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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2014 SESSION

SUBJECT CODE	:	FMB 11302
SUBJECT TITLE	:	MACHINE ELEMENTS
LEVEL	:	BACHELOR
TIME / DURATION	:	(2.5 HOURS) 3.30 pm - 6.00 pm
DATE	:	29 MAY 2014

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 question paper consists of FIVE (5) questions. Answer FOUR (4) questions only.
6. Answer all questions in English.

THERE ARE 5 PAGES OF QUESTIONS AND 1 PAGE OF APPENDIX, EXCLUDING THIS PAGE.

INSTRUCTION: Answer FOUR (4) questions ONLY.
Please use the answer booklet provided.

Question 1

(a) Describe two (2) advantages of V-belt as compared to flat belt type.

(4 marks)

(b) Power is transmitted between two shafts by a V-belt whose mass is 0.9 kg/m length. The maximum permissible tension in the belt is limited to 2.2 kN. The angle of wrap is 170° and the groove angle is 45°. If the coefficient of friction between the belt and pulley is 0.17, compute:

i. Velocity of the belt for maximum power

(3 marks)

ii. Power transmitted at this velocity.

(8 marks)

(c) Analyze the width of the flat belt necessary to transmit 10 kW power to a pulley 300 mm diameter, if the pulley makes 1600 rpm speed and the coefficient of friction between the belt and pulley is 0.22. Assume the angle of contact as 210° and the maximum tension in the belt is not to exceed 8 N for the 1 mm belt width.

(10 marks)

Question 2

(a) Identify two (2) advantages of helical gear application over spur gear.

(4 marks)

(b) Referring to gear train shown in Figure 1, evaluate the rotational speed of the output shaft of the gear if the input shaft is rotates at speed 1160 rpm in counterclockwise direction. Identify the output shaft direction of rotation.

Given, N_A = 18, N_B = 34, N_C = 20, N_D = 62, N_E = 30, N_F = 60, N_G = 2 (worm threads), N_H = 40, N_I = 16 and N_J = 88.

(6 marks)

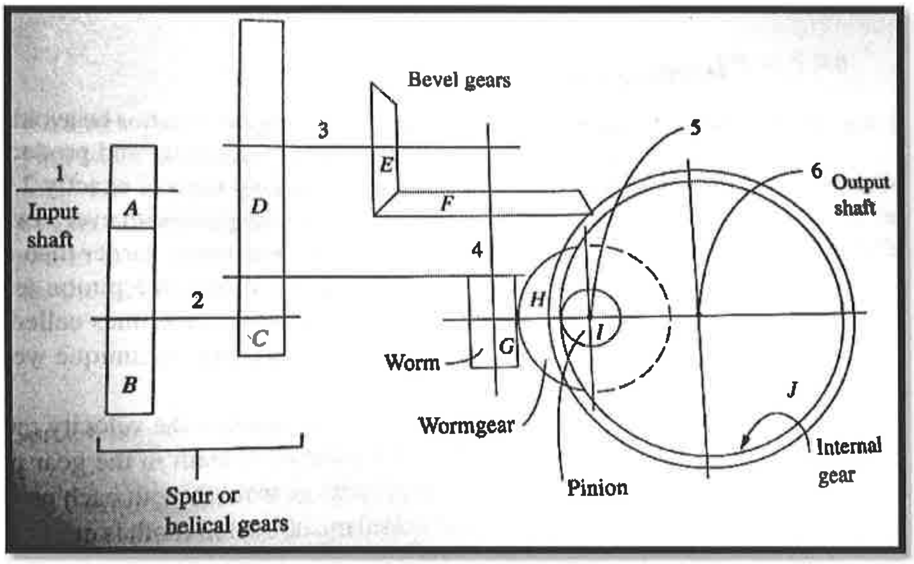

Figure 1

(c) Devise a gear train to reduce an input speed of 1750 rpm to 148 rpm. Use 20° full depth involute teeth and no more than 150 teeth in any gear. Ensure that there is no interference. Sketch the design.

(15 marks)

Question 3

(a) A transmission shaft is basically designed in two bases; *strength basis* and *torsional rigidity basis*. Explain how a transmission shaft is designed when considering the *torsional rigidity basis.*

(6 marks)

(b) A transmission shaft, supporting two pulleys A and B and mounted between two bearings C_1 and C_2 is shown in Figure 2. The shaft transmits 7.5 kW power at 360 rpm from pulley A to B. The diameters of pulley A and B are 200 mm and 300 mm respectively. The belt tensions act vertically downward and ratio of belt tensions on tight side to slack side for each pulley is 2.5:1. The shaft is made of plain carbon steel 45C8 (S_{yt} = 380 N/mm²).

i. Calculate torque supplied to the shaft

(4 marks)

ii. Determine the belt tensions on the tight and lack sides for each pulley

(11 marks)

iii. Estimate the shaft diameter to be used, on the basis of *torsional rigidity*. Given the permissible angle of twist between the two pulleys are 0.5° and the modulus of rigidity is 79300 N/mm².

