



Shree H.N. Shukla Group of Colleges

M.Sc. Mathematics

Sub. Code: EMT-1011

Elec. Sub. 1 : Classical Mechanics 02

PRILIMS PAPER

[Time : 2.5 Hr]

[Total marks:70]

- 1 Attempt the following : (Any Seven) 14
- (1) (i) Define cyclic co-ordinate.
(ii) State Hamilton's variational principle.
 - (2) Define Poisson bracket of the functions u and v .
 - (3) State the postulates of special theory relativity.
 - (4) State only the transformation equations when the generating function is of the type $F_4(p, P, t)$.
 - (5) State only the Euler's equations of motion for a rigid body with one point fixed.
 - (6) State only the Hamilton - Jacobi equation.
 - (7) State minimum two differences each between Lagrange's procedure and Hamilton's procedure.
 - (8) A body has the dimensions represented by $7i + 6j$ mt. in reference frame S . What will be these dimension will be represented in the system S' moving with velocity $0.6 c$ along positive X-axis?
 - (9) The half life of a radioactive particle is 10^{-7} sec when it is at rest. What will be the half life when it is traveling with the speed of $0.99 c$?
 - (10) State only the Jacobi's identity for the Poisson bracket.



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2 Attempt the following : 14

- (a) Show that the angular velocity vector is same in both the co-ordinate systems.

OR

- (a) Derive Lorentz transformation equations.
- (b) Define moment of inertia of a rigid body about some axis. Prove that the moment of inertia about a parallel axis through the C.M. plus the moment of inertia of the body as if concentrated at the C.M. with respect to the original axis.

3 Attempt the following : 14

- (a) Derive Hamilton's canonical equations.
- (b) Discuss in detail the principle of least action.

OR

- (b) For the problem of simple harmonic oscillator prove that

$$q = \sqrt{\frac{2E}{m\omega^2}} \sin(\omega t + \alpha)$$



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4 Attempt the following : 14

- (a) Obtain Hamilton's principal function for the problem of one dimensional simple harmonic oscillator.
- (b) (i) Discuss in detail the phenomenon of length contraction.
- (ii) A rod has proper length 100 cm. is in a satellite which is moving with velocity, $0.6c$. What will be the difference of lengths measured by an observer situated in the (a) laboratory (b) satellite
- (c) (i) State all the four types of generating functions and derive the transformation equations if the generating function is $F_2(q, P, t)$.

(ii) Show that the transformations $Q = \log \left(1 + q^2 \cos p \right)$,

$$p = 2 \left(1 + q^2 \cos p \right) \frac{1}{q^2} \sin p$$
 are canonical and find

the suitable generating function.



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5 Attempt the following : (Any Two) **14**

- (a) Discuss in detail the Routh's procedure.
- (b) Find the analytic solution of a torque free motion
- (c) Prove in the usual notation the relation $E = mc^2$.
- (d) For the Poisson bracket of two function prove that

(i) $[au + bv, w] = a[u, w] + b[v, w]$

(ii) $[uv, w] = [u, w]v + u[v, w]$