TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Electrical & Electronics Engineering
UNIVERSITY EXAMINATION FOR:
Diploma in Electrical Engineering (Y2S1)
EME 2230 : Mechanical Technology (Paper 2)
SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: SEPTEMBER 2018
TIME: 2 HOURS
DATE: Sep 2018

Instruction to Candidates:
You should have the following for this examination
- *Examination Pass & Student ID Card*
- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt any **THREE** questions.
Maximum marks for each part of a question are as shown.
Do not write on the question paper.

Question ONE

a) With the aid of a sketch, illustrate the following types of riveted joints.   **(2 marks)**
   i.   Single riveted lap joint
   ii.   Single riveted double strap butt joint

b) Define the following terms as used in riveted joints.   **(5 marks)**
   i.   Pitch
   ii.   Back pitch
   iii. Marginal pitch

c) A double riveted lap joint is made between 15 mm thick plates. The rivet diameter
   and pitch are 25 mm and 75 mm respectively. If the ultimate stresses are 400 MPa in
   tension, 320 MPa in shear and 640 MPa in crushing, find the minimum force per pitch
   which will rupture the joint. If the above joint is subjected to a load such that the
   factor of safety is 4, find out the actual stresses developed in the plates and the rivets.
                                                                                   (10 marks)

d) With the aid of a well labelled sketch, show the parts of a rivet. **(3 marks)**

Question TWO

a) Define the following terms as used in gear transmission: **(5 marks)**
   i. Pitch circle
   ii. Pitch Point
   iii. Pressure angle
   iv. Addendum
   v. Circular pitch

b) Two gear wheels mesh externally and are to give a velocity ratio of 3 to 1. The teeth are of involute form; module = 6 mm, addendum = one module, pressure angle = 20°. The pinion rotates at 90 rpm. Determine: **(12 marks)**
   i. The number of teeth on the pinion to avoid interference on it and the corresponding number of teeth on the wheel,
   ii. The length of path and arc of contact,
   iii. The number of pairs of teeth in contact,
   iv. The maximum velocity of sliding.

c) List five advantages of using gears in power transmission **(3 marks)**

Question THREE

a) List five advantages of a chain drive over a belt drive. **(5 marks)**

b) A chain drive is used for reduction of speed from 240 rpm to 120 rpm. The number of teeth on the driving sprocket is 20. If the pitch circle diameter of the driven sprocket is 600 mm and centre to centre distance between the two sprockets is 800 mm, determine: **(8 marks)**
   i. The number of teeth on the driven sprocket.
   ii. The pitch
   iii. Length of the chain.

c) Define the following terms as used in chain drives: **(3 marks)**
   i. Pitch of the chain
   ii. Pitch circle diameter
   iii. Factor of safety

d) List four engineering applications of chains **(4 marks)**

Question FOUR

a) List five factors that influence the selection of a belt drive. **(5 marks)**

b) Show that for maximum power transmission: **(8 marks)**
$$T = 3T_c$$
   Where: T is the maximum tension to which the belt can be subjected.
   T_c is the centrifugal tension.

c) Two pulleys, 450 mm and 200 mm diameter are fixed on parallel shafts 1.95 m apart and are connected by a crossed belt. Find: **(4 marks)**
    i.   the length of the belt required,
    ii.   the angle of contact between them.
d) From the Q.4 (c), If power is transmitted when the larger pulley rotates at 200 rev/min, and the maximum permissible tension in the belt is 1 kN, and the coefficient of friction μ = 0.25, Find the power transmitted. **(3 marks)**

Question FIVE
a) Show that for a Carnot cycle, thermal efficiency is given by: **(5 marks)**

$$\eta_{\text{thermal}} = 1 - \frac{T_2}{T_1}$$

Where: T_2 is the lower temperature and T_1 is the higher temperature.
b) 0.5 kg of air (ideal gas) executes a Carnot power cycle having a thermal efficiency of 50 %. The heat transfer to the air during the isothermal expansion is 40 kJ. At the beginning of the isothermal expansion the pressure is 7 bar and the volume is 0.12 m³. Determine:
    i.   The maximum and minimum temperatures for the cycle in K.
    ii.   The volume at the end of isothermal expansion in m³.
    iii. The heat transfer for each of the four processes in kJ.
        (For air c_v = 0.721 kJ/kg ·K, and c_p = 1.008 kJ/kg ·K).

(9 marks)
c) With the aid of a graphical representation explain the processes of a Rankine cycle.
(6 marks)