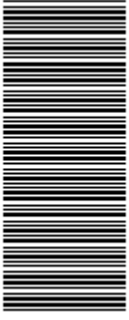


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**higher education
& training**

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

**T1150(E)(N14)T
NOVEMBER 2012**

NATIONAL CERTIFICATE

MECHANICAL DRAWING AND DESIGN N6

(8090086)

**14 November (X-Paper)
09:00 – 13:00**

OPEN-BOOK EXAMINATION.

This question paper consists of 5 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. Number the answers according to the numbering system used in this question paper.
 3. ALL work you do NOT want to be marked must be clearly crossed out.
 4. A correct answer is worth only ONE mark. Show ALL the steps to obtain as many marks as possible. (An incorrect answer which must be carried forward will receive fair consideration.)
 5. One mark = 1%.
 6. Write neatly and legibly.
-

QUESTION 1

The diagram shows a part of a gear reduction unit. The pinion has 25 teeth with a tooth module of 8 mm, rotates at 1 000 r/min and delivers 150 kW. The transmission ratio is 5:1. The spur gear has a mass of 40 kg and is mounted on a hollow shaft with an inside diameter four-tenths of the outside diameter ($d = 0,4 D$).

Consider a temporary overload of 10% when determining the hollow shaft torque.

Calculate the following:

- 1.1 The hollow shaft diameters for combined stresses. Use the following stresses:

Tensile stress : 60 MPa

Shear stress : 50 MPa

(24)

- 1.2 The tooth width for the gear pair. Use the Lewis formula for the gear width calculations. Check the answers.

The spur gear has a basic stress of 250 MPa and the pinion has a basic stress of 320 MPa.

(12)

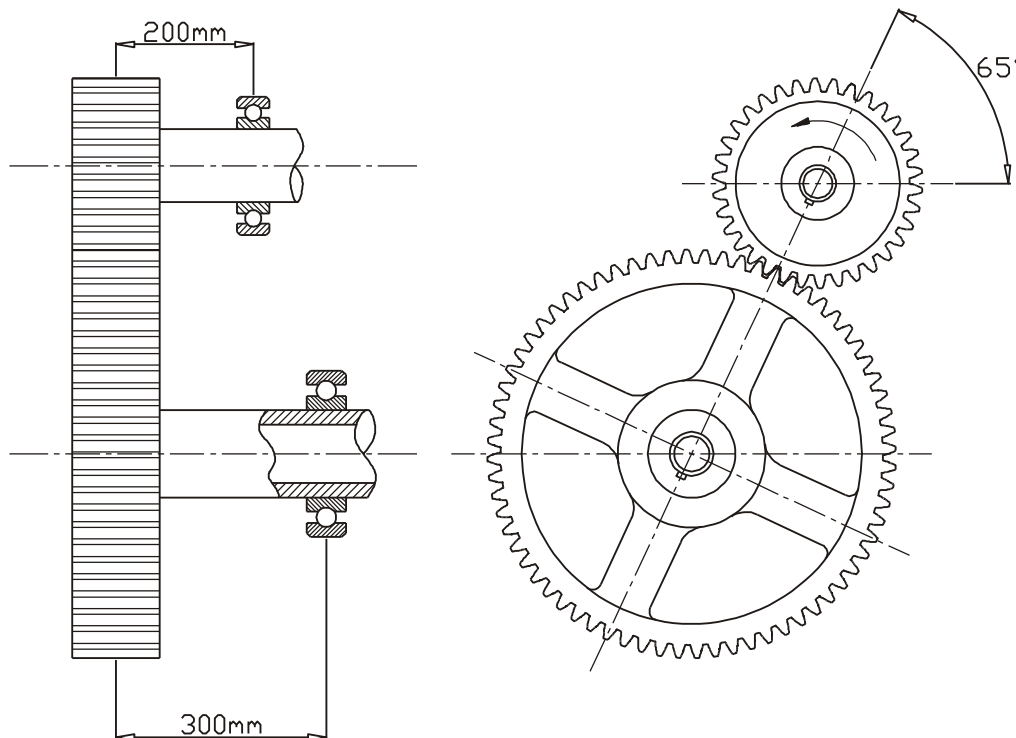
- 1.3 ALL the required gear wheel dimensions including the boss, key, outside diameter and spoke sizes.

