ST.JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE-27.

M.Sc. PHYSICS - I SEMESTER
SEMESTER EXAMINATION: January 2021
PH 7320: Numerical techniques

Time: 2 1/2 hour   **Max Marks: 70**

Part A

Answer the following. Each Question carries 10 mark

1. Derive Newton-Gregory forward interpolation formula and thereby find the value of f(1.83) from the following table.   (10)

x	1	3	5	7	9
f(x)	0	1.0986	1.6094	1.9459	2.1972

2. a. Find the first two derivatives of y at x=54 from the following table.   (5)

x	50	51	52	53	54
y	3.6840	3.7083	3.7325	3.7563	3.7798

   b. Evaluate $\int_0^\pi \sin x \ dx$ by dividing the interval into 8 strips using both trapezoidal rule and Simpson's 1/3 rule.   (5)

3. a. Explain different sources of errors in numerical techniques with examples.

                                                                        (5)
   b. A sample of 800 nursing applications included 75 from men. Find the 95 % confidence interval of the true proportion of men who applied for the program.   (5)

4. a. Explain Bernouli distribution and obtain an expression for the mean and variance of the distribution. Give an example for the same.   (5)
   b. Obtain an expression for the covariance between two random variables X,Y.   (5)

5. Explain one dimensional random walk. What are the different random variables involved in one dimensional random walk? Derive the expressions for the mean values of different random walk variables.   (10)

6. a. Derive also the expression for the variance and S.D. for the random variables of 1-D random walk.   (5)
   b. There is a 1-D lattice with lattice constant 'a'. An atom transits from a site to nearest site in every T seconds, the probability of transiting to the right and to the left are p and q respectively.
   i.   Calculate the average position of atom at time = NT   (N>>1)
   ii.   Calculate the mean square value of displacement at time t.   (5)

7. a. A radioactive source emits 4 particles on average during a five-second period.
   i.   Calculate the probability that it emits 3 particles during a 5-second period.
   ii. Calculate the probability that it emits at least one particle during a 5-second period.
   iii. During a ten-second period, what is the probability that 6 particles are emitted? (5)

   b. Find the inverse Fourier transform of $\delta(\omega-\omega_0)$ and sketch the time domain and frequency domain graphs (5)

8. Calculate the correlation coefficient for the following height in inches of father (x) and their sons (y). Use assumed mean method to verify your answer. (10)

x	65	66	67	67	68	69	70	72
y	67	68	65	68	72	72	69	71

9. Derive the time scaling and time shifting property of Fourier transform with an example in each property. (10)

10. Solve the below given ODE using Euler's method with step size h = 1. Also calculate the exact value of y(3) of the function and the relative true error for y (3).
   $\frac{dy}{dx} + 0.5\,y = 3e^{-x}$ given initial value y(0)= 5. (10)

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