Kafr El-Sheikh University		3nd Year Power Mechanical.
Faculty of Engineering		Final Exam – Jan., 2016
Mechanical Engineering Department	Machine Design	Full Marks: 100, Time: 3 Hrs

Solve all FIVE QUESTIONS, and Assume reasonable values for any missing data.

Question (1): (20 Marks)

Select a single raw deep groove ball bearing from table (1) with the operating cycle listed below, which will have a life of 15000 hours.

Fraction of cycle	Type of load	Radial (N)	Thrust (N)	Speed (R.P.M)	Service factor
1/10	Heavy shocks	2000	1200	400	3
1/10	Light shocks	1500	1000	500	1.5
1/5	Moderate shocks	1000	1500	600	2
3/5	No shocks	1200	2000	800	1

Assume radial and axial load factors (X and Y) to be 1, and 1.5 respectively, and inner race rotating.

Table (1) Basic static and dynamic capacities of various types of radial ball bearings.

Bearing No.	*Basic capacities in kN*							
	Single row deep groove ball bearing		*Single row angular contact ball bearing*		*Double row angular contact ball bearing*		*Self-aligning ball bearing*	
	Static (C_0)	*Dynamic (C)*	*Stctic (C_0)*	*Dynamic (C)*	*Static (C_0)*	*Dynamic (C)*	*Static (C_0)*	*Dynamic (C)*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
214	39	48	47.5	54	71	69.5	21.6	34.5
314	63	81.5	73.5	90	129	137	45	85
414	102	112	—	—	—	—	—	—
215	42.5	52	50	56	80	76.5	22.4	34.5
315	72	90	81.5	98	140	143	52	95
415	110	120	—	—	—	—	—	—

Question (2): (20 Marks)

It is required to design a machine tool speed gear box of 6 speeds using geometric progression where the maximum and minimum speeds are 1200 and 100 rpm respectively. Find:

a) **Detailed sketch for the layout of the gear box.**

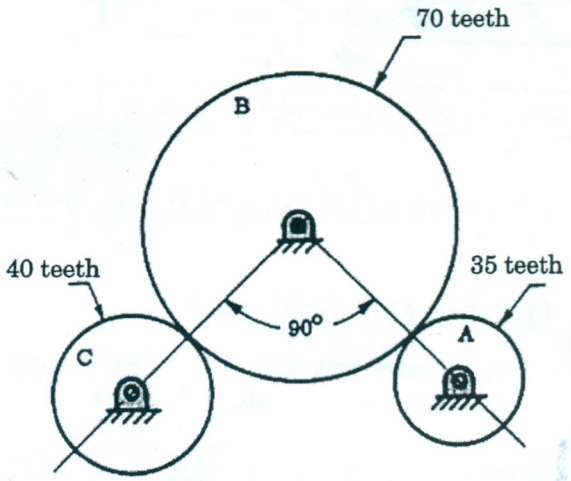
b) **Geometric progression constant and the values of the 6 speeds.**

c) **Minimum number of: shafts, two and three sliding blocks, sliding gears and fixed gears.**

Question (3): (20 Marks)

Figure (1) shows a Gear A, which receives 6 hp at 500 rpm through its shaft and rotates counter clockwise. Gear B is an idler, and Gear C is the driven Gear. Use a module m=4 mm.

1. **What is the torque on the shaft of each Gear?**
2. **What is the tangential force for which each gear must be designed?**
3. **What force is applied to the idler shaft as a result of the gear tooth loads?**



Question (4): (20 Marks)

A single plate clutch effective in both sides such as shown in figure (2), is required to transmit 25 KW at 3000 rpm. Determine the inner and outer diameters of frictional surfaces if the coefficient of friction is 0.255, ratios of diameters is 1.25 and the maximum pressure is not to exceed 0.1 N/mm^2. Also, determine the axial thrust force to be provided by springs. Assume the theory of Uniform Wear.

Question (5): (20 Marks)

A double shoe brake, as shown in Figure (3), is capable of absorbing a torque of 1400 N-m. The diameter of the brake drum is 350 mm and the angle of contact for each shoe is 100°.

If the coefficient of friction between the brake drum and lining is 0.4; find:

1. **The spring force necessary to set the brake**
2. **The width of the brake shoes, if the bearing pressure on the lining material is not to exceed 0.3 N/mm2.**

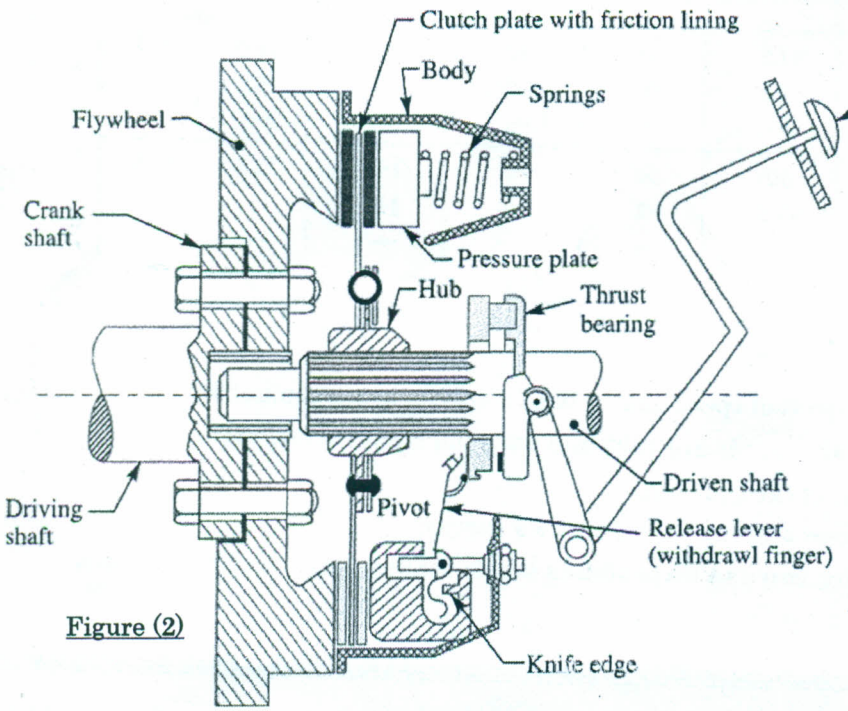


Figure (2)

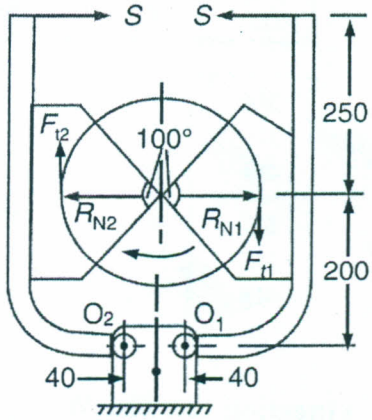


Figure (3)

Good Luck,
Associate Professor
Ahmed Galal