NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

Bachelor of Engineering (Hons) Degree in Industrial and Manufacturing Engineering

APPLIED MECHANICS TIE 1206

Second Semester Main Examination Paper

May 2015

This examination paper consists of six (6) printed pages

Time Allowed: 3 hours

Total Marks: 100

Examiner's Name: Mr. W. Tumbudzuku

INSTRUCTIONS AND INFORMATION TO THE CANDIDATE:

1. Answer any **five (5)** questions.
2. Each question carries 20 marks.
3. Use of calculators is permissible.

Question 1

(a) Explain the term "Force" and list its characteristics. [4]
(b) Explain the terms concurrent and non-concurrent force systems; planar and non-planar System of forces. [4]
(c) Mechanics may be grouped into the following categories. Explain the philosophy behind.

(i) Classical/Newtonian mechanics, [4]
(ii) Relativistic mechanics, [4]
(iii) Quantum /Wave mechanics. [4]

Question 2

(a) With the aid of diagrams, explain the following methods of vector addition:

(i) Parallelogram law of forces, [3]
(ii) Algebraic addition. [3]

(b) For the diagram shown in Figure Q2b, determine the tension in the cables if the weight of the block is 300kG. [6]

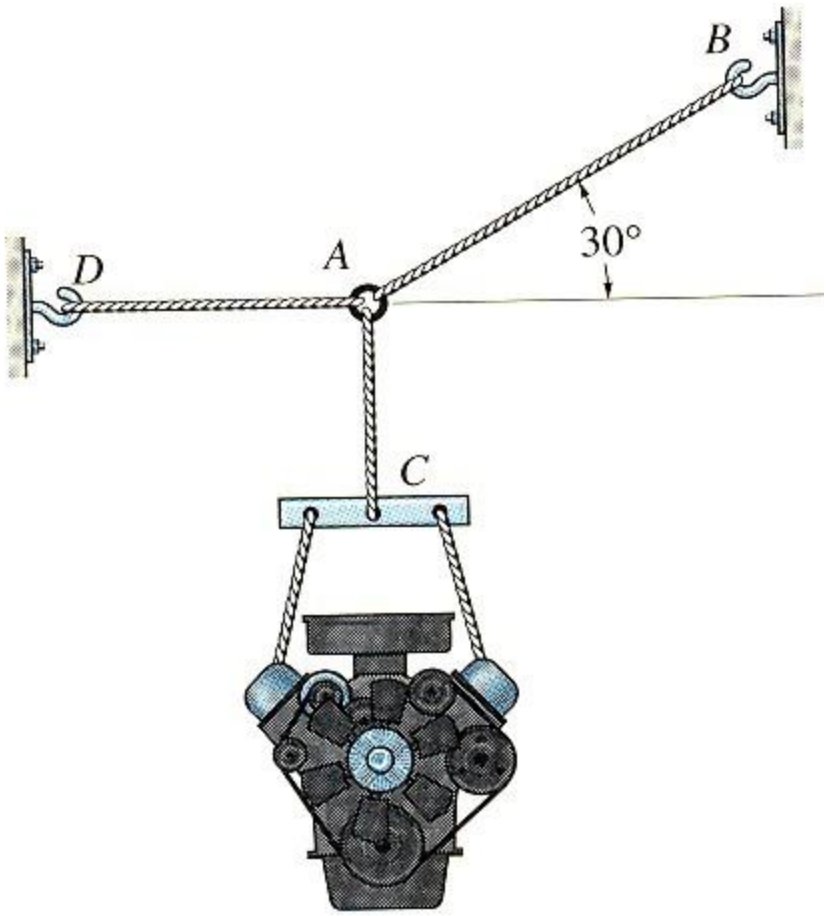

Figure Q 2b Cables under loading

(c) Determine the resultant moment of the four forces acting on the rod about point O shown in figure Q2c. [8]

