Reg. No. : .....

Name : .....

K22U 1563

IV Semester B.Sc. Degree CBCSS (OBE) Regular/Supplementary/ Improvement Examination, April 2022
(2019 Admission Onwards)
COMPLEMENTARY ELECTIVE COURSE IN MATHEMATICS
4C04 MAT – CH : Mathematics for Chemistry – IV

Time : 3 Hours

Max. Marks : 40

PART – A

Answer **any four** questions. **Each** question carries **one** mark.

1. Give an example of a second order partial differential equation.
2. Show that $u = e^x \cos y$ satisfies the Laplace equation.
3. State Fundamental Theorem on superposition.
4. Define a group.
5. Describe the C_2 group.

PART – B

Answer **any seven** questions. **Each** question carries **two** marks.

6. Solve $u_{yy} - u = 0$, where u is a function of x and y.
7. Suppose u is a function of x and t and let $v = x + ct$ and $w = x - ct$. Express the second order partial derivatives u_{xx} and u_{tt} in terms of v and w.
8. Convert the wave equation $u_{tt} - c^2 u_{xx} = 0$ using the substitution $y = ct$.
9. Find the characteristics of $u_{xx} - 6u_{xy} + u_{yy} = 0$.
10. A curve is given by the points (x, y) given by

    (0, 23), (0.5, 19), (1, 14), (1.5, 11), (2, 12.5), (2.5, 16), (3, 19), (3.5, 20), (4, 20).

    Evaluate the area bounded by the curve, the x-axis and the extreme ordinates using trapezoidal rule.

P.T.O.

11. Obtain first 5 terms of the Taylor's series for y(x) if y(x) satisfies $y' = x = y^2$ and $y(0) = 1$.

12. Define conjugate of an element of a group.

13. Write all subgroups of D_{2h}.

14. Show that if, in a group, A is a conjugate of B and B is a conjugate of C, then A, B and C are mutually conjugates.

15. Write the matrix representation of the rotation of an angle θ about the z-axis. Also write the matrix representation of C_{2z} and C_3.

PART – C

Answer **any four** questions. **Each** question carries **three** marks.

16. Write the physical assumptions in modeling the heat flow from a body in space.

17. Find the temperature u(x, t) in a laterally insulated copper bar 80 cm long if the initial temperature is $100 \sin(\pi x/80)$°C and the ends are kept at 0°C. How long will it take for the maximum temperature in the bar to drop to 50°C ? Physical data for copper : density 8.92 g/cm^3, specific heat 0.092 cal/(g°C), thermal conductivity 0.95 cal/(cm sec°C).

18. Determine the value of y when x = 0.1 (take h = 0.05) given that y(0) = 1 and $y' = x^2 + y$ using Euler's method.

19. Given that $\frac{dy}{dx} = y - x$ where y(0) = 2. Find y(0.1) and y(0.2) correct to four decimal places using Runge-Kutta second order formula (with h = 0.1).

20. Using Runge-Kutta fourth-order formula, find y(0.2) and y(0.6) (take h = 0.2) if $\frac{dy}{dx} = 1 + y^2$.

21. Write a short note on point group operations.

22. Show that the three reflections of NH_3 constitute a class.

PART – D

Answer **any two** questions. **Each** question carries **5** marks.

23. Solve the one dimensional wave equation

$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2}{\partial x^2}$ satisfying $u(0, t) = u(L, t) = 0$ for all $t \geq 0$, initial deflection is given by

$$f(x) = \begin{cases} \frac{2k}{L}x & \text{if } 0 < x < \frac{L}{2} \\ \frac{2k}{L}(L - x) & \text{if } \frac{L}{2} < x < L \end{cases}$$ and initial velocity 0.

24. a) Using modified Euler's method, determine the value of y when $x = 0.1$. Given that $y(0) = 1$ and $y' = x^2 + y$.

b) Using Simpson's $\frac{1}{3}^{rd}$ rule, evaluate the following integral (using 4 strips) $\int_1^3 \frac{1}{x}\,dx$.

25. Evaluate $\int_{-2}^{2} \frac{x}{5 + 2x}\,dx$ using trapezoidal rule with five ordinates.

26. What are the symmetry operations for H_2O ? Write the group multiplication table.