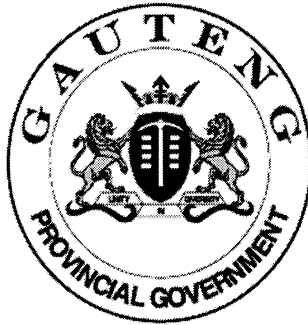


**SENIOR CERTIFICATE
EXAMINATION
*SENIORSERTIFIKAAT-EKSAMEN***



**FEBRUARY / *FEBRUARIE*
MARCH / *MAART***

2005

FITTING AND TURNING

***PAS- EN DRAAI-
WERK***

SG

705-2/0

FITTING & TURNING SG



705 2 0

SG

**10 pages
10 bladsye**

X05



**COPYRIGHT RESERVED / KOPIEREG VOORBEHOU
APPROVED BY UMALUSI / GOEDGEKEUR DEUR UMALUSI**



GAUTENGSE DEPARTEMENT VAN ONDERWYS
SENIORSERTIFIKAAT-EKSAMEN

PAS- EN DRAAIWERK SG

TYD: 3 uur

PUNTE: 200

BENODIGHEDE:

Sakrekenaars en tekeninstrumente

INSTRUKSIES:

- Beantwoord ALLE vrae volledig.
 - Tensy anders vermeld, word alle afmetings in millimeter aangedui.
 - Inligtingsbladsye word saam met hierdie vraestel voorsien.
 - Gebruik SLEGS die standaard- en spesiale ratwiele, asook die indeksplaat soos op die inligtingsblad aangedui.
 - Gebruik SLEGS die formules soos op die inligtingsblad aangedui, hoewel afgeleides van hierdie formules ook gebruik mag word.
-
-

VRAAG 1

Beantwoord Vrae 1.1 tot 1.9 op die **antwoordblad** op die **binne-omslag van jou antwoordboek**. Vir elk van hierdie vrae, dui die korrekte antwoord(e) aan deur die toepaslike letter(s) op die antwoordblad met 'n kruisie te merk. Die puntetoekenning aan die regterkant is 'n aanduiding van die getal korrekte antwoorde vir elke vraag. Vrae 1.10 tot 1.14 moet in jou antwoordboek beantwoord word. Skryf slegs WAAR of ONWAAR by hierdie vrae se antwoorde neer.

1.1 Watter van die volgende bepaal die grootte van 'n freesmasjien?

- A. Die hoeveelheid dwarsbeweging van die saal
- B. Die diameter van die draspil
- C. Die lengte van die masjientafel
- D. Die grootte van die hoofspil-laer (2)

1.2 Maatblokkies word gebruik om _____.

- A. propmate te toets
- B. swaelsterte te toets
- C. gereedskapmaker-knoppies op te stel
- D. snybeitels te posisioneer (2)

GAUTENG DEPARTMENT OF EDUCATION
SENIOR CERTIFICATE EXAMINATION

FITTING AND TURNING SG

TIME: 3 hours

MARKS: 200

REQUIREMENTS:

Pocket calculators and drawing instruments

INSTRUCTIONS:

- Answer ALL questions in full.
 - Unless otherwise indicated, all dimensions are in millimetres.
 - Information sheets are supplied with this question paper.
 - Use ONLY the standard and special gear wheels as well as the index plate as indicated on the information sheet.
 - Use ONLY the formulae as indicated on the formula sheet. However, derivatives of these formulae may also be used.
-
-

QUESTION 1

Answer Questions 1.1 to 1.9 on the **answer sheet** on the **inside cover** of your **answer book**. For each of these questions, indicate the correct answer(s) by crossing out the appropriate letter(s) on the answer sheet. The mark allocation on the right hand side is an indication of the number of correct answers for each question. Questions 1.10 to 1.14 must be answered in your answer book. You are required to write only TRUE or FALSE for these questions.

