Reg. No.										

DEPARTMENT OF SCIENCES, II SEMESTER M.Sc
END SEMESTER EXAMINATION, JUNE 2022
PHY5252: NUMERICAL METHODS & COMPUTATIONAL PHYSICS
(REVISED CREDIT SYSTEM)

Time: 3 Hours MAX. MARKS: 50

Note: (i) Answer all the questions. (ii) Show all necessary steps, calculations and syntax.

1(a) A $n \times n$ square matrix D is said to be a 'nilpotent matrix' with index j if $D^j = 0$ for a positive integer $j \leq n$. Write a C program to check whether any general $n \times n$ matrix entered by the user is nilpotent or not and also display the index if it is nilpotent matrix — 4 M

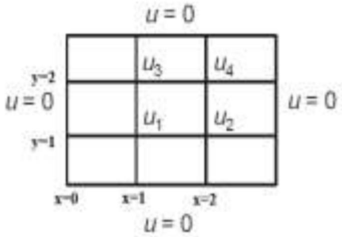
1(b) Derive the Adams–Moulton predictor and corrector formulae from the definition of backward difference — 4 M

1(c) The charging current in a RC circuit is given by the equation, $dq/dt = (V - q/C)/R$. Solve the equation by Euler method to obtain the charge (q) on the plates of the capacitor at intervals of time $t = 1ms, 2ms, 3ms, 4ms$ & $5ms$. Given : $R = 4.7\ k\Omega,\ C = 1\mu F, V = 5V, initial\ charge = 0,\ h = 1ms$ — 2 M

2(a) From the data given below, find f(0.4) by Lagrange's interpolation. Show all necessary steps. — 3 M

x	0.1	0.3	0.5	0.7	0.9	1.1
y=f(x)	1.852	1.604	1.5	1.636	2.108	3.012

2(b)



Solve the equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 8x^2y^2$ in the domain shown in the figure $(h = k = 1)$. Use <u>Gauss elimination</u> method to solve the simultaneous equations. Show all steps of eliminations. — 5 M

2(c) Write a C program to simulate radioactive decay by Monte Carlo method. — 2 M

3(a) Find the inverse of the following matrix by LU decomposition method — 5 M

$$A = \begin{bmatrix} 25 & 5 & 1 \\ 64 & 8 & 1 \\ 144 & 12 & 1 \end{bmatrix}$$

3(b) Find the values of a and b which will fit the function $xy^a = b$ to the following set of data — 5 M

x	3	3.1	3.2	3.3	3.4	3.5
y	1	0.987	0.9745	0.9626	0.9512	0.9402

4(a) Solve the differential equation $y = x + y'$ by Runge-Kutta (II) method where $y(0) = 2$ in the interval $0 \leq x \leq 0.4$ with $h = 0.1$ — 3 M

4(b) Show that after $n + 1$ iterations of Newton Raphson method, the error ε_{n+1} in the approximate root is given by $\varepsilon_{n+1} \approx -{\varepsilon_n}^2 f''(r)/2f'(r)$ — 2 M

4(c) For the following set of data, find $y'\ and\ y''$ at $x = 1.5$ by forward difference method — 5 M

x	1	1.2	1.4	1.6	1.8	2	2.2
y	4	7.0272	11.6032	18.2272	27.4752	40	56.5312

5(a) Write a C program to solve 1D Schrodinger equation for a potential well by finite difference method — 3 M

5(b) Derive the Simpson's 1/3 rule for numerical integration — 5 M

5(c) Obtain the finite difference equivalent for dy/dx and d^2y/dx^2 — 2 M

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