436-202 MECHANICS 1
UNIT 2
DYNAMICS OF MACHINES

NAME. ……………………………………. NAME. ………………………………………

ID. No. ……………………………………. ID. No ……………………………………….

DATE OF SUBMISSION: 1 May 2008

ASSIGNMENT 1.

Problem 1

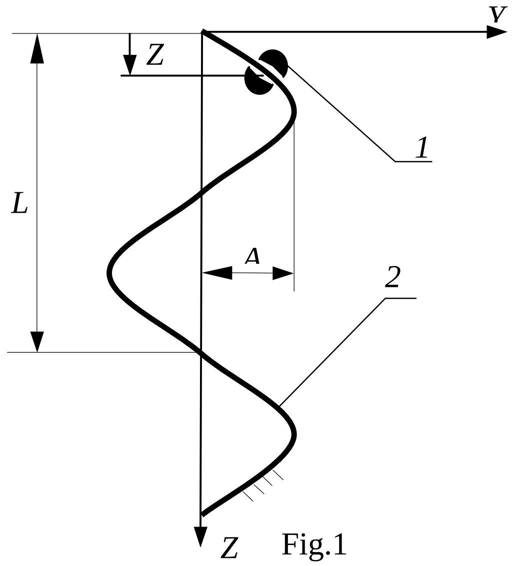

Fig.1

The object *1* that can be treated as a particle of mass *m* can move along the sinusoidal slide *2*. The shape of this slide is defined by the following equation

$$Y = A\sin\omega Z$$

where $\omega = \frac{2\pi}{L}$

The slide is motionless with respect to the vertical plane *YZ* of an inertial space *XYZ*. The motion of the particle is due to gravitation. There is a dry friction between the particle and the slide. The friction coefficient is μ .

Produce

1. The expression for the absolute velocity of the particle *1* as a function of its position *Z*
2. The expression for the absolute acceleration of the particle *1* as a function of its position *Z*
3. The expression for the tangential, normal and binormal unit vector
4. The differential equation of motion of the particle 1
5. The expression for the normal force between the particle and the slide

Problem 2

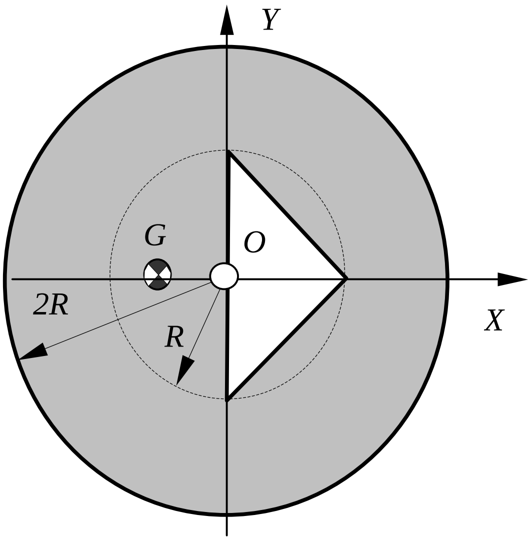

Fig. 2

Fig. 2 shows a flat, uniform and rigid body of mass *m*. Produce

1. The expressions for the coordinates of the centre of gravity G
2. The expression for the moment of inertia of the body about the axis through its centre of gravity *G* and perpendicular to the plane *XY*.

