The Open University of Sri Lanka
B.Sc./B.Ed. Degree, Continuing Education Programme
Open Book Test (OBT) - 2024/2025
Level 4 - Applied Mathematics
ADU4301 – Newtonian Mechanics I

Date :09-02-2025 **Time: 10:30 a.m. To 11:30 a.m.**

Answer All Questions.

1. A particle is projected with velocity u at an angle α to the horizontal in a medium whose esistance per unit mass is kv where v is the speed of the particle. If R is the range or the horizontal plane through the point of projection, and T is the time of flight, prove that

$$kR\left(k\tan\alpha + \frac{g}{u}\sec\alpha\right) + g\ln\left(1 - \frac{kR}{u}\sec\alpha\right) = 0 \text{ and } T = \frac{1}{k}\ln\left(\frac{u}{u - kR\sec\alpha}\right).$$

2. A particle, P moves round the circle whose polar equation is $r = 2a\cos\theta$,

$-\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2}$, where a is a positive constant. It moves so that its acceleration has no transverse component. Show that

(a) $\dot{r}$ is proportional to $\frac{\sin\theta}{r^2}$.

(b) the radial acceleration is proportional to $\frac{1}{r^5}$.

3. A smooth wire in the form of an arch of the cycloid, with intrinsic equation $s = 4a\sin\psi$,

$\frac{\pi}{2} \leq \psi \leq \frac{\pi}{2}$, where a is a positive constant. The wire is fixed in a vertical plane with its axis vertical and its vertex O at its lowest point. A bead P of mass m, moves under gravity on this wire. Given that the bead is projected from the vertex O with speed $2\sqrt{ag}$, show that when P reaches the point at which the tangent is inclined at an angle θ to the horizontal:

(a) its speed is $2\sqrt{ag}\cos\theta$.

(b) the normal contact force exerted by the wire n thr bead is $2mg\cos\theta$.