SCHOOL OF SCIENCES

UTTARAKHAND OPEN UNIVERSITY, HALDWANI (NAINITAL)

उत्तराखण्ड मुक्त विश्वविद्यालय, हल्द्वानी (नैनीताल)

M.Sc. Physics (MSCPHY13)

First Year Assignment

Last Date of Submission: 15 May 2015

Course Title: Mathematical physics and Classical mechanics

Course Code: PHY-501

Year: 2014-15

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 $\int_{-1}^{+1} x^2 \, P_{n+1} \, P_{n+1} \, dx = \frac{2n\,(n+1)}{(2n-1)(2n+1)(2n+3)}$

2- Derive the recurrence relation

$2J_n'(x) = \mathrm{n}\, \mathrm{J}_{\mathrm{n}-1}(\mathrm{x}) - \mathrm{J}_{\mathrm{n}+1}(\mathrm{x})$

3- Find the Fourier transformation of step function

$$F(x) = \begin{matrix} \sqrt{2\pi} & -c < x < c \\ 2c & |x| > c \end{matrix}$$

4- Find the inverse Laplace transformation of

(i) $\frac{1}{(s^2+s+1)^2}$

(ii) $tan^{-1}\frac{1}{s}$

(iii) $\frac{e^{-\pi s}}{s^2}$

5- Define the covariant derivative of a scalar invariant and show that the order of covariant differentiation is commutative in the case of second order covariant derivative of a scalar invariant.

6- By using Lagrange's equation of motion solve the equation of Atwood's Machine, simple pendulum, Linear Harmonic Oscillator and Spherical Pendulum.

7- Derive the canonical transformation equation and give the condition for canonical transformation.

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 Hermite polynomial $H_n(x)$, generating function, Rodrigue's formula and recurrence formula for $H_n(x)$.

2- Derive Hamilton's equation of motion and give its physical significance. Define cyclic coordinates and discuss its applications.

3- Derive Lagrange's interpolation formula and explain it in detail. By using Lagrange's interpolation, fit a polynomial for the data given below and hence estimate y at x=3.

x	-1	1	4	5
y	-19	-7	-4	17

4- Explain Trapezoidal and Simpson's One-Third rules. Find $\int_{1.0}^{1.3} \sqrt{x}\, dx$ by using Trapezoidal and Simpson's One-Third rules. Take the constant interval between successive interval 0.05