Problem 3

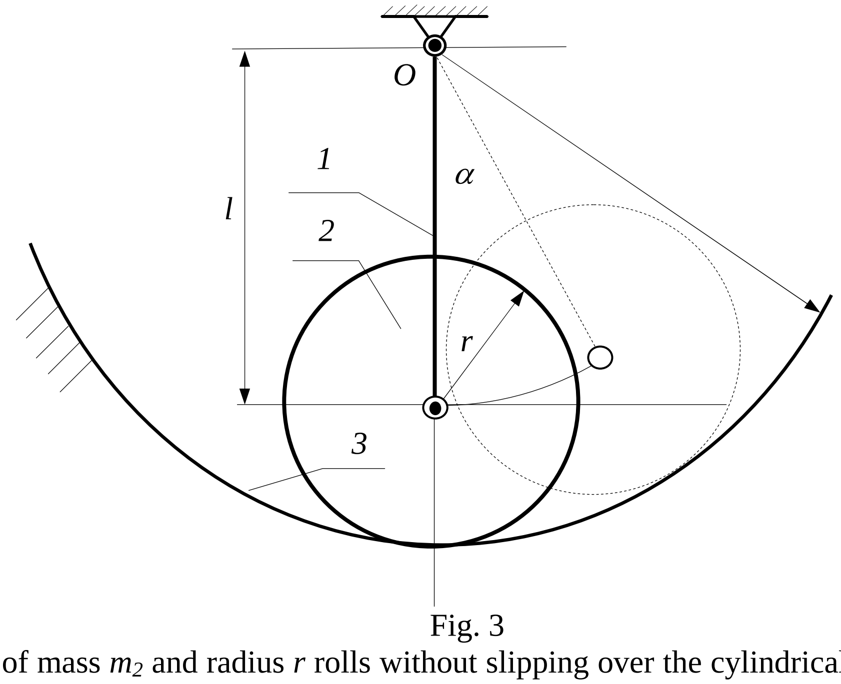

Fig. 3

The cylinder *2* of mass m_2 and radius *r* rolls without slipping over the cylindrical surface *3*. It is driven by the link *1*. The link 1 can be approximated by a uniform rod of mass m_1 and length *l*. Its instantaneous position as a function of time is determined by the angular displacement $\alpha(t)=A\sin\Omega t$. Produce the expression for the kinetic energy of the system as a function of time.

You can work on this assignment individually or in teams of two.

436-202 MECHANICS 1
UNIT 2
DYNAMICS OF MACHINES

NAME. ……………………………………. NAME. ………………………………………

ID. No. ……………………………………. ID. No ……………………………………….

DATE OF SUBMISSION: 22 May 2008

ASSIGNMENT 2.

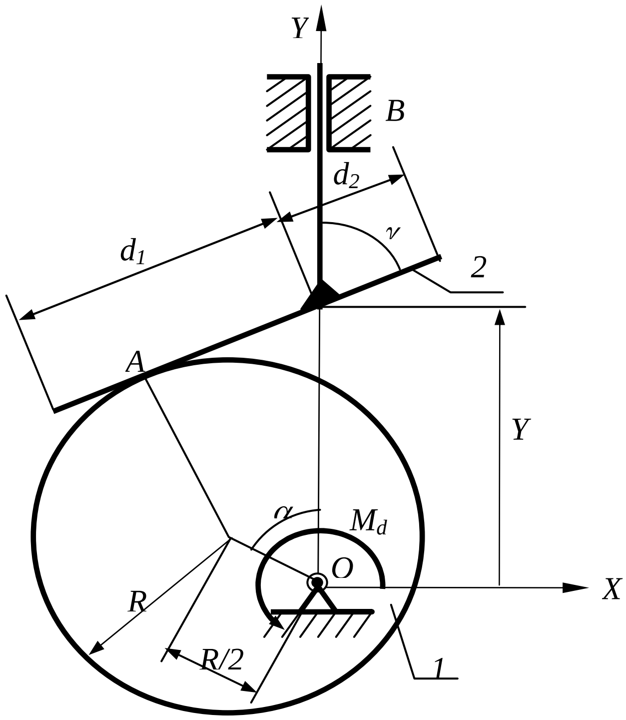

Fig.1

A cam mechanism, shown in Fig. 1, is assembled of the cam *1* of mass m_1 and the flat-faced follower *2* of mass m_2. The cam rotates with a constant angular velocity ω. There is the dry friction between the cam and the follower. This friction is defined by the friction coefficient μ. Friction in the constraint *B* can be neglected. The system operates in the vertical plane *XY* of the inertial space *XYZ.*

Produce:

1. The mobility and number of degrees of freedom of this mechanism
2. The expression for the position *Y(t)* of the follower as a function of time.
3. The expression for the minimal dimensions d_1 and d_2 for which the face of the follower is always tangential to the cam.
4. The expression for the absolute velocity **v** of the follower as a function of time.
5. The expression for the relative velocity $\mathbf{v}_{A1A2}$ and its absolute value
6. The expression for the absolute acceleration **a** of the follower as a function of time.
7. The expression for the relative acceleration $\mathbf{a}_{A1A2}$ and its absolute value
8. The free body diagrams for the cam 1 and the follower 2.
9. The expression for the normal force between the cam and the follower as a function of time.
10. The expression for the driving moment M_d that must be applied to the cam to ensure its rotation with the angular velocity ω.
11. The expression for the maximal angular velocity for which the follower is in continuous contact with the cam.

You can work on this assignment individually or in teams of two.