Kafr El-Sheikh University	MDP [3012] Machine Design	3nd Year Production Students
Faculty of Engineering		Final Exam – Jan., 2019
Mechanical Engineering Department		Full Marks:100, Time: 4 Hours

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

Question1 :(20 Marks)

Figure (1) shows a Motor of P=10hp, and N=1200 rpm. The motor drives Pulley P1 that transmits power to Pulley P2 through a Flat Belt. Gear G1 is mounted with P2 on the same shaft. G2 meshes with Gear G1 and transmits power to a Machine through a Flange Coupling.. It is required to design the following elements:

1. Details of the Flat Belt.
2. Diameter of the Shaft carrying Gear 2.
3. Coupling, its 4 bolts and square Keys.

Element	Diameter
G1	50
G2	100
P1 and P2	150

	Steel
τ_{all}	40MPa
σ_{all}	80MPa

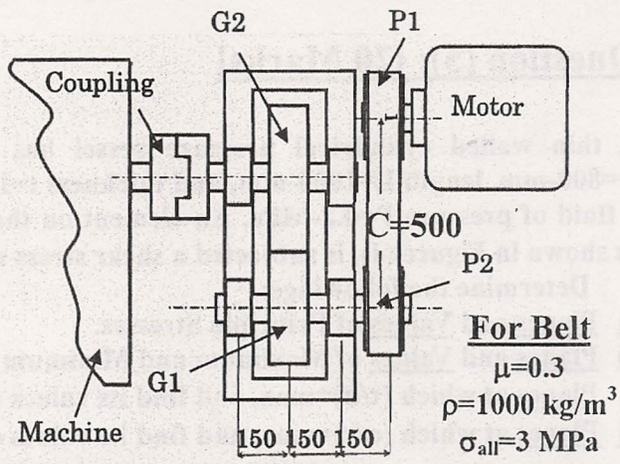

Figure (1)

Question (2): [15 Marks]

A single block brake, as shown in Fig. (2) has a drum diameter of 800 mm. If the brake sustains 250 N-m torques at 600 r.p.m. The coefficient of friction may be taken as 0.3). Find:

(a) The required force (P) to apply the brake for clockwise rotation of the drum.

(b) The required force (P) to apply the brake for counter clockwise rotation of the drum.

(c) The location of the fulcrum to make the brake self-locking for clockwise rotation of the drum.

Question (3): [15 Marks]

A multiple disc clutch employs 3 steel and 2 bronze discs having outer diameter 300 mm and inner diameter 200 mm. For a coefficient of friction of 0.22, find the axial pressure and the power transmitted at 750 r.p.m., if the normal unit pressure is 0.13 N/mm2. Also find the axial pressure of the unit normal pressure, if this clutch transmits 22 kW at 1500 r.p.m.

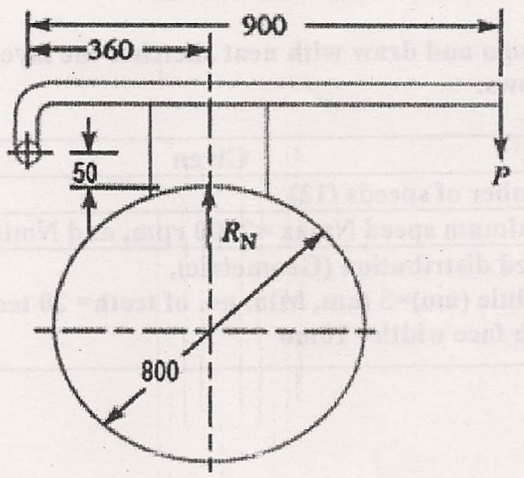

Figure (2)

Question (4): [15 Marks]

Figure (3) shows a steel strut of a diameter d=10 mm which is maintained in the position shown by a pin support at A and by sets of rollers at B and C that prevent rotation of the strut in the plane of the figure. Consider only buckling in the plane of the figure, and use E =200 GPa and a factor of safety with respect to buckling =2.

1. Knowing that L_{AB} =1.0 m, L_{BC} =1.25 m, and L_{CD} = 0.5 m, determine the allowable load F.
2. If L_{AB} =1.4 m, determine:
   (a) The largest values of L_{BC} and L_{CD} that can be used if the allowable load F is to be as large as possible.
   (b) The magnitude of the corresponding allowable load F.

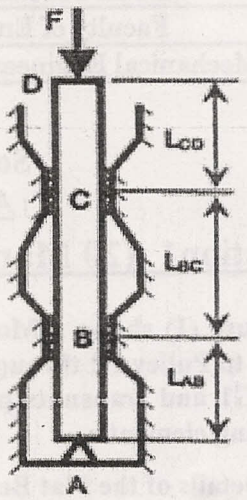

Figure (3)

Question (5): [20 Marks]

A thin walled cylindrical pressure vessel has a mean diameter D=800-mm, length L=1000-mm, and thickness t=1-mm, and contains a fluid of pressure P=0.2-MPa. An element on the wall of the vessel as shown in Figure (4), is subjected a shear stress τ_{xy}=30 MPa.

Determine the followings:

a) Planes and Values of Principle Stresses.
b) Planes and Values of Maximum and Minimum Shear Stresses.
c) Planes at which (τ/σ)=max, and find its values of τ and σ.
d) Planes at which (σ/τ)=max, and find its values of τ and σ.

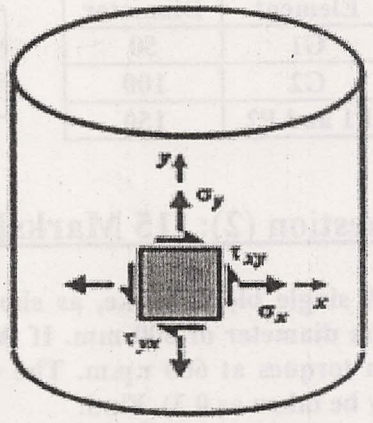

Figure (4)

Question (6): [15 Marks]

Design and draw with neat sketches the layout and speed flow chart of a machine tool speed gear box as follows:

Given	Required
Number of speeds (12)	1. Minimum number of Shafts
Maximum speed Nmax =2000 rpm, and Nmin =100 rpm	2. Number of two and three Sliding Blocks
Speed distribution (Geometric), Module (mo)=5 mm, Min. no. of teeth= 20 teeth, and all teeth face width= 10mo	3. Speed Values (N1, N2,...., N12=Nmax)
	4. Minimum number of Fixed gears
	5. Minimum number of Sliding gears

Good Luck,

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