U.G. 5th Semester Examination - 2021

PHYSICS

[HONOURS]

Discipline Specific Elective (DSE)

Course Code : PHY(H)-P-DSE-1/PR

[PRACTICAL]

(Advanced Mathematical Physics 1)

Full Marks : 20 Time : 2 Hours

The figures in the right-hand margin indicate marks.

Answer any **four** questions: 5×4=20

Write a suitable program in Python/ Matlab/ Octave/Fortran /Scilab to solve the following problems.

1. Perform the multiplication of the following two 3×3 matrices

$$A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}, \quad B = \begin{pmatrix} i & 2 & 3 \\ -i & 3 & 3 \\ 1 & 1 & 3 \end{pmatrix}$$

2. Find out the eigenvalue and eigenvectors of the following matrices

$$A = \begin{pmatrix} 2 & 1 & 1 \\ 1 & 3 & 2 \\ 3 & 1 & 4 \end{pmatrix}, \quad B = \begin{pmatrix} 1 & -i & 3+4i \\ i & 2 & 4 \\ 3-4i & 4 & 3 \end{pmatrix}$$

3. Verify the orthogonal property followed by the Legendre function on the interval $-1 \le x \le 1$

$$\int_{-1}^{1} P_m(x) P_n(x)\, dx = \frac{2}{2n+1}\delta_{mn}$$

(where δ_{mn} denotes the *Kronecker delta*, equal to 1 if $m = n$ and to 0 otherwise)

4. Find the principal axes for a body whose inertia tensor is given by

$$A = \begin{pmatrix} 2 & 2 & 0 \\ 2 & 5 & 0 \\ 0 & 0 & 3 \end{pmatrix}$$

5. Solve the Atwoods machine problem by using Lagrangian mechanics and plot the variation of height and velocity of the masses with time. At time t = 0, take h (height)= 50 cm, v (velocity) = 0. The value of the masses are m^1 = 25 gm and m^2 = 30 gm.

6. Estimation of ground state energy and wave function of a quantum having potential

$=V = -\frac{e^2}{r}$. Take e = 3.795 $(eV\text{Å})^{\frac{1}{2}}$, ħc = 1973 $(eV\text{Å})$ and m = 0.511 × 106 eV/c^2.

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