1.1 Which of the following determine the size of a milling machine?

- A. The amount of cross travel of the saddle
- B. The diameter of the cutter
- C. The length of the machine table
- D. The size of the main spindle bearing (2)

1.2 Gauge blocks are used to _____.

- A. test gauges
- B. test dovetails
- C. set up toolmakers' buttons
- D. position cutting tools (2)

- 1.3 Tussenratte word gebruik om _____.
- A. spoed te verhoog
 - B. spoed te verlaag
 - C. spasie tussen vaste ratte op te neem
 - D. draairigting te verander
- (2)
- 1.4 'n Reguittand-rat het 40 tande en 'n module van 4 mm. Die addendum van die rat is _____.
- A. 10 mm
 - B. 4 mm
 - C. 16 mm
 - D. 5 mm
- (1)
- 1.5 Skroefdraad word gebruik om _____.
- A. plate permanent vas te heg
 - B. druk uit te oefen
 - C. klein verstellings te maak
 - D. Geeneen van die bogenoemdes nie.
- (2)
- 1.6 'n Rattand-noniuss word gebruik vir die meet van die _____.
- A. addendum
 - B. koord-addendum
 - C. dedendum
 - D. koord-dedendum
- (2)
- 1.7 Die funksie van die draaibank-loskop is om die _____.
- A. werkstuk te ondersteun wanneer klein tapse werkstukke gesny word
 - B. werkstuk vas te klem tydens masjinerie
 - C. snybeitel te ondersteun tydens masjinerie
 - D. Geeneen van die bogenoemdes nie.
- (1)
- 1.8 Numeries beheerde draaibanke maak slegs van twee asse gebruik. Kies die korrekte kombinasie uit die onderstaande lys.
- A. $x + z$
 - B. $x + y$
 - C. $y + z$
 - D. $z + x$
- (1)
- 1.9 Die tafeltoevoerspoed is belangrik wanneer freeswerk gedoen word. Watter van die volgende sal jy oorweeg wanneer jy die toevoerspoed kies?
- A. Diameter van die snyer
 - B. Afmetings van die werkstuk
 - C. Krag van die masjien
 - D. Toestand van die masjien
- (2)

- 1.3 Intermediate gears are used to _____.
- A. increase speed
 - B. decrease speed
 - C. make up space between fixed gears
 - D. change direction of rotation
- (2)
- 1.4 A spur gear has 40 teeth and a module of 4 mm. The addendum of the gear is _____.
- A. 10 mm
 - B. 4 mm
 - C. 16 mm
 - D. 5 mm
- (1)
- 1.5 Screw threads are used to _____.
- A. fasten plates permanently
 - B. exert pressure
 - C. make small adjustments
 - D. None of the above.
- (2)
- 1.6 A gear tooth vernier is used to measure the _____.
- A. addendum
 - B. chordal addendum
 - C. dedendum
 - D. chordal dedendum
- (2)
- 1.7 The function of a lathe tailstock is that it _____.
- A. supports the work when small tapers are being cut
 - B. clamps the work piece during machining
 - C. supports the cutting tool during machining
 - D. None of the above.
- (1)
- 1.8 Numerically controlled lathes only make use of two axes. Select the correct combination from the list below.
- A. $x + z$
 - B. $x + y$
 - C. $y + z$
 - D. $z + x$
- (1)
- 1.9 The speed of the table feed of a milling machine is important when performing a milling operation. Which of the following would you consider when selecting the table feed rate?
- A. Diameter of the cutter
 - B. Dimensions of the work
 - C. Power of the machine
 - D. Condition of the machine
- (2)

Beantwoord die volgende vrae in jou **antwoordboek**. Antwoord slegs WAAR of ONWAAR.

- 1.10 Wrywing tussen twee oppervlakke hang af van die grootte van die kontakoppervlaktes.
- 1.11 Heliese ratte word soms gekerf om druk op die freesmasjien se draspil te verlig.
- 1.12 Een van die voordele van die prosesuitleg van masjiene is dat die produksieproses aaneenlopend is.
- 1.13 Een rede waarom werkstukke gebalanseer behoort te wees is dat ongebalanseerde werkstukke die draaibank-laers kan laat faal.
- 1.14 Transmissieskerms word op roterende as-ente gebruik. (10)
[25]

