**MAY 2013** **P/ID 37456/PMAG**

Time : Three hours Maximum : 100 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions.

Each question carries 2 marks.

1. Define configuration space.

2. What is meant by scleronomic system?

3. Define ignorable coordinates.

4. Define natural systems.

5. Define stationary values of a function.

6. Write down the brachistochrone problem.

7. Give an example for rheonomic transformation.

8. Define contact transformation.

9. What is meant by twin paradox?

10. State the Einstein's principle of relativity.

PART B — (5 × 6 = 30 marks)

Answer ALL questions.

Each question carries 6 marks.

11. (a) Define workless constraints and give an example.

Or

(b) Discuss the generalized force.

12. (a) Obtain Lagrange's equations of motion for a non-holonomic system.

Or

(b) Find the differential equations of motion for a spherical pendulum of length '$l$'.

13. (a) Find the stationary values of the function $f = z$, subject to the constraints

$$\phi_1 = x^2 + y^2 + z^2 - 4 = 0$$
$$\phi_2 = xy - 1 = 0 .$$

Or

(b) State and prove Jacobi's theorem.

14. (a) Discuss the generating function for the transformations.

Or

(b) Derive Jacobi's identity.

15. (a) Discuss the time dilation and longitudinal contraction.

Or

(b) Write a short note on accelerated systems.

PART C — (5 × 10 = 50 marks)

Answer ALL questions.

Each question carries 10 marks.

16. (a) State and prove the principal of virtual work.

Or

(b) Derive the Lagrangian form of d' Alembert's principle.

17. (a) Define Routhian function. Prove that the Routhian procedure has succeeded in eliminating the ignorable coordinates from the equations of motion.

Or

(b) Reduce the spherical pendulum problem to quadratures and obtain the integrals of the motion.

18. (a) Derive the Euler-Lagrange's equation.

Or

(b) State the problem of geodesics in calculus of variations and solve it.

19. (a) Consider the transformation

$$Q = q - t\,p + \frac{1}{2} g\,t^2$$

$$\underline{P} = p - gt$$

Find $K - H$ and the generating functions.

Or

(b) State and prove Poisson's theorem.

20. (a) Suppose a round trip is to be made by rocket from the earth to a nearby star, Alpha Centauri, which is about 4 light-years distant. The rocket is capable of a constant acceleration $g = 9.50$ m/sec$^2$ (1 lt-yr/yr$^2$) relative to its momentary rest frame. What is the required time for the trip?

Or

(b) Obtain the Lorentz transformation equations.

———————