UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET	
COURSE CODE	: DMT 2043
COURSE TITLE	: MECHANICS OF MACHINE
SEMESTER/SESSION	: 2-2022/2023
DURATION	: 3 HOURS

Instructions:

1. This booklet contains **FOUR (4)** questions, answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise up your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 6 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

a) Define terms **"SIMPLE MACHINE"** in mechanics of machine. (2 marks)

b) LIST out at least **three (3)** simple machine and give an explanation each of them (4 marks)

c) A lever must have **three (3)** basic elements which are **Effort, Load and Fulcrum**. Describe these elements. (6 marks)

d) Classify **three (3)** categories of lever an give an example of each category (4 marks)

e) Figure 1 below show a wheel barrow.

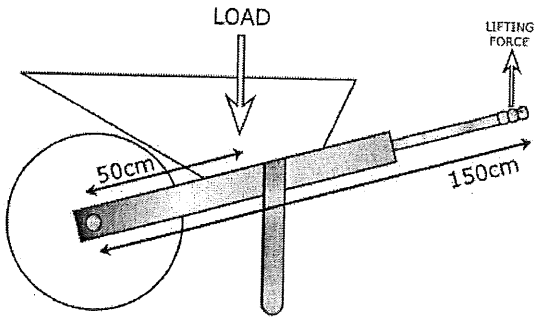

Figure 1: A Wheel Barrow

i. Identify the lever category of wheel barrow (1 mark)

ii. Determine the lifting force needed to overcome load of 360N (4 marks)

QUESTION 2

a) List **two (2)** types of belt considered in this course. (2 marks)

b) Describe why belt must be tensioned in pulley drive system even when the wheel is stationary? (3 marks)

c) A flat belt drives system having tension pulley belt of 110N when stationary. The wheel is 460mm diameter and the coefficient of friction is 0.23. The lap angle is 155° and the wheel speed is 2400rev/min. Compute:

i. The belt velocity. (2 marks)

ii. Tension of each side of the belt (F_1 & F_2) (4 marks)

iii. Power transmitted when the belt is on the point of slipping (2 marks)

d) A pulley system uses a flat belt of cross sectional area of 400mm^2 and density 1600 kg/m^3. The angle of lap is 170° on the smaller wheel. The coefficient of friction is 0.25. The maximum force in the belt is 600N and the wheel is rotate at 960 rev/min. Belt run at 16m/s. Compute

i. Power transmitted if centrifugal forced is included (4 marks)

ii. Power transmitted if centrifugal forced is not included (2 marks)

iii. Initial tension in the belts which consider centrifugal force (2 marks)

QUESTION 3

i. There are **two (2)** theories concerning the torque required to produce slip between the surfaces of a clutch. Explain both of them (4 marks)

ii. Uniform pressure theory formula for conical clutch is given by $T = \frac{\mu R}{3\sin\beta}\left[\frac{D_o^3 - D_i^3}{D_o^2 - D_i^2}\right]n$, show that with steps and explanation, for flat plate clutch, the uniform pressure theory become $T = \frac{\mu R}{3}\left[\frac{D_o^3 - D_i^3}{D_o^2 - D_i^2}\right]n$ (7 marks)

iii. A Conical clutch has an included angle of 80°. The outer and inner diameters are 110 and 30 mm respectively. The coefficient of friction is 0.23. Determine torque and force required to press the halves together if it is to transmit 1200W at 1000 rev/min by using uniform pressure theory

(6 marks)

iv. A multi flat plate clutch must have five contact surfaces and transmits power at 1500 rev/min. The coefficient of friction is 0.4. The inner and outer diameters are 30 and 150 mm respectively. The axial force applied to the plates is 400N. Compute the torque and power that can be transmitted without slipping using

i. Uniform pressure theory (6 marks)

ii. Uniform wear theory (6 marks)

QUESTION 4

a) Define a term "simple gear train". (3 marks)

b) Explain the compound gear train system (2 marks)

c) Describe:-

i. The meaning of **"epicyclic"** in epicyclic gear train (3 marks)

ii. The main components of epicyclic gear train (3 marks)

iii. The advantage of epicyclic gear train (3 marks)

d) A simple gear train has two spur gears. The input gear has 25 teeth and the output gear has 100 teeth. The input rotates at 2000 rev/min clockwise. The input torque is 15Nm and the efficiency is 65%. Compute:-

i. Gear Ratio (2 marks)

ii. Output speed (3 marks)

iii. Output power (4 marks)

iv. Holding torque (6 marks)

----------**End of questions**----------

Criteria	Marks
All questions answered will be marked according to the answer scheme	/100

Formulae

SIMPLE MACHINE

Lever

$$\frac{F_B}{F_A} = \frac{a}{b}$$

BELT DRIVE

Belt Velocity

$$v = \pi ND$$

Force in belt drive

$$\frac{F_1}{F_2} = e^{\mu\theta}$$

Initial tension

$$F_{initial} = (F_1 + F_2)/2$$

Power transmitted

$$P = v(F_1 - F_2)$$

Centrifugal force

$$F_C = \rho A v^2$$

Power transmitted (include centrifugal force)

$$P = v(F_1 - F_C)(1 - e^{\mu\theta})$$

FRICTION CLUTCH

Uniform wear theory

$$T = \frac{\mu R}{4\sin\beta}\left[D_o + D_i\right]n$$

Power transmitted

$$P = 2\pi NT$$

GEAR TRAIN

Power output

$$P_{output} = \eta P_{input}$$

Gear ratio

$$G.R = \frac{N_{input}}{N_{output}} = \frac{t_{output}}{t_{input}}$$

Holding Torque

$$T_{holding} + T_{output} + T_{input} = 0$$