VRAAG 2

- 2.1 Beskryf kortliks wat met die produkuitleg van masjiene bedoel word. (3)
- 2.2 Noem VYF voordele van die prosesuitleg van masjiene. (5)
- 2.3 Noem VYF maatstawwe waaraan 'n goeie werkswinkel-uitleg moet voldoen. (5)
- 2.4 Maak 'n netjiese, benoemde skets van 'n verdeelkop-ratrangskikking wanneer 'n heliese rat gesny moet word. (6)
- 2.5 Bereken die snydiepte van 'n heliese rat met 'n ware module van 8,95 mm. Die steeksirkel-diameter van die rat is 537 mm en die helikshoek is $26^{\circ} 36'$. (7)
- 2.6 'n Tandstang moet vervaardig word om met 'n reguittand-rat met 12 tande en 'n buitendiameter van 66,85 mm in te kam. Die verdeelkop-verhouding is 40:1 en die freesmasjien-leiskroefsteek is 6 mm. Die dryfrat het 72 tande en die gedrewe rat het 24 tande. Bereken die minimum indeksering wat benodig word om die tandstang te sny. (9)
[35]

VRAAG 3

- 3.1 Vyf eweredig gespasiëerde gate moet in 'n ronde plaat op 'n sekere steeksirkel geboor word. Gereedskapmaker-knoppies met 'n diameter van 12 mm word vir die opstelling gebruik. Die afstand tussen knoppies nommer 1 en nommer 2 is 68 mm. Maak 'n netjiese skets van die opstelling en bereken dan die
 - 3.1.1 koordafstand tussen gate no. 1 en no. 2.
 - 3.1.2 steeksirkeldiameter van die gate.
 - 3.1.3 afstand tussen knoppies no. 1 en no. 4. (12)

Answer the following questions in your **answer book**. Answer only TRUE or FALSE.

- 1.10 Friction between two surfaces depends on the size of the contact areas.
- 1.11 Helical gear teeth are nicked to relieve pressure on the milling machine arbour.
- 1.12 One of the advantages of the process layout of machines is that the production process is continuous.
- 1.13 One reason why work pieces should be balanced is that unbalanced work pieces can cause the lathe bearings to fail.
- 1.14 Transmission guards are used on rotating shaft ends. (10)
[25]

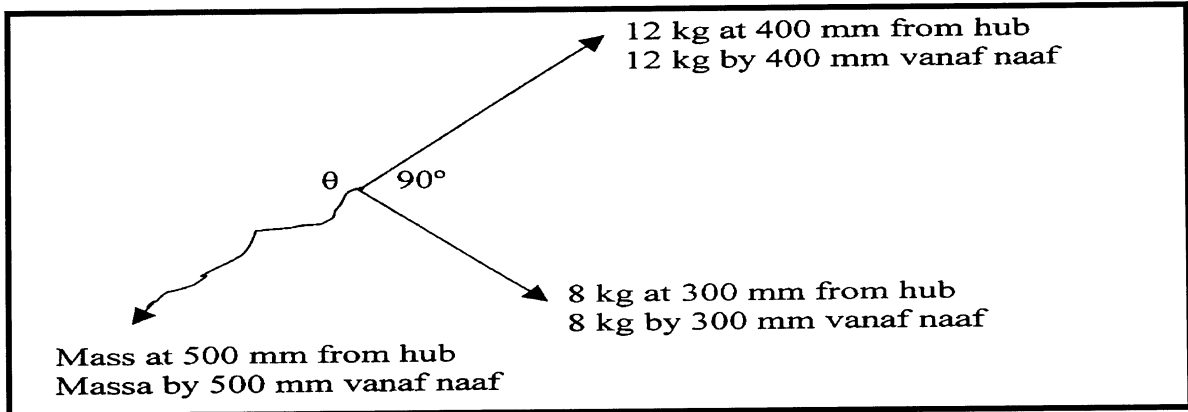
QUESTION 2

- 2.1 Briefly explain what is meant by the product layout of machines. (3)
- 2.2 Mention FIVE advantages of the process layout of machines. (5)
- 2.3 Name FIVE standards to which a good workshop layout must comply. (5)
- 2.4 Make a neat, labelled sketch of the dividing head gear arrangement when a helical gear is machined. (6)
- 2.5 Calculate the cutting depth for a helical gear with a real module of 8,95 mm. The pitch circle diameter of the gear is 537 mm and the helix angle is $26^{\circ}36'$. (7)
- 2.6 A gear rack must be made to mesh with a spur gear with 12 teeth and an outside diameter of 66,85 mm. The dividing head ratio is 40:1 and the milling machine lead screw pitch is 6 mm. The drive gear has 72 teeth and the driven gear has 24 teeth. Calculate the minimum indexing required to mill the rack. (9)
[35]

