Mansoura University | **Mechanical Power Eng. Department**
Faculty of Engineering | **Second year**
Final Exam. 2011/2012 | **Exam. Time: 3 Hours**

THEORY OF MACHINES

Question 1:

The sun gear 1, of the planetary gear train (shown in Fig.(1)), has 26 external gear teeth, the planet gear 2 has 22 external gear teeth, the planet gear 2' has 30 external gear teeth, the sun gear 4 has 20 external gear teeth, the planet gear 5 has 18 external gear teeth, and the ring gears 3, 6 are internally teethed.

The gears 2 and 2' are fixed on the same shaft. The gear 1 rotates with input angular speed 100 rpm, in clockwise (CW) direction, and *the ring gear 3 is fixed (not rotate)*. All the gears have the same module.

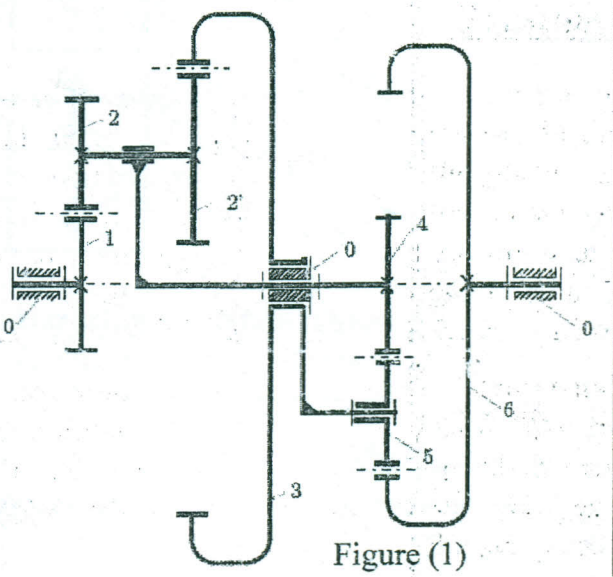


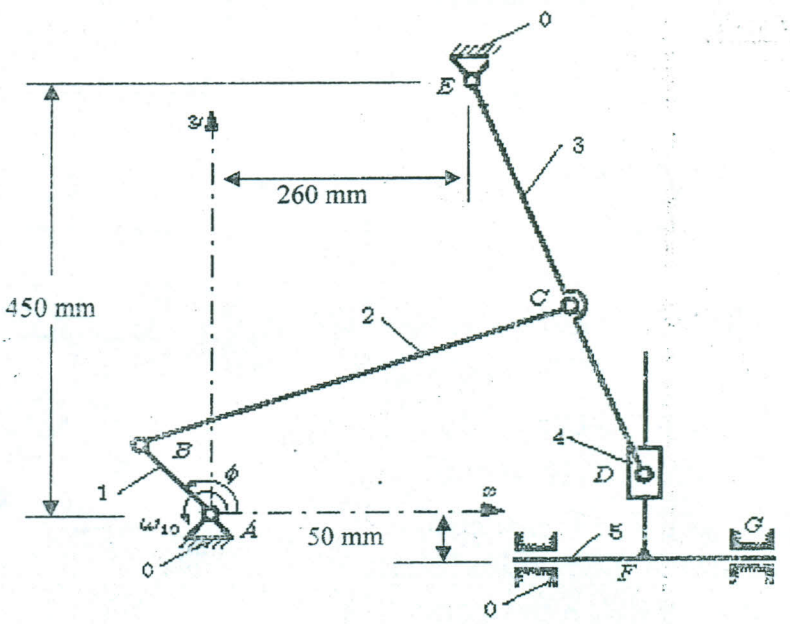
Figure (1)

Find:

a) The number of teeth of the internally teethed ring gears 3, 6.
b) The angular velocity and direction of rotation (CW or CCW) of each gear.

