F 5133 (Pages : 2) Reg. No.....

Name.....

M.Sc. DEGREE (C.S.S.) EXAMINATION, JANUARY/FEBRUARY 2017

First Semester

Faculty of Science

Branch II–Physics–A–Pure Physics

PH 1C 02—CLASSICAL MECHANICS

(2012 Admission onwards)

Time : Three Hours Maximum Weight : 30

Part A

Answer any **six** *questions.*
Each question carries a weight of **1.**

1. What are degrees of freedom, generalized co-ordinates and generalized momentum ?
2. State the principle of least action.
3. Explain the term virtual displacement.
4. What are action angle variables ?
5. Explain normal co-ordinate.
6. Write a note on holonomic and non-holonomic constraints.
7. Explain cyclic co-ordinates.
8. What do you mean by Rayleigh dissipation function ?
9. What are normal co-ordinates ?
10. Evaluate Poisson bracket $[J_x, P_y]$.

(6 × 1 = 6)

Part B

Answer any **four** *questions.*
Each question carries a weight of **2.**

11. Obtain the equation of motion for a damped harmonic oscillator with Hamiltonian

$$H = \frac{P^2}{2m} e^{-\gamma t} + \frac{1}{2} m^2 x^2 e^{\gamma t}.$$

Turn over

12. Derive normal mode of vibration of a CO_2 molecule.

13. Discuss the phase space diagram of simple pendulum.

14. Calculate the inertia tensor for the system of four point masses 3g, 3g, 4g and 2g located at the points (1, 1, 0), (1, –1, 0), (1, 1, –1) and (1, –1, 1).

15. Find the values of α and β so that the equation $Q = 2q^{\alpha} \cos \beta p$ and $P = q^{\alpha} \sin \beta p$ represent canonical transformation.

16. Evaluate the Poisson bracket [a, a*], [a.a*], [a, H] for harmonic oscillator.

(4 × 2 = 8)

Part C

Answer any **all** *questions.*
Each question carries a weight of 4.

17. (A) Explain in detail the conservation theorems and symmetry properties.

Or

(B) Derive the Hamilton equation from variational principle.

18. (A) (i) Set up Euler equations of motion for a rigid body

(ii) What do you mean by inertia ? Explain its physical significance.

Or

(B) (i) Apply Hamilton Jacoby equation to solve harmonic oscillator problem.

(ii) Explain Hamilton Jacoby equation as the short wavelength limit of Schrodinger picture.

19. (A) What are action angle variables ? Discuss how they are applied to the Kepler problem.

Or

(B) Define the term 'canonical transformation' and hence derive the condition for a canonical transformation. Also Define Poisson bracket and express Hamilton's equation of motion using Poisson's equation.

20. (A) (i) Deduce Newton's gravitational theory from Einstein's field equations.

(ii) Explain Poisson approximation.

Or

(B) Discuss the precisional motion with and without rotation of a spinning top under gravity.

(4 × 4 = 16)