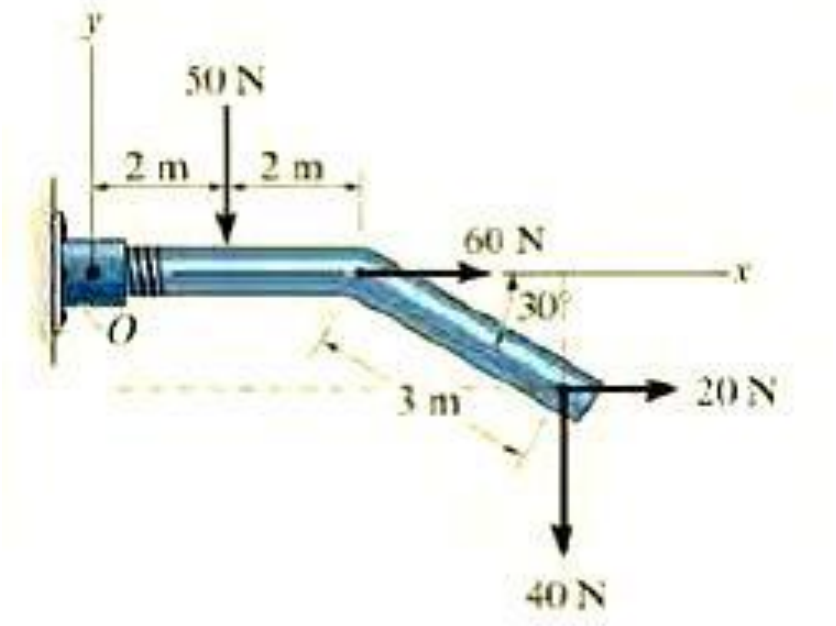

Figure Q2c Rod under loading

Question 3

(a) For the structure under loading as shown in Figure Q3,determine the reactions at the supports. [4]

(b) Determine forces in all the members using method of joints. Mention whether the members are in tension or compression. [16]

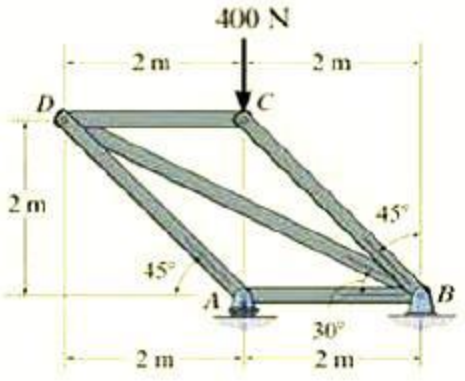

Figure Q3 Structure under loading.

Question 4

For the truss shown in Figure Q4 determine forces inmembers HG,BG,BC,GE,CE and CD using method of sections given that L=10m and P is 15KN. [20]

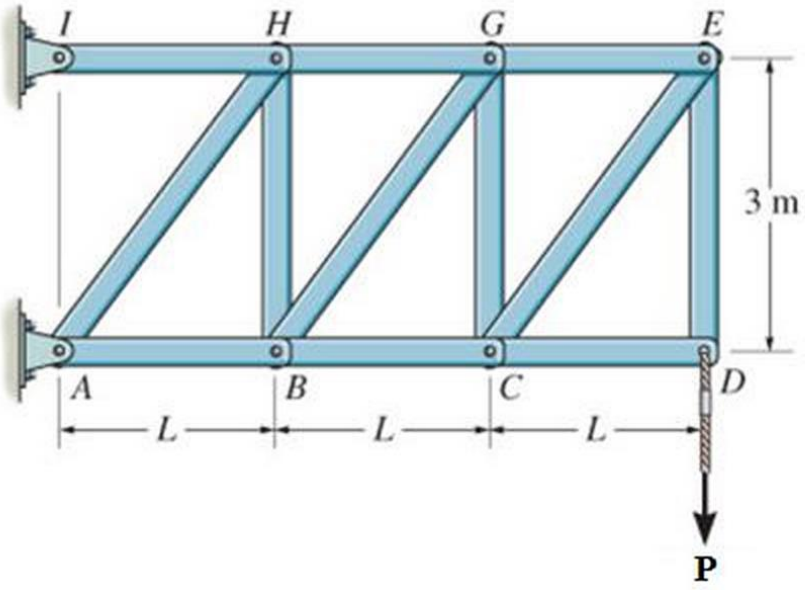

Figure Q4 Truss under loading.

Question 5

(a) Mention the types of loading found in beams. [4]
(b) The beam is loaded and supported as shown in Fig Q5b. Write equations for the shear force V and the bending moment M for any section of the beam. [10]
(c) Draw the shear force and bending moment diagrams for the beam under Figure Q5b loading. [6]

