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) State the two differences between direct and iterative methods for solving the system of linear equations. (2+8)

   (b) Using the power method determine the largest eigenvalue and the corresponding eigenvector of the matrix $\begin{pmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{pmatrix}$

2. (a) State and prove Lagrange's interpolation formula. (5+5)

   (b) Use Lagrange's interpolation formula to fit a polynomial to the data

x	0	1	3	4
f(x)	-12	0	6	12

   Find the value of y when $x=2$

3. (a) Explain the order of truncation error in the trapezoidal formula. (8+2)

   (b) Compare Trapezoidal rule and Simpson's 1/3 rule for evaluating numerical integration.

4. (a) Write the merits and demerits of the Taylor series method of ordinary differential equations. (3+7)

(b) Solve the following initial value problem involving two independent functions $x(t)$ and $y(t)$ using Taylor series method.

$$\frac{dx}{dt} = ty + 1 \;:\; \frac{dy}{dt} = -tx\,,\; t = 0\,,\; x = 0\,,\; y = 1.$$ Evaluate x and y at $t = 0.1\,, 0.2.$

5. (a) Derive the formula for least square method of linear regression analysis? (5+5)

(b) The sales of a company (in million dollars) for each year are shown in the table below.

x (year)	2005	2006	2007	2008	2009
y (sales)	12	19	29	37	45

i) Find the least square regression line y = ax + b.

ii) Use the least squares regression line as a model to estimate the sales of the company in 2012.

6 . Using Euler's method (a) solve $\frac{dy}{dx} = 1 + xy$ with $y(0) = 2$. Find $y(0.1), y(0.2),$ and $y(0.3)$ also find the values by modified Euler's method. (10)

7. (a) Write the Runge-Kutta algorithm of second order for solving (3+2+5)

$$y' = f(x, y),\;\; y(x_0) = y_0.$$

(b) What are the distinguishing properties of Runge-Kutta methods?

(c) Solve using fourth order Runge-Kutta method.

$$\frac{dy}{dx} + \frac{y}{x} = \frac{1}{x^2} \;;\; y(1) = 1$$

8. (a) Explain Poisson distribution is a properly normalized probability distribution ?

   (b) Explain how to find the mean value when the distribution is binomial.

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

   (b) What are conditions 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.

    (b) What is Maximum Likelihood Method? (8+2)