(4 marks)

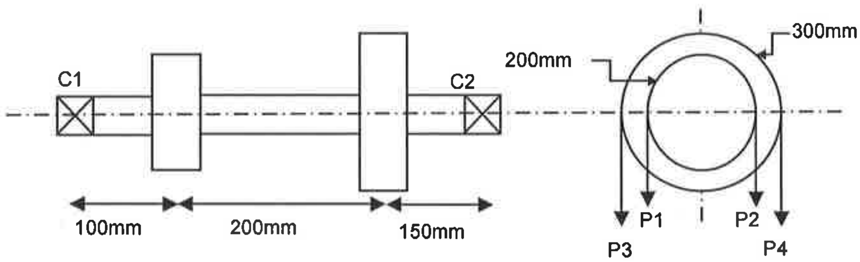

Figure 2

Question 4

(a) In a clutch mechanism, driving and driven members are subjected to *'engaged'* and *'disengaged'* during the operation. Interpret these conditions.

(8 marks)

(b) A single disc clutch with both sides of the disc effective is used to transmit 10 kW power at 900 rpm. The axial pressure is limited to 0.085 N/mm². The external diameter of the friction lining should be 1.25 times the internal diameter and the coefficient of friction may be taken as 0.3. Assume uniform wear condition, analyze:

i. The required inner and outer diameters of the friction lining.

(13 marks)

ii. The axial force exerted by the springs to keep the clutch engaged.

(4 marks)

Question 5

(a) Explain the condition of 'self-locking' brake in a *differential band brake* type and state the two (2) main importance of the application.

(6 marks)

(b) A differential band brake, as shown in Figure 3, has an angle of contact of 225°. The band has a compressed woven lining and bears against a cast iron drum of 350 mm diameter. The brake is to sustain a torque of 350 Nm and the coefficient of friction between the band and the drum is 0.3. Evaluate:

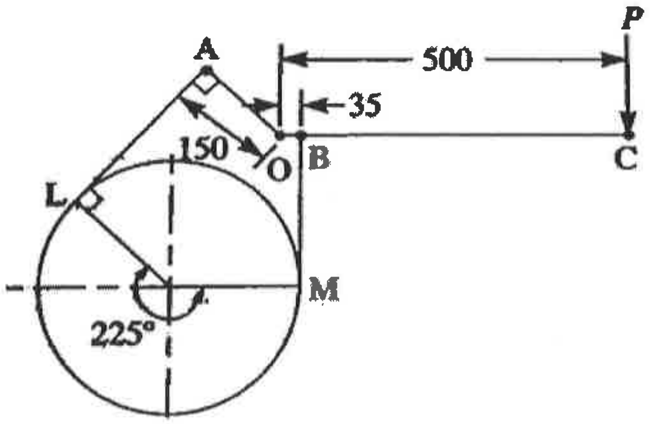

Figure 3

i. The necessary force to be applied to stop the clockwise rotation of the drum.

(10 marks)

ii. The necessary force to be applied when the drum rotates anticlockwise.

(4 marks)

iii. The 'OA' length for the brake to be self-locking, when the drum rotates clockwise.

(5 marks)

END OF QUESTION

APPENDIX

FMB11302 MACHINE ELEMENTS

BELT DRIVES

$$v = \sqrt{\frac{T_{max}}{3m}} \qquad v = \frac{\pi dn}{60(1000)} \qquad kW = \frac{(T_1 - T_2)v}{1000}$$

$$\frac{T_1}{T_2} = e^{f\alpha/\sin(\theta/2)} \qquad \frac{T_1}{T_2} = e^{f\alpha} \qquad T_{max} = T_1 + T_c \qquad T_c = mv^2$$

GEARS

$$TV = \frac{n_{in}}{n_{out}} = (VR1)(VR2)... \qquad VR = \frac{n_A}{n_B} = \frac{N_B}{N_A}$$

SHAFTS

$$M_t = \frac{PX60}{2\pi.n} \qquad M_t = (P_1 - P_2)R \qquad M_b = W \text{ x L}$$

$$\tau_{max} = \frac{16}{\pi d^3}\sqrt{(M_b)^2 + (M_t)^2} \qquad \theta = \frac{584M_t l}{Gd^4}$$

CLUTCHES

$$M_t = \frac{\pi\mu p_a d}{8}(D^2 - d^2) \qquad M_t = \frac{\mu P}{4}(D + d) \qquad M_t = \frac{60X10^6(kW)}{2\pi n}$$

$$P = \frac{\pi p_a d}{2}(D - d)$$

BRAKES

$$\frac{T_1}{T_2} = e^{f\alpha} \qquad T_B = (T_1 - T_2)R \qquad \frac{T_1}{T_2} \geq \frac{a}{b} \qquad \frac{T_2}{T_1} \geq \frac{a}{b}$$