FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGERIA
SCHOOL OF ELECTRICAL ENGINEERING AND TECHNOLOGY
DEPARTMENT OF MECHATRONICS ENGINEERING
SECOND SEMESTER 2017/2018 B.Eng. DEGREE EXAMINATION
COURSE : MCE 321: Design of Machine Elements
**INSTRUCTION: Attempt four questions in all, and atleast question 5
or 6 is compulsory. All questions carry equal mark.**
TIME ALLOWED: 3 Hours

Q1.   An elemental part shaft of a flying robot subjected to combined stresses is expanded as
       shown in figure 1. Determine using Morh's circle method:
a)   The principal planes.   5 marks
b)   The principal stresses.   5 marks
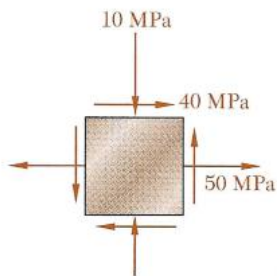c)   The maximum shear stress and the corresponding normal stress.   5 marks
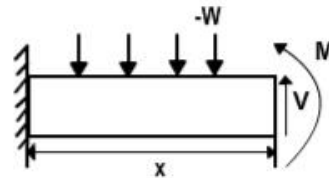

Figure 1:   Figure 2:

Q2.   Part of the supporting structure of a robotic arm is shown in figure 2. W = 0.5 N/m and x
       = 200cm. Determine the maximum shear force and bending moment. And plot them.
                                                                                   15marks

Q3a)   From first principle derive the principal stress equations 1 and 2 for a stress at a point in
       body.   8 Marks

b).   The state of plane stress at a point extracted from a component in a moving mobile robot
       is represented by the stress element below. Determine the principal stresses and their
       angles.   7 Marks
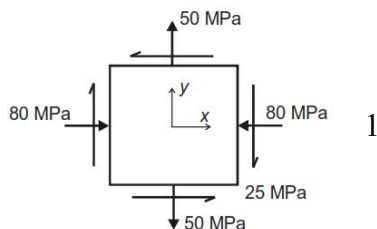
$$\sigma_{1,2} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\tan 2\theta_p = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$$

Q4a). An engineer design a conveyor system for transporting fruits can in a production line. What are the factors he/she need to consider in selecting a belt drive?   4 marks

b). State the possible belt type he/she can used in the design.   3 marks

c) The pulley of a lathe machine is driven by a flat belt running at a speed of 600 m/min. the coefficient of friction between the pulley and the belt is 0.3 and the angle of lap is 160o. If the maximum tension in the belt is 700 N. Find the power transmitted by a belt. 8 marks

Q5a) What constitute gear train? Hence using diagrams only, show the following gear trains; simple, compound, reverted and planetary types respectively.   7 Marks

b) In a planetary gear train, gear1 was fixed: Calculate for number of teeth in gear2, given that gear1 had 40 teeth. The ratio of speed of gear2 to arm was 3:2.   3 Marks

c) What is brake? List three main types of brakes   5 Marks

Q6a) With supporting diagram, show what cam and follower type is used in a sewing machine's needle mechanism.   2 Marks

b) Show the follower displacement diagram for a 1440° cycles of operation.   8 Marks

c) List five factors you would need to consider as an engineer in charge of brake selection for a company you work for when you graduate from F.U.T. Minna. 5Marks