Exam Seat No:_____ Enrollment No:_____

C.U.SHAH UNIVERSITY

WADHWAN CITY

University (Winter) Examination -2013

Course Name :M.Sc(Physics) Sem-I **Subject Name: -Classical Mechanics** **Marks :70**

Duration :- 3:00 Hours **Date : 18/12/2013**

Instructions:-

(1) Attempt all Questions of both sections in same answer book / Supplementary.
(2) Use of Programmable calculator & any other electronic instrument is prohibited.
(3) Instructions written on main answer Book are strictly to be obeyed.
(4) Draw neat diagrams & figures (If necessary) at right places.
(5) Assume suitable & Perfect data if needed.

SECTION-I

Q.1 Write answers of the following Questions

1. Give the difference between Co-ordinate system and Frame of reference. 2
2. Define Scattering cross-section. 2
3. How the Bertrand's theorem and perturbation of orbits are useful in astronomical units? 2
4. What is the maximum centrifugal acceleration value of earth ? 1

Q.2 A. Derive the differential equation of orbit. 5

B. Show that the angular acceleration is the same in Fixed and Rotating frames. 5

C. Write a note on Virial theorem. 4

OR

Q.2 A. Derive the Lagrange's equations from Hamilton's principle. 5

B. Find the equation of orbit and classify different types of orbits on the basis of energy and eccentricity. 5

C. What is coriolis force? Explain it in brief. 4

Q.3 A. With the neat diagram discuss the Scattering phenomenon and obtain the expression for differential Scattering cross-section as 7

$$\sigma(\theta)=\frac{1}{4}\left(\frac{zz\dot{e}^2}{2E}\right)\text{cosec}^4\frac{\theta}{2}$$

B. Derive the Inverse square law of force. 7

OR

Q.3 A. Discuss Bertrand's theorem with necessary mathematical expression. 7

B. Using Lagrange's equation for r,obtain the following integral 7

$$t=\int_{r_0}^{r}\frac{dr}{\sqrt{\frac{2}{m}[E-V(r)-\frac{l^2}{2mr^2}}}$$

SECTION-II

Q.4 Write answers of the following Question.

1. For Poisson's brackets and prove $[X,X]=0$. 2
2. With Example explain stable and unstable equilibrium in small oscillations. 2
3. If the generating function is $F_2=q_ip_i$then prove $p_i=P_i, Q_i=q_i$ and k=H. 2
4. Prove $[u,p_j]=\frac{\partial u}{\partial q_j}$ 1

Q.5 A. For small oscillations obtain Lagrange's equation as 5

$$\sum_j T_{jk}\ \ddot{q}_j + \sum_j V_{jk}\, q_j = 0$$

What are V_{jk} and T_{jk} ?

B. What are normal co-ordinates? Explain briefly. 5

C. Explain Gauge transformation. 4

OR

Q.5 A. Discuss the Eigen Vectors and Eigen Frequencies using two coupled pendulum. 5

B. Give the Example of Harmonic Oscillator. 5

C. Define the Poisson's brackets and prove the following 4

$$[[\dot{p}_j, H], H] = \ddot{p}_i$$

Q.6 A. What is Canonical transformation ? Obtain the transformation equation for generating function F_1. 7

B. Derive Hamilton-Jacobi equation and obtain its solution. 7

OR

Q.6 A. Derive expressions for Small Oscillations of particle on string. 7

B. Obtain Hamilton's characteristics function and find the relation in which the time is as a co-ordinate and Hamiltonian is its conjugate momentum. 7

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