QUESTION 3

- 3.1 Five equally spaced holes must be drilled in a circular plate on a certain pitch circle. Toolmakers' buttons with a diameter of 12 mm are used for the set up. The distance between buttons number 1 and number 2 is 68 mm. Draw a neat sketch of the set up and then calculate the
- 3.1.1 chordal distance between holes no. 1 and no. 2
- 3.1.2 pitch circle diameter of the holes.
- 3.1.3 distance between buttons no. 1 and no. 4. (12)

- 3.2 Twee arms van 'n ongebalanseerde masjienonderdeel word hieronder deur 'n eenvoudige lynskets aangedui. Bepaal grafies die massa van 'n balansarm wat op 'n afstand van 500 mm vanaf die middel van die naaf geplaas moet word om die twee arms te balanseer. Bepaal ook hoek θ . Gebruik 'n skaal van 1 mm = 50 kg.mm vir u vektordiagram. Stel 'n massa/afstand tabel op om die eenhede wat u gaan gebruik vir u vektordiagram aan te dui. (11)

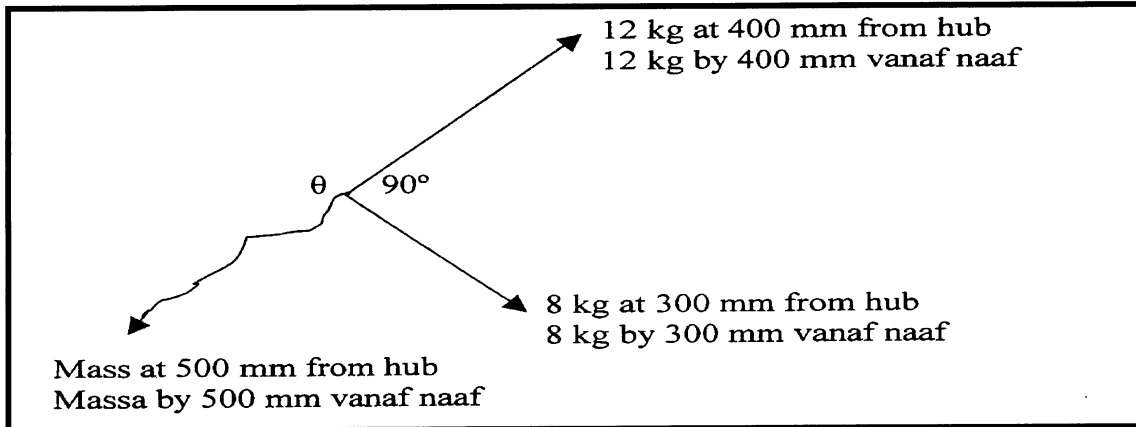


- 3.3 Noem VIER nadele van die masjinering van ongebalanseerde werk op 'n draaibank. (4)
- 3.4 Maak 'n netjiese skets om aan te dui wat met absolute programmering met betrekking tot 'n numeries beheerde draaibank bedoel word. Dui ook die verwysingspunt aan. (3)
- 3.5 Noem VYF komponente wat aan 'n draaibank gekoppel kan word om die masjien numeries beheerd te maak. (5)
- [35]

VRAAG 4

- 4.1 'n Driegange vierkantige binneskroefdraad moet op 'n draaibank gesny word. Die steek van die draad is 6,5 mm en die **effektiewe diameter** is 78 mm. Die vryloophoek van die snybeitel is 3°. Bereken die
- 4.1.1 styging van die skroefdraad.
- 4.1.2 helikshoek van die skroefdraad.
- 4.1.3 ingryphoek van die snybeitel.
- 4.1.4 nasleefhoek van die snybeitel. (9)
- 4.2 4.2.1 Verduidelik volledig hoe die skroefdraad in Vraag 4.1 op 'n draaibank gesny moet word deur die saamgesteldeslee-metode te gebruik. (10)
- 4.2.2 Noem EEN **voordeel** en EEN **nadeel** van die gebruik van die saamgesteldeslee-metode om meergang-skroefdraad te sny. (2)

