



**UNIVERSITI KUALA LUMPUR
Malaysia France Institute**

**FINAL EXAMINATION
SEPTEMBER 2013 SESSION**

SUBJECT CODE : FMB11302
SUBJECT TITLE : MACHINE ELEMENTS
LEVEL : BACHELOR
TIME / DURATION : 2.5 HOURS
DATE :

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper **CAREFULLY**.
 2. This question paper is printed on both sides of the paper.
 3. Please write your answers on the answer booklet provided.
 4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
 5. This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions only.
 6. Answer all questions in English.
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THERE ARE 5 PAGES OF QUESTIONS, 4 PAGES OF APPENDICES, EXCLUDING THIS PAGE.

INSTRUCTION: Answer any FOUR questions.

Please use the answer booklet provided.

Question 1

- (a) Describe the advantages of chain drive. (2 marks)
- (b) A chain drive using bush roller chain transmits 5.8 kW of power. The driving shaft on an electric motor runs at 1400 rpm and velocity ratio is 5. The center distance of the drive is restricted to 550 mm and allowable pressure on the pivot joint is not to exceed 10 N/mm^2 . The drive is required to operate 8 hours per day with periodic lubrication and driven machine is such that load can be regarded as fairly constant with shock.
- i. Design the chain drive by calculating leading dimension, number of teeth on the sprocket and specify the breaking strength of the chain. Assume a factor of safety of 13. (12 marks)
- ii. Calculate the number of chain link and length of chain. (3 marks)
- (c) A simple roller chain no.10B is used to transmit power from a 1000 rpm electric motor to a line shaft running at 350 rpm. The number of teeth on the driving sprocket wheel is 19. The operation is smooth without any shock. Calculate;
- i. The power design from the chain drive can be recommended. (3 marks)
- ii. The tension in the chain for this rated power. (3 marks)
- iii. The factor of safety for the chain based on the breaking load. (2 marks)

Question 2

- (a) Name one type of material used for belts. (1 mark)
- (b) A flat belt, 8 mm thick and 100 mm wide transmits power between two pulleys, running at 1600 m/min. The mass of the belt is 0.9 kg/m length. The angle of lap in the smaller pulley is 165° and the coefficient of friction between the belt and pulleys is 0.3. If the maximum permissible stress in the belt is 2 MN/m^2 , determine;
- Maximum power transmitted. (8 marks)
 - Initial tension in the belt. (2 marks)
- (c) A compressor, requiring 90 kW, is to run about 250 rpm. The drive is by V-belt from an electric motor running at 750 rpm. The diameter of the pulley on the compressor shaft must not be greater than 1 meter while the center distance between the pulley is limited to 1.75 meter. The belt speed should not exceed 1600 m/min.
- Determine the number of V-belt required transmitting the power if each belt has a cross sectional area of 375 mm^2 , density 1000 kg/m^3 and allowable tensile stress of 2.5 MPa. The groove angle of the pulleys is 35° . The coefficient of friction between the belt and the pulley is 0.25. (13 marks)
 - Calculate the length required of each belt. (1 mark)

Question 3

- (a) State three advantages of gear drive. (3 marks)
- (b) An 8 -pitch pinion with 18 teeth mates with a gear having 64 teeth. The pinion rotates at 2450 rpm. Compute the following;
- i. Center distance (1 mark)
 - ii. Velocity ratio (1 mark)
 - iii. Speed of gear (3 marks)
 - iv. Diameter of pinion and gear (2 marks)
- (c) Devise a gear train using all external gears on parallel shafts. The input shaft rotates at exactly 1800 rpm and the output speed must be within the range of 21 to 22 rpm. Power transmission analysis indicates that it would be desirable for the reduction ratio for the second pair of gears to be somewhat greater than that for the first pair. Ensure there is no interference. Sketch the layout for your design. (15 marks)

Question 4

(a) Name three types of brakes.

(3 marks)

(b) A single block brake, as shown in Figure 1, has a drum diameter of 720 mm. If the brake sustains 225 Nm torque at 500 rpm, the coefficient of friction is 0.3. Compute;

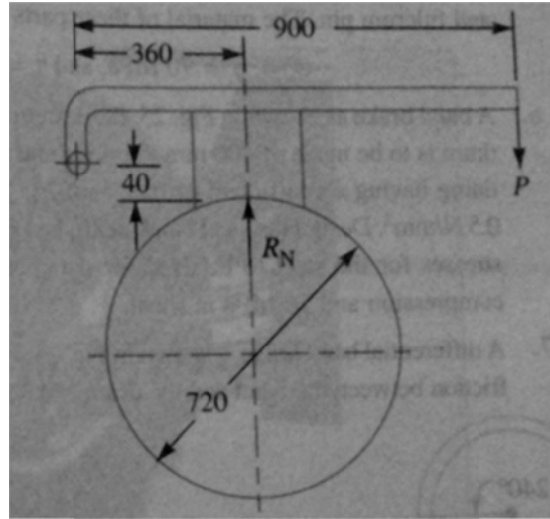


Figure 1 (all unit in mm)

i. The required force, P to apply the brake for clockwise rotation of the drum

(3 marks)

ii. The required force, P to apply the brake for counter clockwise rotation of the drum

(3 marks)

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

(2 marks)

(c) A rope drum of an elevator having 700 mm diameter is fitted with a brake drum of 1.25 meter diameter. The brake drum is provided with four cast iron brake shoes each subtending an angle 45° . The mass of the elevator when loaded is 2500 kg and moves with a speed of 3 m/s. The brake has a sufficient capacity to stop the elevator

in 3 meters. Assuming the coefficient of friction between the brake drum and shoes as 0.25. Calculate the width of the shoe, if the allowable pressure on the brake shoe is limited to 0.4 N/mm^2 .

(14 marks)

Question 5

(a) List the stresses in shaft.

(3 marks)

(b) Determine the diameter of solid steel shaft to transmit 20 kW at 200 rpm. The ultimate shear stress for the steel may be taken as 370 MPa and factor of safety as 9. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5.

(12 marks)

(c) A hollow transmission shaft having inside diameter 0.6 times outside diameter, is made of plain carbon steel 40C8 ($S_{yt} = 380 \text{ N/mm}^2$) and the factor of safety is 3. A belt pulley, 1000 mm in diameter is mounted on the shaft that overhang the left hand bearing by 250 mm. The belt is vertical and transmits power to the machine shaft below the pulley. The tensions on tight and slack sided of the belt are 3 kN and 1 kN respectively, while the weight of the pulley is 550N. The angle of wrap of the belt on pulley is 180° . Calculate the outside and inside diameters of the shaft.

(10 marks)

END OF QUESTION