Register Number:
Date:

ST.JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27
M.Sc. PHYSICS - II SEMESTER
SEMESTER EXAMINATION: APRIL 2018.
PH 8215: NUMERICAL TECHNIQUES

Time: 2.5 hours **Max Marks: 70**

This paper contains 3 printed pages

PART – A

Answer any 7 questions. Each question carries 10 marks. (7x10=70)

1. (a) Using General 3x3 matrix, write down the steps involved to find the inverse of a matrix to solve simultaneous equations? (5+5)

(b) Using Gaussian method find the inverse of the matrix $A = \begin{pmatrix} 2 & 1 & 1 \\ 3 & 2 & 3 \\ 1 & 4 & 9 \end{pmatrix}$.

2. (a) Using Stirling formula, derive the expression for the first, second and third derivatives of a function f(x) at $x = x_0$. (5+5)

(b) Find the slope of the road which is located at the middle point(t=900) of the elevation above a datum line of seven points of road which are given below:

t	0	300	600	900	1200	1500	1800
θ	135	149	157	183	201	205	193

3. (i) when do you apply Simpson's $\frac{1}{3}$ rule?

(i) Evaluate $\int_0^1 \frac{dx}{1+x}$ (2+8)

Using (i) Trapezoidal rule (ii) Simpson's one third rule (iii) Simpson's three eight rule.
(iv) Find the error in each method by comparing with the actual integration upto 4 places of decimals. Take $h = \frac{1}{6}$ for all cases.

4. (a) Evaluate the values of $y(0.1)$ and $y(0.2)$ Given $y'' - x(y')^2 + y^2 = 0; y(0) = 1, y'(0) = 0$ by using Taylor series method. (8+2)

(b) Define: (i) Point wise methods (ii) Step by step methods.

5. A second hand car dealer has 10 cars for sale. She decides to investigate the link between the age of the cars, x (years), and millage y (thousand miles). The data shown below

Age, x (years)	2	2.5	3	4	4.5	4.5	5	3	6	6.5
Mileage,y (thousands)	22	34	33	37	40	45	49	30	58	58

(a) Find s_{xx} and s_{xy} (3)

(b) Find the equation of the least squares regression line in the form $y = a + bx.$. Give the values of a and b to 2 decimal places. (4)

(c) Give the practical interpretation of the slope b. (1)

(d) Using your answer to part (b), find the mileage predicted by the regression line for a 5 year old car. (2)

6. (a) Write down the algorithm to solve the differential equation using Euler's method. (2)

(b)Given $\frac{dy}{dx} + \frac{y}{x} = \frac{1}{x^2}$, $y(1) = 1$. Evaluate $y(1.3)$ by Modified Euler's method. (8)

7. Using Runge-Kutta method of fourth order find $y(0.1)$, $y(0.2)$ and $y(0.3)$, given that $\frac{dy}{dx} = 1 + xy$; $y(0) = 2$. (10)

8. Discuss in detail about Gaussian distribution. (10)

9. (a) Define: Fourier integral theorem. (2+2+6)

(b) What are the conditions that should be satisfied for Fourier integral theorem?

(c) Prove that the Fourier Transform of the product of two functions is $\frac{1}{\sqrt{2\pi}}$ times the Convolution of their Fourier Transforms.

10. (a) State and prove Central Limit Theorem. (8+2)

(b) What is Maximum Likelihood estimation (MLE)?

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