- 3.2 Two arms of an out-of-balance machine part are shown below by means of a simple line sketch. Determine graphically the mass of a balancing arm fitted at a distance of 500 mm from the centre of the hub in order to balance the two arms. Also determine angle θ . For your vector diagram use a scale of 1 mm = 50 kg.mm. Draw up a mass/distance table to indicate the units you are using for the vector diagram. (11)



- 3.3 Mention FOUR disadvantages of machining unbalanced work in a centre lathe. (4)
- 3.4 Draw a neat sketch to illustrate what is meant by absolute programming with reference to a numerically controlled lathe. Also indicate the reference point. (3)
- 3.5 Name FIVE components fitted to a lathe that will make the machine numerically controlled. (5)
- [35]

QUESTION 4

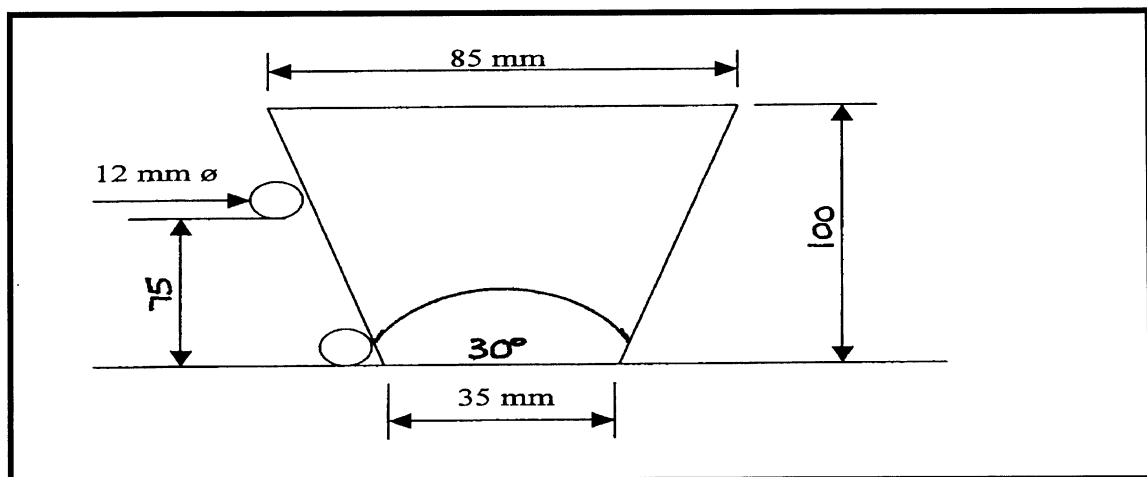
- 4.1 A three-start internal square thread must be cut on a lathe. The pitch of the thread is 6,5 mm and the **effective diameter** is 78 mm. The tool clearance angle is 3°. Calculate the
- 4.1.1 lead of the screw thread.
- 4.1.2 helix angle of screw thread.
- 4.1.3 leading angle of the screw cutting tool.
- 4.1.4 following angle of the screw cutting tool. (9)
- 4.2 4.2.1 Explain in detail how the thread in Question 4.1 should be cut on a lathe using the compound slide method. (10)
- 4.2.2 Mention ONE **advantage** and ONE **disadvantage** of using the compound slide method of cutting multiple start screw threads. (2)

- 4.3 Beskryf **klimfrees**-werk kortliks onder die volgende opskrifte:
- 4.3.1 Maak 'n skets om aan te toon wat klimfrees is.
- 4.3.2 DRIE voordele van klimfrees.
- 4.3.3 TWEE nadele van klimfrees. (8)
- 4.4 Noem VIER besonderhede wat op die kant van 'n involute ratsnyer gestempel moet word. (4)
- 4.5 Noem kortliks die doel van 'n verstelbare draspil-kraag. (2)
- [35]

VRAAG 5

- 5.1 Die tapse propmaat in die onderstaande skets moet vir akkuraatheid getoets word deur twee stelle rollers te gebruik. Bereken die mate oor beide die onderste en boonste stelle rollers.

