

2008

**APPLIED MATHEMATICS WITH OCEANOLOGY
AND COMPUTER PROGRAMMING**

(1st Semester Examination)

(Classical Mechanics)

PAPER—MA-1105

Full Marks : 50

Time : 2 hours

Answer Q. No. 1 and any two from rest

The figures in the right-hand margin indicate marks

*Candidates are required to give their answers in their
own words as far as practicable*

Illustrate the answers whenever necessary

1. Answer any *four* questions: 2 × 4

(a) Find the components of velocity when a particle rotating about a fixed point.

(Turn Over)

- (b) State the basic postulates of relativity.
- (c) Define Poisson brackets $[X, Y]$ of two dynamical variables X, Y . Prove that

$$[X, YZ] = Y[X, Z] + [X, Y]Z.$$

- (d) If H is the Hamiltonian and f is any function depending on position, momenta and time show that

$$\frac{df}{dt} = \frac{\partial f}{\partial t} + [f, H].$$

- (e) Define generalised force. Find its expression in terms of generalized coordinates.
- (f) State and prove the conservation law of energy.
2. (a) Show that the path followed by a particle in sliding from one point to another in the absence of friction in the shortest time is a cycloid.

- (b) If X, Y, Z are three dynamical variables then

$$[X, [Y, Z]] + [Y, [Z, X]] + [Z, [X, Y]] = 0.$$

(c) Find the condition that the transformation

$$P = ap + bq, \quad Q = cp + dq$$

is canonical.

8 + 5 + 3

3. (a) Deduce the Euler's equations of motion when a rigid body is rotating about a fixed point.

(b) If the equations of transformation do not depend explicitly on time and if the potential energy is velocity dependent, then show that H is the total energy of the system.

(c) Deduce Hamilton's equation of motion for a conservative and unconnected holonomic system.

7 + 3 + 6

4. (a) Derive the expressions for Lorentz transformation in special theory of relativity. Also show that $x^2 + y^2 + z^2 - c^2 t^2$ is invariant under this transformation.

(b) State Hamilton's principle. Deduce Hamilton's principle from D'Alembert's principle.

(6 + 2) + (2 + 6)

[*Internal Assessment* — 10 Marks]
