UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

MAIN EXAMINATION, FIRST SEMESTER DECEMBER 2011

TITLE OF PAPER:	**ENGINEERING MECHANICS AND MATERIALS SCIENCE**
COURSE CODE:	**EE201**
TIME ALLOWED:	**THREE HOURS**

INSTRUCTIONS:

1. Answer any **four (4) questions**
2. Each question carries 25 marks.
3. Marks for different sections are shown in the right-hand margin.

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This paper has 4 pages including this page.

Question 1

Determine the forces in members AB, BD, CD, and CE of the roof truss shown in Figure1. (25 marks)

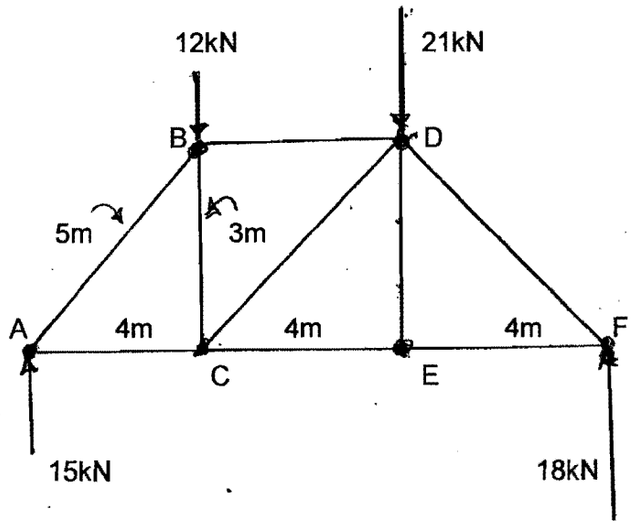

Figure 1

Question 2

An internal combustion engine of 65 horsepower (hp) transmits power to the car wheels of an automobile at 1000rev/min (rpm). (Note that 1hp = 745.7W)

a) Determine the torque available from the engine. (6 marks)

b) Neglecting any transmission losses, and if the maximum shear stress in the shaft is limited to 70MPa, determine the minimum permissible external diameter of hollow steel shaft with a wall thickness of one tenth (1/10) of the external diameter. (14 marks)

Note: The polar second moment of area of a hollow shaft,

$$J = \frac{\pi}{32}\left[\left(External\_diameter\right)^4 - \left(Internal\_diameter\right)^4\right]$$

c) What would be the resulting angle of twist, due to the applied torque, over a length of 2 m and a shaft diameter of 60 mm, given that the rigidity modulus is 50GPa? (5 marks)

Question 3

A block B in Figure 3 weighs 25 N and is attached to a weightless cord which is wrapped around disk A, causing it to rotate about its centroidal axis. The disk A has its moment of inertia I_C equal to 0.2 m.N.sec^2. A constant bearing-friction moment FM of 0.75 Nm resists rotation. After 1 second, determine the angular acceleration of the disk A, the linear acceleration of block B, and the tension T in the cord.

(25 marks)

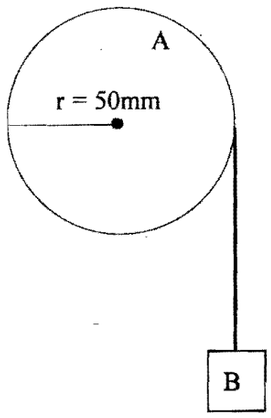

Figure 3

Question 4

a) It is said that uses of aluminium and its alloys are limitless, so list the uses of aluminium in:

i) Electrical engineering. (4 marks)

ii) Structural and civil engineering. (4 marks)

iii) Household. (4 marks)

b) What are the uses of each of the following types of types of plastics:

i) Aminos. (4 marks)

ii) Acrylonitrile-butadiene-styrene (ABS). (5 marks)

iii) Polymethyl methacrylate (acrylic group of plastics, or Perspex). (4 marks)

Question 5

What is each of the following processes and why is each process carried out?

i) Annealing process. (6 marks)
ii) Normalizing process. (7 marks)
iii) Hardening process. (6 marks)
iv) Tempering process. (6 marks)