Wenk: Kopieer een helfte van die skets op jou antwoordboek en dui AL die meetkundige konstruksies wat jy gaan gebruik op die skets aan. (18)



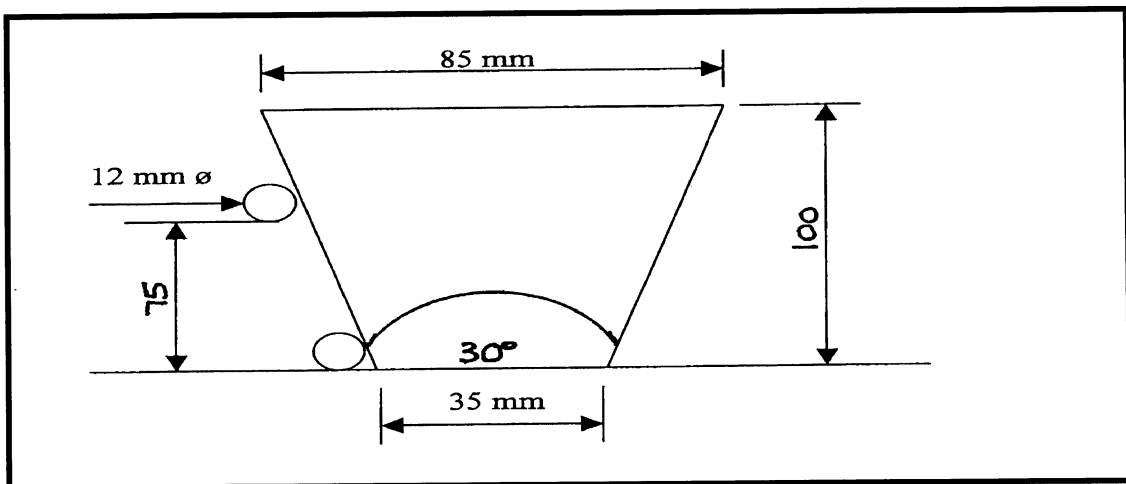
- 5.2 'n Groot ronde pilaar ondersteun 'n seksie van 'n brug. 'n Vragmotor wat staal vervoer, raak onklaar op die seksie wat deur die pilaar gesteun word. Die vragmotor, die vrag en die seksie van die brug het 'n gesamentlike massa van 60 000 kg. [1 kg = 10 N]. Bereken die spanning in die pilaar as dit 'n diameter van 0,75 m het. (7)
- 5.3 'n Krag van 100 N word op die suier van 'n hidrouliese pomp toegepas. Die suier het 'n diameter van 35 mm. Bereken die druk op die vloeistof in die pomp. (7)
- 5.4 Noem DRIE gevalle in 'n werkwinkel waar wrywing as 'n **voordeel** beskou word. (3)
- [35]

- 4.3 Briefly describe **down cut** milling under the following headings:
- 4.3.1 Sketch to illustrate what down cut milling is
- 4.3.2 THREE advantages of down cut milling.
- 4.3.3 TWO disadvantages of down cut milling. (8)
- 4.4 Mention FOUR particulars that must be stamped on the side of an involute gear cutter. (4)
- 4.5 Briefly state the purpose of an adjustable arbour collar. (2)
- [35]

QUESTION 5

- 5.1 The taper plug gauge in the sketch below must be tested for accuracy using two sets of rollers. Calculate the measurement over both the bottom and the top sets of rollers.

Hint: Copy one half of the sketch in your answer book and indicate ALL the geometric constructions you are going to use on your sketch. (18)

