



First Year Assignment

Last Date of Submission: 15 May 2014

Course Title: Mathematical physics and
Classical mechanics

Course Code: PHY-501

Year: 2013-14

Maximum Marks: 40

Section A

Section A contains 08 short answer type questions of 5 marks each. Students are required to answer 4 questions only. Answers of short answer type questions should be 250 words approximately.

1- Show that
$$H'_n = 2n H_{n-1}(x)$$
$$H_n(-x) = (-1)^n H_n(x)$$

2- Solve differential equation

$$\frac{d^2y}{dx^2} - \cot x \frac{dy}{dx} - (1 - \cot x)y = e^x \sin x$$

3- Find the eigen values and eigen vectors of

$$A = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

4- By using Laplace transformation solve the differential equation

$$Y''(t) + 9y(t) = \cos 2t \text{ if } Y(0) = 1 \text{ and } Y\left(\frac{\pi}{2}\right) = -1$$

5- Define Christoffel symbols.

6- Define Generalized coordinate and D'Alembert principle.

7- Show that the transformation

$$Q = \log(1 + \sqrt{q} \cos p)$$

$$P = 2\sqrt{q}(1 + \sqrt{q} \cos p) \sin p$$

is canonical. Find the generating function $F(p, Q)$

8- Define the shift operators E and E^{-1} , and difference operators Δ and ∇ .

Section B

Section B contains 04 long answers type question of 10 marks each and students are required to answers 02 questions only.

- 1- Discuss the Legendre polynomial $P_n(x)$, generating function, Rodrigue's formula and recurrence formula for $P_n(x)$.
- 2- Derive Hamilton's equation of motion and give its physical significance. Define cyclic coordinates and discuss its applications.
- 3- Obtain Hamilton Jacobi equation and its physical significance. Solve harmonic oscillator problem by Hamilton Jacobi method.
- 4- Explain Runge's formula and Runge- Kutta formula. Apply Runge- Kutta method (forth order), to find an approximate value of y when $x=0.2$, given that $\frac{dy}{dx} = x + y^2$ and $y = 1$ when $x = 0$.