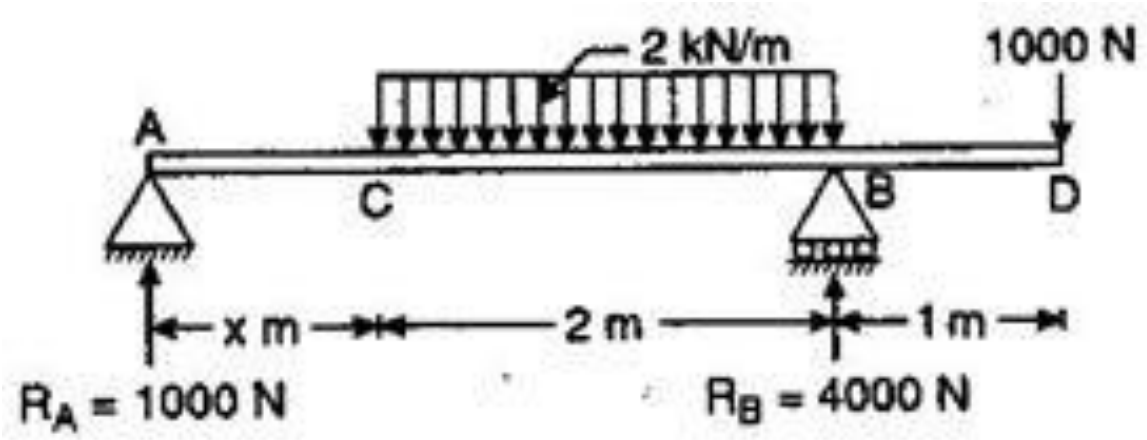

Figure Q5b Beam under loading.

Question 6

(a) With the aid of the diagram in figure Q 6a, derive an expression for the variation of the shear force versus the intensity as well as the bending moment versus the shear force from first principles. [8]

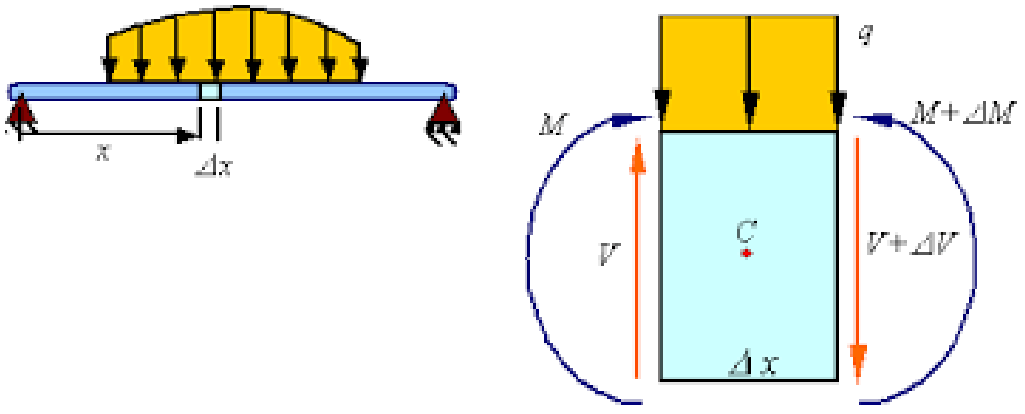

Figure Q6a Relationship between the intensity, shear force and bending moment.

(b) A parabolic shape is defined by the equation $y=x^3$ for the given values, $0 \leq x \leq 4$and $0 \leq y \leq 12$. Locate the centroidal axis about the x and y axis from first principles. [12]

Question7

(a) Derive an expression for the parallel axis theorem. [6]

(b) With reference to Figure Q7c determine centroid about the x' and y' axis. [8]

(c) Also determine the centroid of the rectangle in Figure Q6c about the

x_b and y_b axis. [6]

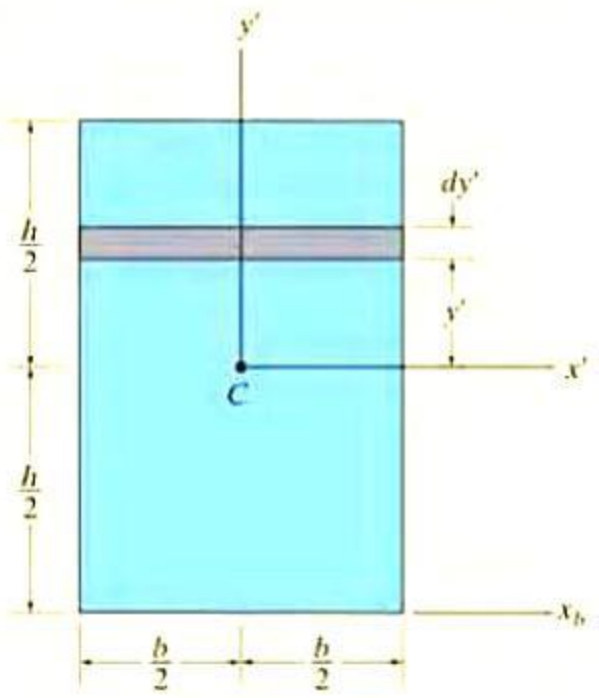

Figure Q7c Rectangular shape

End of Examination