



K22U 3420

Reg. No. : .....

Name : .....

I Semester B.Sc. Degree (C.B.C.S.S. – O.B.E. – Regular/Supplementary/  
Improvement) Examination, November 2022  
(2019 Admission Onwards)

COMPLEMENTARY ELECTIVE COURSE IN MATHEMATICS  
1C01MAT-PH : Mathematics for Physics – I

Time : 3 Hours

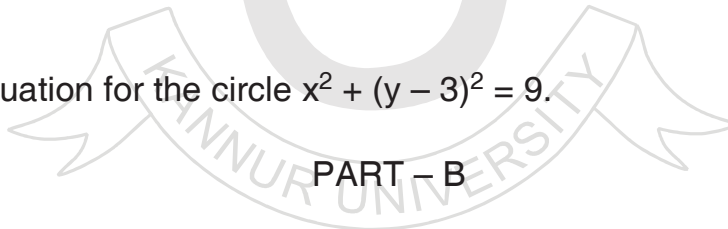
Max. Marks : 40



PART – A

Answer **any four** questions from among the questions 1 to 5. **Each** question carries **one** mark.

1. Find the  $n^{\text{th}}$  derivative of  $\sin(ax + b)$ .
2. State generalized mean value theorem.
3. State Rouché's theorem.
4. Prove that the transformation  $y_1 = 2x_1 + x_2 + x_3$ ,  $y_2 = x_1 + x_2 + 2x_3$ ,  $y_3 = x_1 - 2x_3$  is regular.
5. Find polar equation for the circle  $x^2 + (y - 3)^2 = 9$ .



PART – B

Answer **any seven** questions from among the questions 6 to 16. **Each** question carries **2** marks.

6. If  $x = a(\cos t + t \sin t)$ ,  $y = a(\sin t - t \cos t)$ , find  $\frac{d^2y}{dx^2}$ .
7. If  $y = (2 - 3x)^{10}$ , find  $y_9$ .
8. If  $y = e^{ax} \sin bx$ , prove that  $y_2 - 2ay_1 + (a^2 + b^2)y = 0$ .
9. Verify Rolle's theorem for  $f(x) = \frac{\sin x}{e^x}$  in  $(0, \pi)$ .

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10. Using Maclaurin's series, expand  $\tan x$  upto the term containing  $x^5$ .
11. Find  $\lim_{x \rightarrow 0} x^n \log x$ ,  $n > 0$ .
12. Evaluate  $\lim_{x \rightarrow \frac{\pi}{2}} (\sin x)^{\tan x}$ .
13. Determine the rank of  $A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 4 & 2 \\ 2 & 6 & 5 \end{bmatrix}$ .
14. Using the Gauss-Jordan method, find the inverse of  $A = \begin{bmatrix} 8 & 4 & 3 \\ 2 & 1 & 1 \\ 1 & 2 & 1 \end{bmatrix}$ .
15. If  $A = \frac{1}{3} \begin{bmatrix} 1 & 2 & a \\ 2 & 1 & b \\ 2 & -2 & c \end{bmatrix}$  is orthogonal, find  $a$ ,  $b$ ,  $c$  and  $A^{-1}$ .
16. Find the spherical co-ordinate equation for the sphere  $x^2 + y^2 + (z - 1)^2 = 1$ .

### PART - C

Answer **any four** questions from among the questions **17 to 23**. Each question carries **three** marks.

17. Find the  $n^{\text{th}}$  derivative of  $\frac{x}{(x-1)(2x+3)}$ .
18. If  $y = (\sin^{-1}x)^2$ , show that  $(1 - x^2)y_{n+2} - (2n + 1)xy_{n+1} - n^2y_n = 0$ .
19. Expand  $\log(1 + \sin^2x)$  in powers of  $x$  as far as term in  $x^6$ .
20. Reduce the matrix  $A = \begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$  into its normal form and hence find its rank.
21. Solve the following system of equations by Cramer's rule  
 $3x + y + 2z = 3$ ,  $2x - 3y - z = -3$ ,  $x + 2y + z = 4$ .
22. Calculate  $\frac{ds}{dx}$  for the curve  $ay^2 = x^3$ .
23. Find the radius of curvature at the point  $\left(\frac{3a}{2}, \frac{3a}{2}\right)$  of the Folium  $x^3 + y^3 = 3axy$ .



PART – D

Answer **any two** questions from among the questions **24** to **27**. **Each** question carries **five** marks.

24. State and prove Leibnitz's theorem for the  $n^{\text{th}}$  derivative of the product of two functions.

25. Evaluate

i)  $\lim_{x \rightarrow 0} \frac{xe^x - \log(1+x)}{x^2}$

ii)  $\lim_{x \rightarrow 1} \frac{x^x - x}{x - 1 - \log x}$ .

26. Find the value of  $\lambda$  for which the equations

$$(\lambda - 1)x + (3\lambda + 1)y + 2\lambda z = 0$$

$$(\lambda - 1)x + (4\lambda - 2)y + (\lambda + 3)z = 0$$

$$2x + (3\lambda + 1)y + 3(\lambda - 1)z = 0$$

are consistent, and find the ratios of  $x : y : z$  when  $\lambda$  has the smallest of these values. What happens when  $\lambda$  has the greater of these values ?

27. Find the co-ordinates of the centre of curvature at any point of the parabola  $y^2 = 4ax$ .

