higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

MECHANICAL DRAWING AND DESIGN N6

(8090086)

20 April 2021 (X-paper)
09:00–13:00

OPENBOOK EXAMINATION

This question paper consists of 4 pages and 1 diagram sheet.

251Q1A2120

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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 according to the numbering system used in this question paper.
4. Use *g* as 9,81 m/s^2.
5. Use only a black or blue pen.
6. Write neatly and legibly.

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QUESTION 1

The DIAGRAM SHEET (attached) shows a line shaft driven by an electric motor that transmits 70 kW at 1 500 r/min. The line shaft is driven by a belt drive to allow slip during operation. A simple gear system with three gears is used for speed reduction from the line shaft to the screw conveyor.

LINE SHAFT

The line shaft is mounted on two bearings 800 mm apart with the driving gear C mounted 300 mm from the right-hand bearing. Pulley B overhangs the left-hand bearing by 160 mm. The flywheel with a mass of 120 kg is mounted 100 mm from the right-hand bearing. Maximum bending and shear stresses induced in a shaft may not exceed 90 MPa and 60 MPa respectively.

GEARS

The gears are made of cast iron. The basic stress for cast iron is 50 MPa. The pressure angle is 20°. The driving gear has a PCD of 260 mm and 26 teeth. All meshing gears have a module of 10 mm. The centre distance between shafts 2 and 3 is 320 mm and 450 mm between shafts 3 and 4. Gear D is mounted on shaft 3 and vertically below gear C. Gear E is mounted on shaft 4 and vertically below gear D.

BELT

An open belt with a rectangular cross-section is used. The width of the belt is three times its thickness. The maximum stress in the belt may not exceed 2,5 MPa. The coefficient of friction between the belt and the pulleys is 0,3. The PCD for the driving pulley A and driven pulley B is 240 mm and 360 mm respectively. The centre distance between pulleys A and B is 900 mm.

BEARINGS

Both bearings are journal bearings. The coefficient of friction between the bearing and the shaft is 0,08. Each bearing has a bearing length of 90 mm.

Calculate:

1.1 The actual angle of contact for the belt (3)

1.2 The tensions on the tight and slack sides of the belt (6)

1.3 The suitable thickness, width and length of the belt (6)

1.4 The rotational speeds of shafts 2, 3 and 4 in r/min (10)

1.5 Whether there is any interference taking place between all meshing gears (10)

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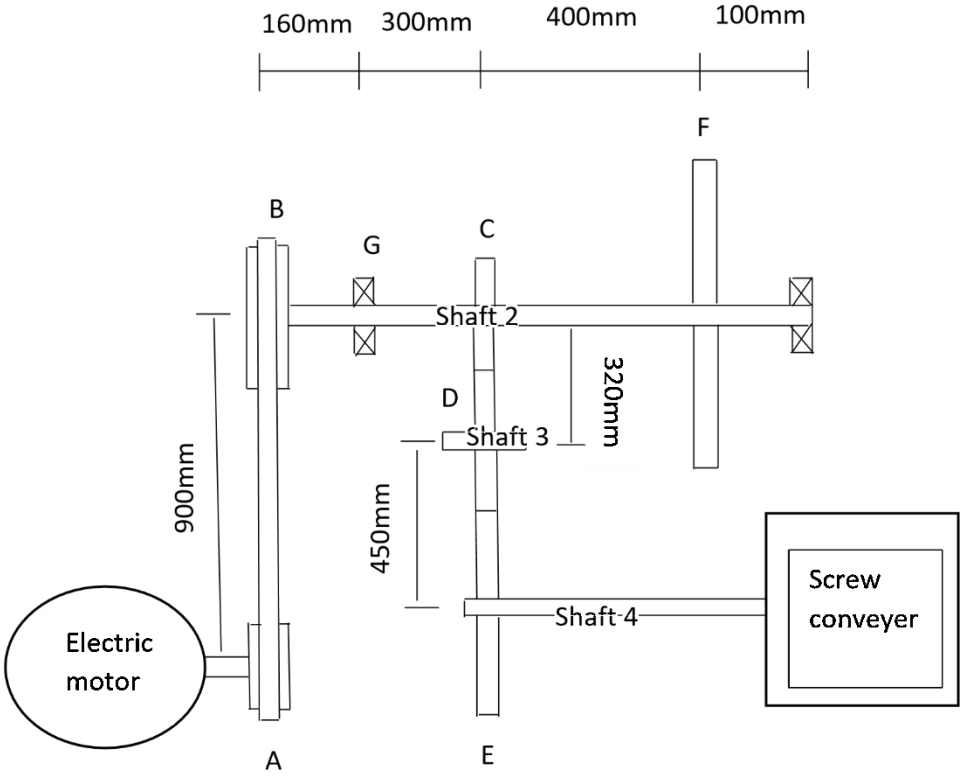
1.6	A suitable face width using Lewis formula and check if it is within the limits	(13)
1.7	The maximum torque transmitted by shaft 2 assuming no overloading	(2)
1.8	The maximum bending moment induced on shaft 2 assuming the belts are vertical and parallel	(19)
1.9	The suitable diameter for shaft 2 neglecting the shock and fatigue factors	(11)
1.10	The resultant radial load on each bearing	(4)
1.11	The frictional power on each bearing	(12)
1.12	The bearing pressure induced on each bearing	(4)
		[100]

TOTAL: 100

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DIAGRAM SHEET



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