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$3^{\text {rd }}$ Semester Regular/Back Examination 2017-18
CLASSICAL MECHANICS AND SPECIAL THEORY OF RELATIVITY-II BRANCH(S): M.Sc.I(AP)

Time: 3 Hours
Max marks: 70
Q.CODE : B957

## Answer Question No. 1 which is compulsory and any five from the rest. The figures in the right hand margin indicate marks.

## Q1 Answer the following:

a) What is virial theorem?
b) State moment of inertia of a parallel axes theorem.
c) Find the kinetic and potential energies in normal co-ordinates of a two coupled oscillation.
d) What is stable, unstable and Neutral equilibrium?
e) A particle of mass moves under the action of central force whose potential is $V(r)=K m r^{3}(K>0)$, then
(i)For what kinetic energy and angular momentum will the orbit be a circle of radius R about the origin?
(ii) Calculate the period of circular motion.
f) What is Minkowski space?
g) Show by means of Lorentz transformation equations that $x^{\prime 2}-c^{2} t^{-2}=x^{2}-c^{2} t^{2}$
h) Write the two postulates of special theory of relativity.
i) Find the conservation of linear momentum of a motion of system of particle.
j) A particle moving in a central force field located at $\mathrm{r}=0$, describe the spiral $\mathrm{r}=e^{-\theta}$. Prove that the magnitude of force is inversely proportional to $r^{3}$

Q2 a) Derive an expression for the rotational kinetic energy of a rigid body.
b) Show that the angular momentum J of a rotating rigid body is given by $\mathbf{J}=\mathbf{l} \boldsymbol{\omega}$,
where $\omega$ is the angular velocity.
Q3 Two identical harmonic oscillators are coupled together. Set up the equation of motion and obtain the general solutions. Describes the two normal modes.

Q4 a) What is differential scattering cross section?
b) Discuss the problem of scattering of charged particles by a coulomb field and obtain Rutherford's formula for the differential scattering cross-section.

Q5 a) Derive Lorentz space and time transformation equations giving $x^{\prime}, y^{\prime}, z^{\prime}, t^{\prime}$ in terms of $x, y, z, t$, the moving frame coincides with stationary one at $t^{\prime}=t=0$.
b) Prove that when v much smaller than velocity of light Lorentz transformation reduce to Galelian transformation.

Q6 a) Obtain the differential equation for a particle undergoing a central force motion and use it to verify Kepler's laws of planetary motion.
b) A particle moves on a curve $\mathrm{r}^{\mathrm{n}}=\mathrm{a}^{\mathrm{n}} \cos n \theta$ under the influence of a central force.

Find the law of force.

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[^0]:    Q7 Discuss relativistic Doppler effect and Derive relation for
    i) Iongitudinal Doppler effect
    ii) transverse Doppler effect

    Q8 Discuss the vibrations of a parallel pendulum. Determine T and V matrices, The equation of motion and the general solution