Gear wheel spokes : 4

Ratio of axis of elliptical spokes : 2 : 1

Allowable bending stress in arms : 16 MPa

(12)



[48]

QUESTION 2

Collar bearings are used to support a shaft with an axial load of 150 kN. The shaft rotates at 400 r/min. The outside diameter of the collar bearings is 250 mm and the inside diameter is 80 mm. The average permissible intensity of normal pressure on the collars is 250 kPa and the coefficient of friction is 0,03.

Determine the following:

- 2.1 The number of collars required (2)
- 2.2 The actual intensity of normal pressure on the collars (2)
- 2.3 The torque required to overcome friction in the bearings (4)
- 2.4 The heat generated in J/s at the bearings (3)
- 2.5 The amount of cooling oil which must be circulated through the bearings in litres per minute to absorb the heat generated if the specific heat capacity of the oil is 1,8 kJ/kg °C. The density of the oil is 800 kg/m³. The difference in oil temperature between exit and entrance is 30 °C. (4)

[15]**QUESTION 3**

A single-plate clutch has inside and outside diameters of 160 mm and 300 mm respectively. The friction material provides a coefficient of friction of 0,4 when in contact with the flywheel. The maximum engine torque is 245 Nm. A clamping force of 1 200 N is provided by each of the EIGHT springs when the springs are compressed to 6 mm.

Calculate the following:

- 3.1 The factor of safety with respect to slippage when the clutch is new (uniform pressure) (6)
- 3.2 The factor of safety with respect to slippage after initial wear has taken place (uniform wear) (4)
- 3.3 How much can the friction material wear before the clutch will slip? (4)
- 3.4 The power transmitted at 900 r/min (uniform wear) (1)

[15]

QUESTION 4

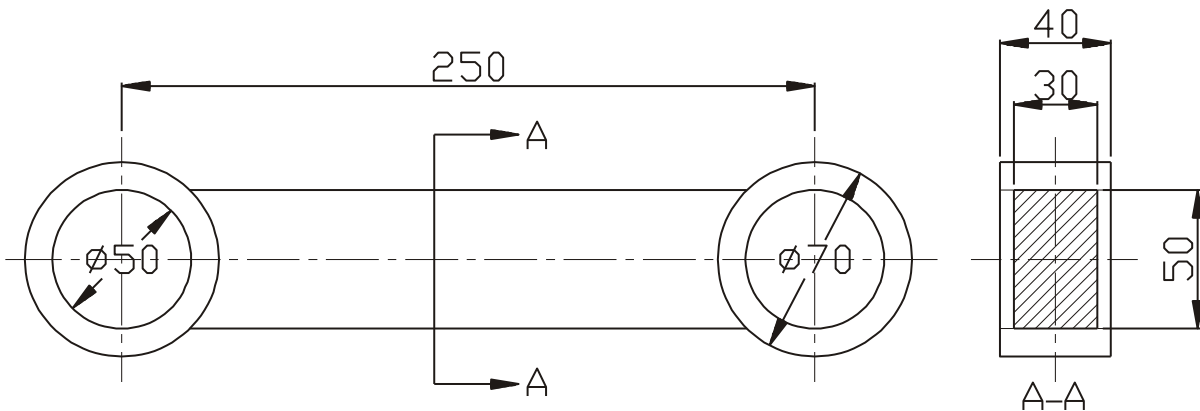
The diagram shows a mild steel compression member.

The 50 mm diameter pins each has a bearing surface length of 40 mm and when the member is in compression the bearing pressure in the eye portion is 8 MPa.

Regard the member as a column with the end fixation conditions as follows:

- 4.1 Relative to the X-X axis the ends may be regarded as pivoted (hinged)
- 4.2 Relative to the Y-Y axis the ends may be regarded as fixed.

Use the Rankine formula with appropriate constants and determine the stresses induced in the material for the above conditions in 4.1 and 4.2.

**[13]****QUESTION 5**

A 350 mm pulley rotating at 900 r/min has to transmit 42 kW by means of a flat belt to a second pulley 750 mm in diameter, the pulley centres being 1,5 m apart. The belt, 18 mm thick, has a mass of 0,8 kg/m and may be loaded to a maximum value of 30 N/mm belt width. Assume the friction coefficient as 0,4 and calculate the following:

- 5.1 Belt width (8)
- 5.2 Belt length (1)

[9]**TOTAL: 100**