Mansoura University
Faculty of Engineering
Dept. of production & Mechanical Design

Final Exam June 2013
Date: 2-1-2013
Time: 3 hours
Full mark: (110 mark)

Exam of Theory of machines (2)
For Prod. & Mech. Design Dept. Grad 3 students

## Question One:

*The mass m is attached to one end of a weightless stiff rod which is rigidly connected to the center of a homogeneous cylinder of radius r as shown in Fig. 1. If the cylinder rolls without slipping, what is the natural frequency of oscillation of the system?*

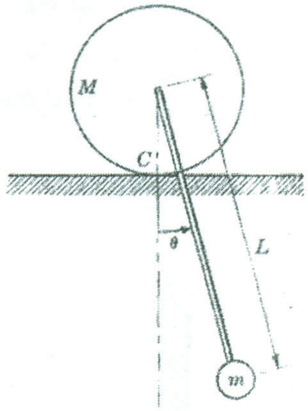


**Fig. 1**

## Question Two:

*A mass of 50 kg is attached to the free end of a vertical spring, which is fixed at the other end, causes a static deflection of 1.635 cm. When the support is given a simple harmonic motion of circular frequency equal to 20 radians per second, the vibration amplitude is found to be 15 cm when damping is negligible. But when damping varies, the amplitude is found to be 7.5 cm. Determine:*

a) *The damping coefficient.*
b) *The logarithmic decrement.*
c) *The periodic time of the damped vibration.*
d) *The phase angle when damping is in operation.*
e) *The magnification factor when damping is in operation.*

## Question Three:

*The amplitude of vibration of the system shown in Fig. 2 is observed to decrease to 25% of the initial value after five consecutive cycles of motion as shown in Fig.2. Determine the damping coefficient c of the system if k = 20 Kgf/cm and m = 10 Kg.*

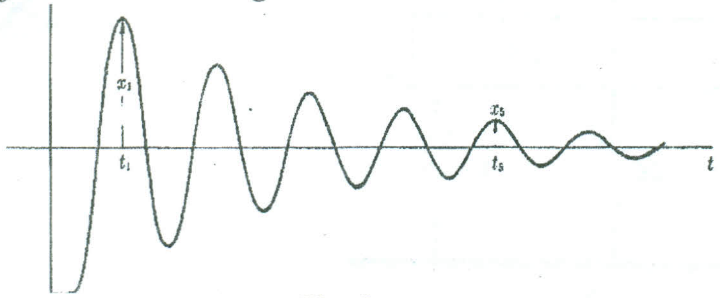


**Fig. 2**

***Question Four:***

*A reciprocating internal combustion engine is coupled to centrifugal pump though gearing as shown in Fig. 3. The shaft from the flywheel of the engine to the gear wheel is 6 cm diameter and 95 cm long. Shaft from the pinion to the pump is 4 cm diameter and 30 cm long. Engine speed is $1/4^{th}$ the pump speed. Other particulars are the following:*

| | |
|---|---|
| *Moment of inertia of the flywheel* | $= 800\ kg.m^2$ |
| *Moment of inertia of the gear wheel* | $= 15\ kg.m^2$ |
| *Moment of inertia of the pinion* | $= 4\ kg.m^2$ |
| *Moment of inertia of the pump impeller* | $= 17\ kg.m^2$ |

*Determine the natural frequency of the tensional oscillation of the system.*

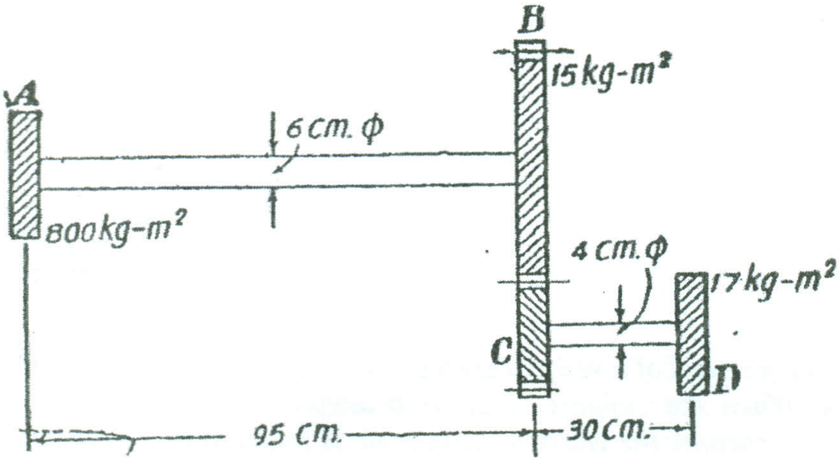


***Fig. 3***

***Question Five:***

A rigid beam of mass *m* and a mass moment of inertia $2ma^2$, about an axis perpendicular to the plane of the diagram and through its center of gravity *G*, as shown in the following figure in its position of static equilibrium. Assume no horizontal motion of the beam, determine the frequencies of the small oscillations in the plane of the diagram.

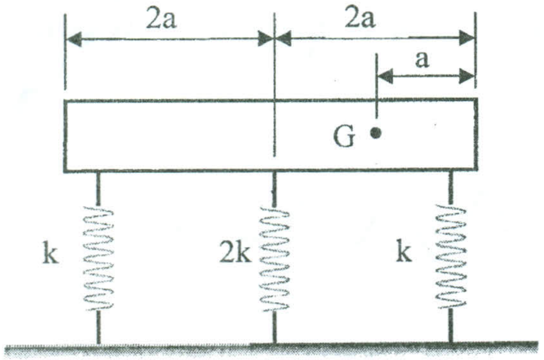


***Fig. 4***

**Best Wishes**

**Dr. Noha Fouda**