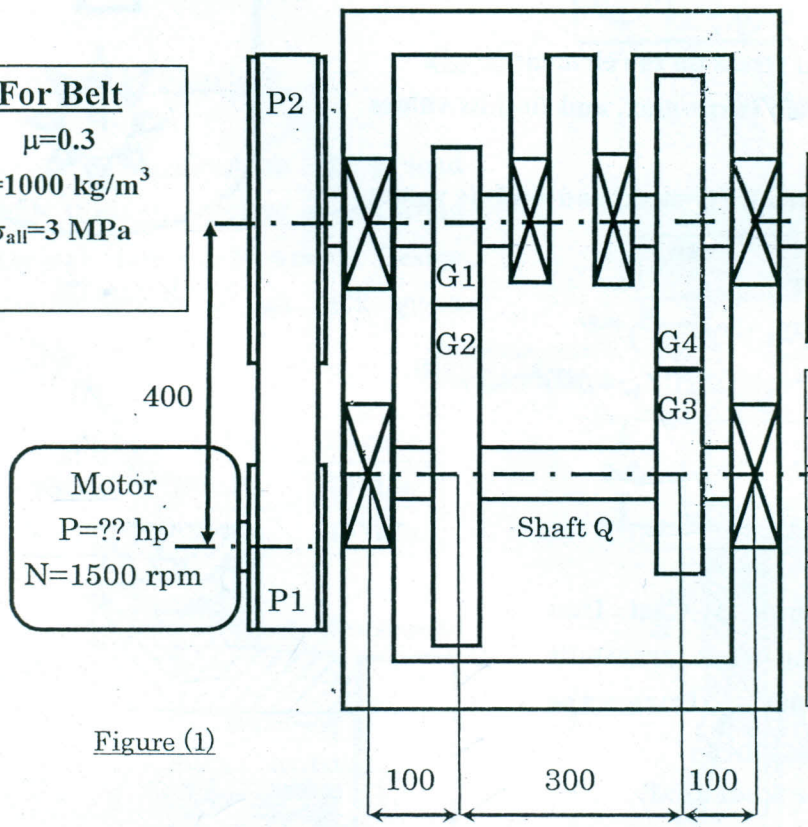
Mansoura University		2nd Year Production
Faculty of Engineering		1st Term – 28 December, 2013
Prod. And Mech. Design Dept.	Machine Design Final Exam	Full Marks: 100, Time: 3 Hours

- **Solve all Questions. All dimensions are in mm.**
- **Assume reasonable values for any missing data.**

Question 1:(25 Marks)

For Shaft (MPa)	
σ_{all}	τ_{all}
80	40

For Belt
μ=0.3
ρ=1000 kg/m^3
σ_{all}=3 MPa



Element	Diameter
P1	200
P2	400
G1	160
G2	400
G3	180
G4	360

Figure (1)

Figure (1) shows a Motor which drives Pulley P1 at 1500 rpm, and transmits power through a Flat Belt to Pulley P2 which is mounted on a Shaft that carries Gear G1 which meshes with Gear G2. Gear G3 is mounted together with Gear G2 on Shaft Q, and transmits power to Machine Z through Gear G4 which is subjected to a Torque T4=475 N.m. Assuming no losses and neglecting the weights of elements, find:

1. Torque at Gear G1 (T1) and Motor Power (P) in Horse Power.
2. Design details of the Flat Belt.
3. Diameter of Shaft Q that carries Gears G2 and G3 .

Question2:(20 Marks)

A thin walled cylindrical pressure vessel has a mean diameter D=1000, length L=2000, and thickness (t), and contains a fluid of pressure P=1.6 KPa. An elements on the wall of the vessel as shown in Figure (2), is subjected a shear stress τ_{xy}=30 MPa. If the allowable (maximum) shear stress (τ_{max}) for the vessel must not to exceed 50 MPa, find:

1. The vessel thickness (t).
2. Maximum normal stress on the element (σ_{max}).
3. The planes at which (τ/σ)=max, and find its values of τ and σ.
4. The planes at which (σ/τ)=max, and find its values of τ and σ.

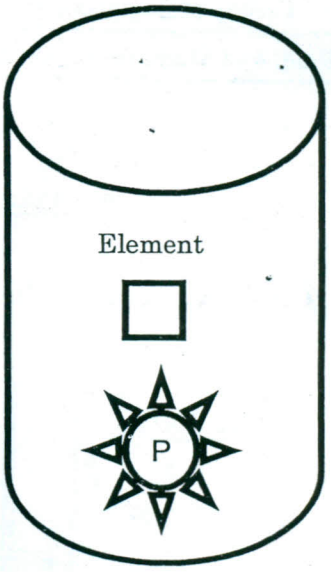


Figure (2)

Note that:

$$\tau_{max} = (((\sigma_x - \sigma_y)/2)^2 + \tau_{xy}^2)^{(0.5)}$$

$$\sigma_{max} = (\sigma_x + \sigma_y)/2) + (((\sigma_x - \sigma_y)/2)^2 + \tau_{xy}^2)^{(0.5)}$$

Question3:(15 Marks)

Figure (3) shows a Cast Iron Flange Fixed Coupling that transmits 15kW from A to B at 900rpm. Design the following with neat sketches:

- Diameter of the steel shaft.
- Flange coupling.
- 4 steel bolts.
- Square steel key.