Question 2:

Figure (2)



For the mechanism shown in Fig. (2), the crank AB inclined by $\varphi = 120°$, and rotates with constant angular velocity ω_{10} equals 1 rad./sec (CCW). The lengths of different links are: $AB = 100$ mm, $BC = 450$ mm, $ED = 450$ mm, $EC = 250$ mm.

Find ;

(a) The magnitude and direction of velocity and acceleration of slider *F*, and
(b) The angular velocity and the angular acceleration of link *DE*.

Question 3:

Four masses *A, B, C* and *D,* given in table below are to be completely balanced. The planes containing masses *B* and *C* are 300 mm apart. The angle between planes containing masses *B* and *C* is 90°. *B* and *C* make angles of 120° and 210° respectively with *D* in the same sense.

Mass	*Weight (N)*	*Radius (mm)*
A	*W*	180
B	30	240
C	50	120
D	40	150

Find:

(a) the weight and the angular position of mass *A;*

(b) the position of planes A and D.

Question 4:

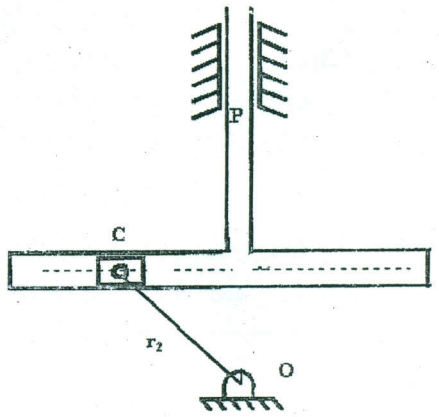
For the Scotch-yoke mechanism shown in Fig. 3

Given: $\Theta_2 = 135$,

$\omega_2 = 1$ rad/s (in clockwise CW direction),

$\alpha_2 = 2$ rad/s^2 (CCW direction), and the crank OC length, $(r_2) = 120$ mm,

Find the velocity and acceleration of slider P.



Question 5:

Figure (4) shows a schematic diagram of an eight-link mechanism. The link lengths are ;

AB = 450 OF = FC = 250

AC = 300 CG = 150

BD = 400 HG = 600

BE = 200 QH = 300

Determine the required shaft torque on link 8 for static equilibrium against an applied load of 400 N on the link 3.

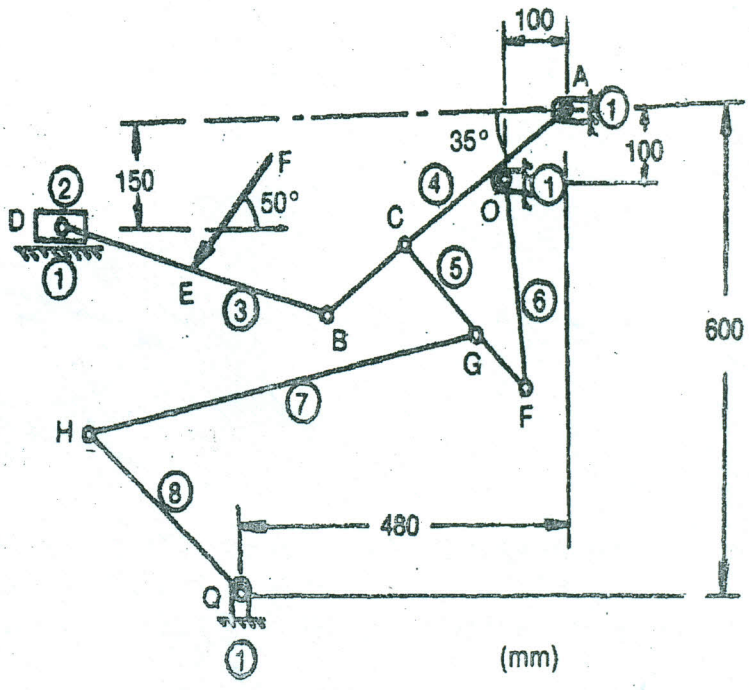


Figure (4)

With my Best Wishes for You &

Dr. SAMY EL-GAYYAR