



UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
SEPTEMBER 2014 SESSION

SUBJECT CODE : FMB22202
SUBJECT TITLE : MACHINE DESIGN
LEVEL : BACHELOR
TIME / DURATION : 9.00 AM – 11.30 AM
(2.5 HOURS)
DATE : 5 JANUARY 2015

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.
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THERE ARE 4 PAGES OF QUESTIONS AND 4 PAGES OF APPENDIX, EXCLUDING THIS PAGE.

INSTRUCTION: Answer FOUR (4) questions ONLY.**Please use the answer booklet provided.****Question 1**

- (a) Describe the two main purposes of chain drives. (4 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. 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 moderate shock. Design the chain drive by identifying the following parameters:
- i. Number of teeth on the sprockets and the diameters (7 marks)
 - ii. Suitable chain number to be used and the chain specifications. (5 marks)
 - iii. Factor of safety of the chain drive (5 marks)
 - iv. The chain length (4 marks)

Question 2

- (a) Describe why did the slack side of the belt of a horizontal belt drive is preferable to place on the top side. (4 marks)
- (b) A belt is required to transmit 18.5 kW from a pulley of 1.2 m diameter running at 250 rpm to another pulley which runs at 500 rpm. The distance between the centers of pulleys is 2.7 m. Mass of the belt material is approximately 0.26 kg/m length and the coefficient of friction is 0.25. It is determined that the safe working stress for the belt is 1.75 N/mm². If the thickness of belt is 10mm, analyze the following parameters:

- i. The width and length of belt, taking centrifugal tension into account (18 marks)
- ii. Initial tension in the belt. (3 marks)

Question 3

- (a) In the design of a special speed reducer for a laboratory test stand, it is necessary to transmit power from one rotating shaft to another. The center lines of the two shafts intersect. The driver shaft speed is 3600 rpm and the desired speed of the output shaft is 1200 rpm. Quiet operation is important factor. Identify the types of gearing would you recommend. State your reasons. (4 marks)
- (b) The gear train shown in Figure 1 has an input speed of 720 rpm clockwise and an input torque of 33.9 Nm. Determine the following.

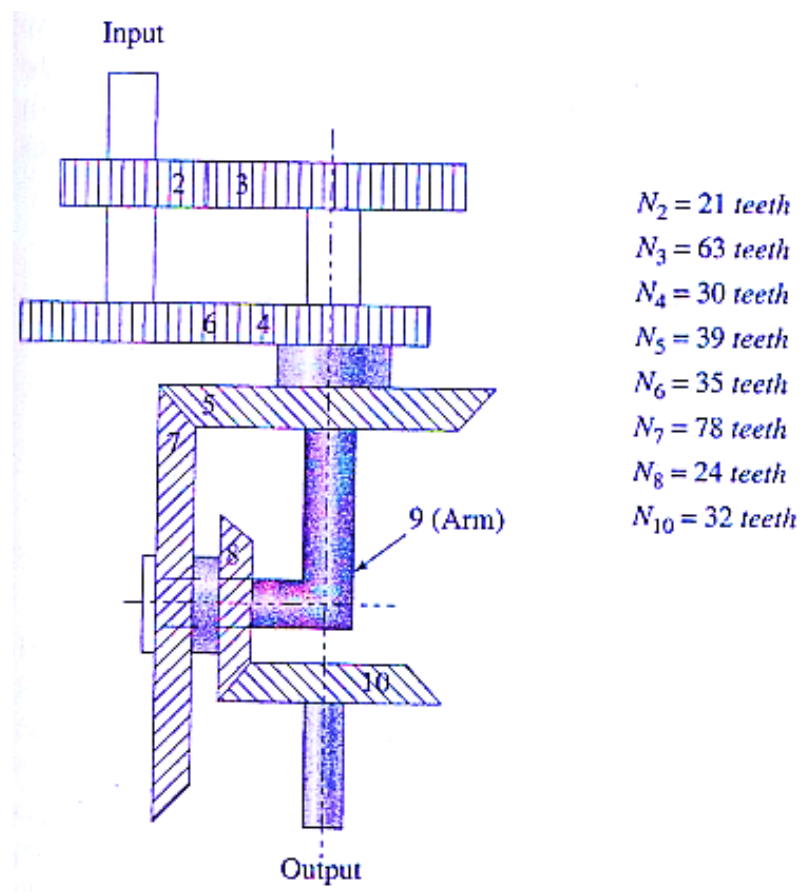


Figure 1

- i. The speed and direction of rotation of the output shaft.
(6 marks)
 - ii. The output torque.
(4 marks)
- (b) A straight-tooth spur gear set is being considered for a simple speed reduction device at an early stage in the design process. It is being proposed to use standard 20° involute full-depth gear teeth with a diametral pitch of 4 and a 16-tooth pinion. A reduction ratio of 2.5 is needed for the application. Compute the following:
- i. Number of teeth on the driven gear.
(2 marks)
 - ii. Circular pitch
(3 marks)
 - iii. Center distance
(3 marks)
 - iv. Analyze whether you expect “interference” to be a problem for this gear mesh.
(3 marks)

Question 4

- (a) A hollow shaft has greater strength and stiffness than solid shaft of equal weight. Explain the factors that contribute to these conditions.
(6 marks)
- (b) A turbine shaft transmits 500 kW power at 900 rpm. The permissible shear stress is 80 N/mm^2 while twist is limited to 0.5° in a length of 2.5 m. Take $G = 0.8 \times 10^5 \text{ N/mm}^2$, on the basis of *torsional rigidity*;
- i. Determine diameter of shaft if solid shaft is used.
(7 marks)
 - ii. If hollow shaft is chosen with $d_i/d_o = 0.6$, determine the suitable diameters of the shaft. Analyze the percentage saving in the material.

(12 marks)

Question 5

(a) Explain the two theories applied in the design of a friction clutch.

(8 marks)

(b) A disk clutch has a single set of mating annular friction surfaces having an outer diameter of 300 mm and inner diameter of 225 mm. The estimated coefficient of friction between the two contacting surfaces is 0.25, and the maximum allowable pressure for the lining material is 825 kPa. At speed 750 rpm, analyze the following:

i. Power transmitting capacity under conditions that make the uniform wear assumption more nearly valid.

(6 marks)

ii. Power transmitting capacity under conditions that make the uniform pressure assumption more nearly valid.

(6 marks)

iii. Evaluate factors that contribute to the difference value of the power transmitting capacity when applying these two different theories.

(5 marks)

END OF QUESTION