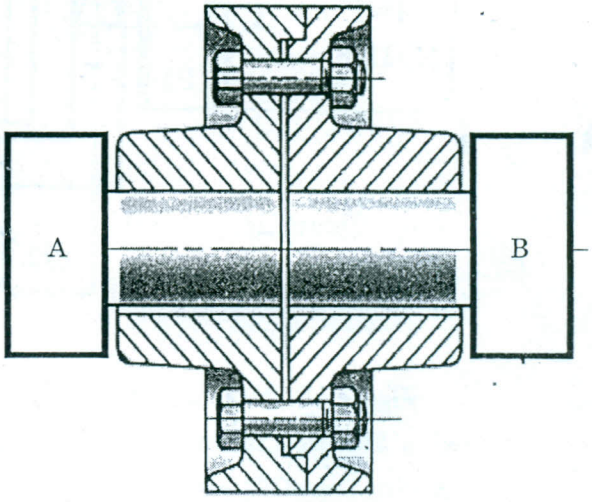


Figure (3)

	Steel	Cast Iron
τ_{all}	40MPa	8MPa

Allowable $\sigma_{bearing}$= 80MPa

Question 4:(15 Marks)

Figure (4) shows a bracket fixed to a steel structure by 4 steel bolts of equal size, and carries a load of P=5kN, determine:

- The resultant force on each bolt.
- The size of the bolts.

Given that for bolt material, τ_{all} = 50MPa.
Use L2=50, L1=400, and e=200.

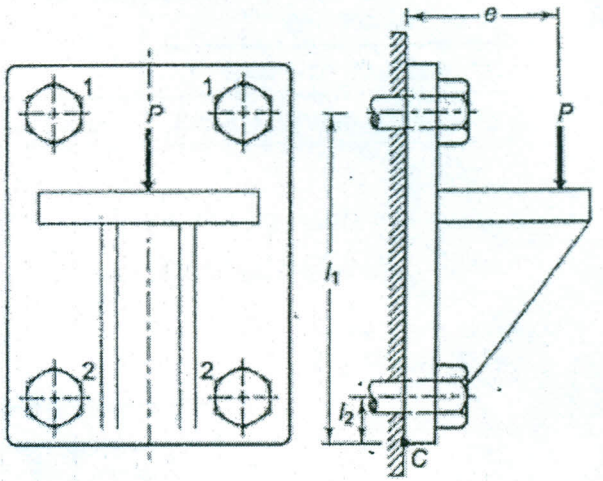


Figure (4)

Question5:(25 Marks)

It is required to lift a load W=10kN through a height of 500 using a screw jack shown in Figure (5). Design all possible details of this Jack, given that:

	Steel	Cast Iron	Bronze
τ_{all}	60MPa	25MPa	20Mpa
σ_{all}	100MPa	50Mpa	40MPa

Allowable Bearing Stresses of Bronze are:

With Steel	With Cast Iron
18MPa	35MPa

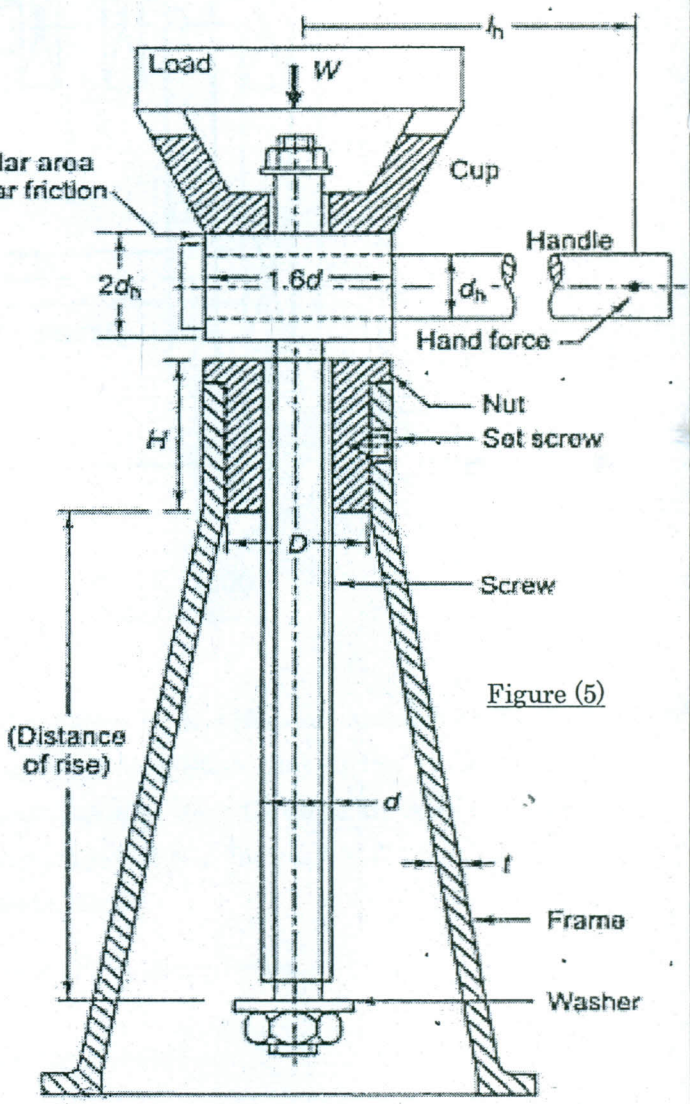


Figure (5)

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End of the Exam

Good Luck
Dr. Ahmed Galal