Kafrelsheikh University	Final Term Exam 04/06/2016	2nd year
Faculty of Engineering		Machine Design (MDP2008)
Mechanical engineering		Time Allowed: 4 Hr.

Answer all the questions:

1- A shaft is supported by two bearings placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulleys is 1800 and $\mu = 0.24$. Determine the suitable diameter for a solid shaft, allowing working stress of 63 MPa in tension and 42 MPa in shear for the material of shaft. Assume that the torque on one pulley is equal to that on the other pulley. **(20 marks).**

2- Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15 kW at 200 r.p.m. and having an allowable shear stress of 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14 MPa. **(20 marks).**

Shaft diameter (mm) upto and including	Key cross-section		Shaft diameter (mm) upto and including	Key cross-section	
	Width (mm)	Thickness (mm)		Width (mm)	Thickness (mm)
44	14	9	260	63	32
50	16	10	290	70	36

3- A cast iron pulley transmits 20 kW at 300 r.p.m. The diameter of pulley is 550 mm and has four straight arms of elliptical cross-section in which the major axis is twice the minor axis. Find the dimensions of the arm if allowable bending stress is 15 Mpa. Mention the plane in which the major axis of the arm should lie. **(10 marks).**

4- Two parallel shafts whose centre lines are 4.8 m a part, are connected by an open belt drive. The diameter of the larger pulley is 1.5 m and that of smaller pulley 1 m. The initial tension in the belt when stationary is 3 kN. The mass of the belt is 1.5 kg/m length. The coefficient of friction between the belt and the pulley is 0.3. Taking centrifugal tension into account, calculate the power transmitted, when the smaller pulley rotates at 400 r.p.m. **(10 marks).**

5- A machine component is subjected to a flexural stress which fluctuates between + 300 MN/m2 and -150 MN/m2. Determine the value of minimum ultimate strength according to 1. Gerber relation; 2. Modified Goodman relation; and 3. Soderberg relation. Take yield strength = 0.55 Ultimate strength; Endurance strength = 0.5 ultimate strength; and factor of safety = 2. **(15 marks).**

6- Find the efficiency of the following riveted joints: 1. Single riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 50 mm. 2. Double riveted lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 65 mm. Assume permissible tensil stress in plate = 120 MPa, permissible shearing stress in rivets = 90 MPa, permissible crushing stress in rivets= 180 MPa. **(10 marks)**

7- A screw jack is to lift a load of 80 kN through a height of 400 mm. The elastic strength of screw material in tension and compression is 200 MPa and in shear 120 MPa.

The material for nut is phosphor-bronze for which the elastic limit may be taken as 100 MPa in tension, 90 MPa in compression and 80 MPa in shear. The bearing pressure between the nut and screw is not exceed 18 N/mm2. Design the screw jack. The design should include the design of 1. Screw, 2. Nut.Taking factor of safety equal 2 and coefficient of friction $\mu = 0.14$. Assume the load is distributed uniformly over the cross sectional area of nut. **(20 marks)**

Nominal diameter (d_1)	*Major diameter*		*Minor diameter*	*Pitch*	*Depth of thread*		*Area at core* (A_c) mm^2
	Bolt (d)	*Nut* (D)	(d_c)	(p)	*Bolt* (h)	*Nut* (H)	
(46)	46	46.5	38				1134
48	48	48.5	40	8	4	4.25	1257
50	50	50.5	42				1385
52	52	52.5	44				1521
55	55	55.5	46				1662
(58)	58	58.5	49	9	4.5	5.25	1886

8- Design a chain drive to actuate a compressor from 15 kW electric motor running at 1000 r.p.m, the compressor speed being 350 r.p.m. The minimum centre distance is 500 mm. The compressor operates 16 hours per day. The chain tension may be adjusted by shifting the motor on slides. Load factor for variable load with heavy shock = 1.5, lubrication factor for drop lubrication = 1, rating factor for 16 hours per day = 1.25. **(15 marks)**

Type of chain	*Number of teeth at velocity ratio*					
	1	2	3	4	5	6
Roller	31	27	25	23	21	17
Silent	40	35	31	27	23	19

ISO Chain number	*Pitch (p) mm*	*Roller diameter* (d_1) *mm* *Maximum*	*Width between inner plates* (b_1) *mm* *Maximum*	*Transverse pitch* (p_t) *mm*	*Breaking load (kN) Minimum*		
					Simple	*Duplex*	*Triplex*
10 B	15.875	10.16	9.65	16.59	22.2	44.5	66.7
12 B	19.05	12.07	11.68	19.46	28.9	57.8	86.7
16 B	25.4	15.88	17.02	31.88	42.3	84.5	126.8
20 B	31.75	19.05	19.56	36.45	64.5	129	193.5

Speed of smaller sprocket or pinion (r.p.m.)	*Power (kW)*				
	06 B	08 B	10 B	12 B	16 B
500	1.09	2.72	5.01	8.53	20.57
700	1.48	3.66	6.71	11.63	27.73
1000	2.03	5.09	8.97	15.65	34.89

Type of chain	*Pitch of chain (mm)*	*Speed of the sprocket pinion in r.p.m.*								
		50	200	400	600	800	1000	1200	1600	2000
Bush roller chain	12 – 15	7	7.8	8.55	9.35	10.2	11	11.7	13.2	14.8
	20 – 25	7	8.2	9.35	10.3	11.7	12.9	14	16.3	–
	30 – 35	7	8.55	10.2	13.2	14.8	16.3	19.5	–	–
Silent chain	12.7 – 15.87	20	22.2	24.4	28.7	29.0	31.0	33.4	37.8	42.0
	19.05 – 25.4	20	23.4	26.7	30.0	33.4	36.8	40.0	46.5	53.5

With my best wishes
Dr. Eng. Fatma Elerian
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