



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION 2013/2014

THIRD YEAR FIRST SEMESTER UNIVERSITY EXAMINATION FOR THE
DEGREE OF BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2311 : DESIGN OF TRANSMISSION SYSTEMS

TIME: 2 HOURS

SERIES: DECEMBER, 2013

INSTRUCTIONS TO CANDIDATES

1. You are required to have the following for these examinations:
 - Drawing Instruments
 - Scientific Calculator
2. This paper has **FIVE** Questions.
3. Answer **ANY THREE** Questions.
4. All Questions carry equal marks.
5. This paper consists of **FOUR Printed pages**.

QUESTION 1

(a) Illustrate with neat sketches the profiles of the following threads:

- (i) Square
- (ii) Acme
- (iii) Buttress
- (iv) Metric ISO thread

(8 marks)

(b) A square thread power screw has a major diameter of 32mm and a pitch of 4mm with double threads, and it is to be used for lifting operations. Calculate:

- (i) Thread depth
- (ii) Thread width
- (iii) Mean or pitch diameter
- (iv) Minor diameter
- (v) Lead

Use neat sketch to show clearly these elements.

(7marks)

- (c) A transport vehicle fuel tank contains 400kg of diesel oil. The tank is positioned underneath the body and it is supported by 6 bolts of high tensile steel. If the maximum allowable tensile stress for the bolts material is not to exceed 42N/mm^2 , recommended the size of the bolts to be used. **(5 marks)**

QUESTION 2

In the epicyclic reduction gear shown in Figure Q2 the sun wheel D has 60T and is keyed to the input shaft. Two planet wheels B, each having 30T, gear with D and are carried by arm A fixed to the output shaft. The wheels B also mesh with an internal gear C which is fixed. The input shaft rotates at 1800rpm. Determine the speed of the output shaft and torque required to fix C when the gears are transmitting 30kW. **(20 marks)**

QUESTION 3

- (a) Show that the torque required to accelerate two gears A and B which are in contact is given by:

$$T = [I_a + n_{ba}^2 I_b] \alpha_a$$

Where:

T	=	Torque required to accelerate both gears from gear A.
I_a	=	Moment of inertia of gear A and its shaft
I_b	=	Moment of inertia of gear B and its shaft
n	=	Velocity ratio between gears A and B
α_a	=	Angular acceleration of gear A

(8 marks)

- (b) A hoist with drum of diameter 1m lifts a cage by means of a wire rope that winds on the drum. The drum is driven by an electric motor through double reduction gear. Determine the motor torque to give the cage acceleration upwards of 1.2m/s^2 , given the following:

	Speed in rev/min	Mass Kg	K mm
Rotor of motor and pinion	720	120	60
Intermediate gear	170	180	120
Low speed gear	75	450	325
Drum and shaft	75	550	275
Cage	-	900	-
Rope (Rising)	-	225	-

(12 marks)

QUESTION 4

Design a muff coupling to be used to connect two shaft transmitting 40kW at 360 rpm. The material for the key is plain carbon steel with allowable shear stress and crushing stress of 42 and 84 MPa respectively. The material for the muff is cast iron for which the allowable shear stress maybe taken as 15MPa.

(20 marks)

QUESTION 5

- (a) List **FOUR** requirements of materials to be used for; Timing friction surfaces of clutches.
- (b) Explain with help of sketches the principles of operation of a centrifugal clutch and show that torque transmitted.

$$T = n\mu R(F - P)$$

Where:

- T = Torque transmitted in N – M
 F = Centrifugal Force in each shoe in N
 P = Inward Force on each shoe exerted by spring in N
 R = Inside radius of the rim
 μ = Coefficient of friction
 n = Number of shoes

(12 marks)

- (c) A plate clutch has four pairs of contact surfaces each of 360mm external diameter and 240mm internal diameter. Assuming uniform pressure, find the total spring load pressing the plates together to transmit 36KW at 600rpm. Take $\mu = 0.3$.

(4 marks)