\text{curl } (\nabla\phi) = 0$ , where  $\phi$  is a scalar function in x, y and z.



8. Evaluate  $\int_C 2xy dx + (x^2 + y^2) dy$  along the circular arc C given by  $x = \cos t$ ,  $y = \sin t$

$$0 \leq t \leq \frac{\pi}{2}$$

9. Using Green's theorem, evaluate  $\int_C x^2 y dx + x dy$  along the triangular path with vertices (0, 0) (1, 0) and (1, 2).

10. Find the outward flux of the vector field  $F(x, y, z) = z\hat{k}$  across the sphere  $x^2 + y^2 + z^2 = a^2$ .

11. Show that  $E = 1 + \Delta$ .

12. Using Taylor series, solve  $y' = x - y^2$ ,  $y(0) = 1$ . Also find  $y(0.1)$  correct to 4 decimal places.

13. Use Euler's method with  $h = 0.1$ , find  $y(1.1)$ .  $\frac{dy}{dx} - \sqrt{xy} = 2$ ,  $y(1) = 1$ . (7×2=14)

### SECTION - C

Answer any 4 questions from among the questions 14 to 19. These questions carry 3 marks each.

14. If  $F = f(x, y, z)$  is a differentiable vector fields and  $\phi = \phi(x, y, z)$  is a scalar field. Then prove that  $\text{curl}(\phi F) = \nabla\phi \times F + \phi \text{Curl} F$ .

15. Show that the differential form under the integral sign of

$$I = \int_C 2xyz^2 dx + (x^2 z^2 + z \cos yz) dy + (2x^2 yz + y \cos yz) dz$$

is exact and find the value of I from A(0, 0, 1) to B $\left(1, \frac{\pi}{4}, 2\right)$ .

16. Find the real root of the equation  $x^3 - x - 1 = 0$  by bisection method.

17. Find the cubic polynomial which takes the following values  $y(0) = 1$ ,  $y(1) = 0$ ,  $y(2) = 1$ ,  $y(3) = 10$ .



18. Find a formula for  $\frac{dy}{dx}$  using Newton's forward formula.

19.  $\frac{dy}{dx} = \frac{x^2}{y^2 + 1}$  with initial condition  $y = 0$  when  $x = 0$ . Use Picard's method to obtain  $y$  for  $x = 0.25$ . (4×3=12)

### SECTION - D

Answer any 2 questions from among the questions 20 to 23. These questions carry 5 marks each.

20. Show that  $f(x, y, z) = \frac{c}{(x^2 + y^2 + z^2)^{3/2}} (x\hat{i} + y\hat{j} + z\hat{k})$  is solenoidal.

21. Verify Gauss divergence theorem for  $f(x, y, z) = 2x\hat{i} + 3y\hat{j} + z^2\hat{k}$  across the unit cube.

22. Calculate the approximate value of  $\int_0^{\pi/2} \sin x dx$  by Simpson's  $\frac{1}{3}$  rule.

23. Use Runge-Kutta method, solve  $\frac{dy}{dx} = 1 + y^2$ ,  $y = 0$  when  $x = 0$ . Find  $y(0.2)$ ,  $y(0.4)$ . (2×5=10)