NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

SOLID MECHANICS I

TIE 2103

First Semester Supplementary Examination Paper

August 2015

This examination paper consists of 4 printed pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: None

Examiner's Name: Nicholas Tayisepi

INSTRUCTIONS AND INFORMATION TO CANDIDATE

1. Answer any four (4) questions.
2. Each question carries 25 marks.
3. Use of calculators is permissible.

MARK ALLOCATION

QUESTION	MARKS
1.	**25**
2.	**25**
3.	**25**
4.	**25**
5.	**25**
6.	**25**
TOTAL MARKS ATTAINABLE BY CANDIDATE	**100**

Question One

A beam AB 4 m long is simply supported at both ends. It carries point loads at C, 15 kN in magnitude and another one at D 30 kN, 2m from C. Point C is 2 m from A. The beam also carries a Uniformly Distributed Load of 10 kN/m between C and D. Draw, for the set-up:

a) the shear force diagram, **[15]**

b) the bending moment diagram. **[10]**

Question Two

A copper transmission shaft is 600 mm long and external diameter 60 mm. It is bored to diameter 30 mm for half its length and to diameter 40 mm for the rest of its length. Determine the maximum power transmitted when the shaft rotates at 240 revolutions per minute and the shear stress is not to exceed 60 MN/m^2. **[25]**

Question Three

Calculate the thickness and number of leaves of a semi- elliptic carriage spring which is required to support a 3 kN central load on a span of 1.5 m if the maximum stress is limited to 200 MN/m^2 and central deflection to 85 mm. Use a breadth of 100 mm for each load and E = 200 GN/m^2. **[25]**

Question Four

Determine the slope and deflection for a cantilever, 6 m long if it carries a Uniformly Distributed Load (UDL) of 30 kN/m length over the whole length. **[25]**

Question Five

The part shown in Figure Qu5 is part of the support structure of a machine mounting in a production factory. It is effectively loaded by P_A, P_B and P_C at the points as shown on the diagram .The machine part forms a prismatic bar. At the loading regime shown:

(a) draw a free-body diagram of the system **[7]**

(b) determine the internal axial force N **[7]**

(c) write an expression of the magnitude of the elongation which the bar experiences under the loading arrangement. **[6]**

(d) If P_A = 30 kN , P_B = 10 kN ,P_C = 20 kN. If $L_1 = L_2 = (4/3)L_3$. Determine the change in length of the bar. **[5]**

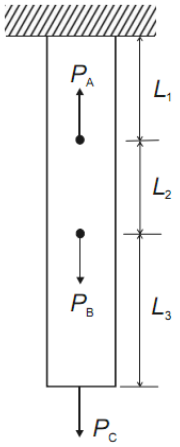

Figure Qu5

Question Six

A hallow shift transmits 6 kW at 200 revs/min at a maximum allowable stress which is not to exceed 70 MN/m^2 nor an angle of twist of 0.5° per metre length of the shaft. If the outside diameter of the shaft is 280mm, find the minimum thickness of the hollow shaft to satisfy the above conditions. G = 90 GN/m^2. **[25]**

……End of Examination……