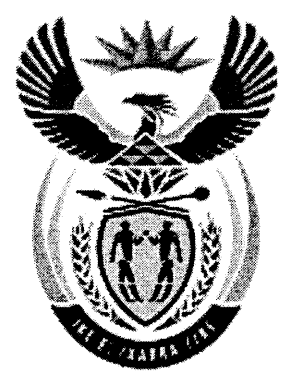


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Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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APRIL 2011

NATIONAL CERTIFICATE

MECHANICAL DRAWING AND DESIGN N6

(8090086)

24 March (X-Paper)
09:00 – 13:00

OPEN-BOOK EXAMINATION.

This question paper consists of 4 pages.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
MECHANICAL DRAWING AND DESIGN N6
TIME: 4 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
 2. Read ALL the questions carefully.
 3. Number the answers correctly according to the numbering system used in this question paper.
 4. A correct answer is worth only one mark. Show ALL the steps to achieve as many marks as possible. (An incorrect answer which must be carried forward will receive fair consideration.)
 5. One mark = 1 percent.
 6. Candidates may use personal notes.
 7. ALL work you do not want to be marked, must be clearly crossed out.
 8. Write neatly and legibly.
-

QUESTION 1

Design a gear on a shaft with a diameter of 40 mm. The involute gear system is 20° full depth. The static stress is 140 MPa with a module of 5. The gear has 30 teeth and rotates at 720 r/min. Use 4 spokes with a bending stress of 70 MPa. The spokes are rectangular with the depth twice the width. Assume the power transmitted as 24,6 kW.

[22]

QUESTION 2

A centrifugal friction clutch has a driving member consisting of a spider carrying four shoes which can slide radially in grooves in the spider. This movement is resisted by flat springs in each shoe until the increase of centrifugal force on the shoes during rotation overcomes the resistance of the springs. The clutch transmits 30 kW at 960 r/min and engagement commences at approximately 600 r/min. The inside diameter of the drum is 300 mm. The coefficient of friction is 0,3. The centre of gravity of each shoe from the shaft axis is 110 mm when the shoes make contact with the drum. The flat spring in each shoe has a stiffness of 180 kN/m.

Determine the following:

- 2.1 The mass of each shoe
- 2.2 The speed in r/min at which engagement would commence as well as the power that could be transmitted at 1 000 r/min, if each shoe has worn down by 2 mm

(6)

(16)
[22]

QUESTION 3

A link of a machine is made from a pipe with a diameter ratio of 0,7. The effective length is 2 m and the ultimate stress is 600 MPa. Use an end-fixing constant of $\frac{1}{7500}$ and a factor of safety of 6 to calculate the dimensions of the link if the compressive load is 6 000 kg.

[20]

QUESTION 4

Two journals of a shaft 300 mm in diameter carry a flywheel with a weight 98 kN which is positioned one metre from the centerline of the left-hand bearing. The centre distance between the two bearings (journals) is 2 metres.

If the friction coefficient is 0,08 when the shaft rotates at 200 r/min, calculate the following:

- 4.1 The power loss due to friction
- 4.2 The bending stress induced in the shaft

(4)

(3)

- 4.3 The quantity of cooling oil in litres per minute that flows through each bearing to absorb the heat generated

Specific heat capacity of oil is 3,14 kJ/kg °C. Specific weight is 0,85 kg/L.
The oil enters at 25 °C and leaves the bearing at 63 °C

(4)

- 4.4 The journal length and the power transmitted if the flywheel transmits a torque of 9,5 kNm. Bearing pressure is 230 kPa .

(1)

[12]

QUESTION 5

In the lifting crab, shown in FIGURE 1 below, the pinion A is fixed to the shaft XY which is driven by a motor providing a torque of 180 Nm at 1 200 r/min. The pinion C and gear wheel B are fixed to the shaft WZ. The gear wheel D and pinion E are fixed together but are loose on the shaft XY. The gear wheel F and drum G are fixed together but are loose on the shaft WZ. The number of teeth on gears A, B, C, D, E and F are 25, 100, 30, 95, 22 and 128 respectively. All the gears are 20° full depth involute and the modules for all the gears is 6 mm.

Calculate the following:

- 5.1 The maximum load in kg that can be lifted if the drum has a diameter of 500 mm (neglect friction)

(6)

- 5.2 The diameters of shafts XY and WZ if the shear stress may not exceed 45 MPa (ignore the effect of bending)

(4)

- 5.3 The width of gears A, B, C and D using the Lewis equation (check your answers). Gears A and B have a basic stress of 80 MPa. Gears C and D have a basic stress of 98 MPa.

(14)

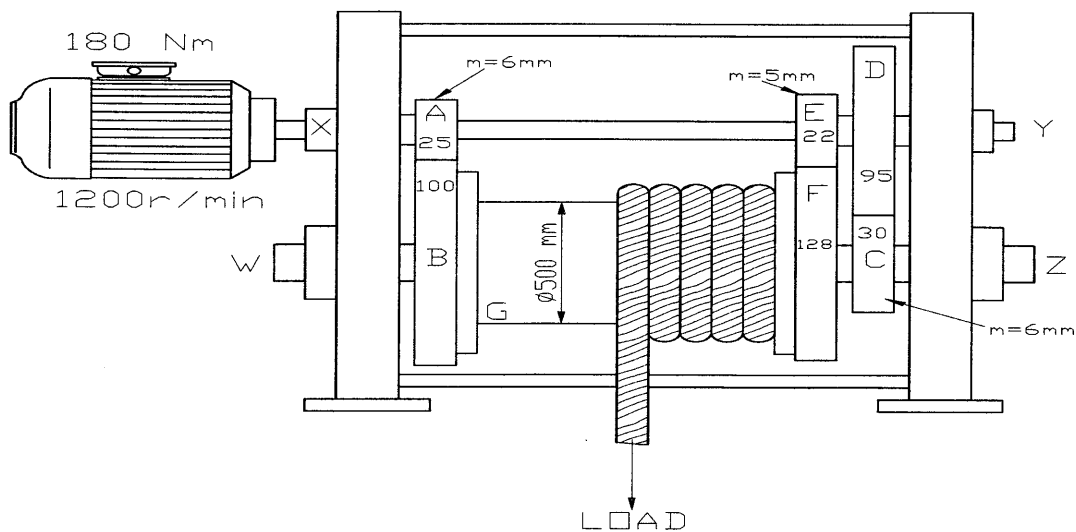


FIGURE 1

TOTAL: [24]
100