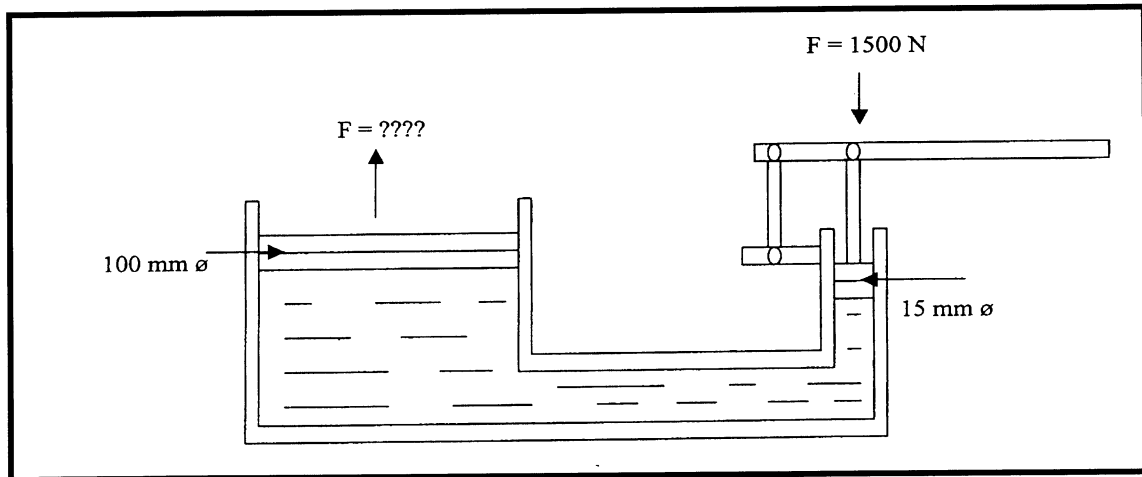


- 5.2 A large circular pillar supports a section of a bridge. A truck carrying steel has a breakdown on the section supported by the pillar. The truck, its load and the section of the bridge have a combined mass of 60 000 kg. [1 kg = 10 N]. Calculate the stress in the pillar if it has a diameter of 0,75 m. (7)
- 5.3 A force of 100 N is applied on the piston of a hydraulic pump. The piston has a diameter of 35 mm. Calculate the pressure on the liquid in the pump. (7)
- 5.4 Mention THREE instances in a workshop where friction is regarded as an **advantage**. (3)

[35]

VRAAG 6

- 6.1 Die skets hieronder toon 'n lyndiagram van 'n hidrouliese pers. Bereken die
- 6.1.1 las wat deur die ram gelig kan word.
- 6.1.2 afstand wat die ram opwaarts sal beweeg wanneer die suier 12 mm afwaarts beweeg. (12)



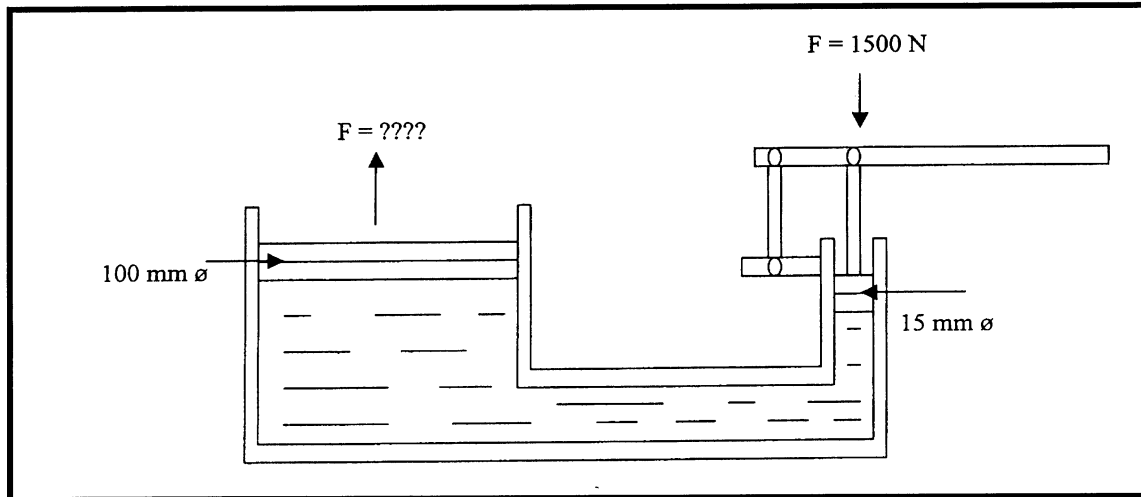
- 6.2 Bereken die indeksering vir 150 indelings. (4)
- 6.3 Noem DRIE funksies van 'n freemasjien verdeelkop. (3)
- 6.4 'n Ronde skyf moet in 137 indelings verdeel word. Gebruik differensiaal-indeksering en bereken die volgende. Kies 140 indelings.
- 6.4.1 Die nodige indeksering.
- 6.4.2 Die wisselratte wat benodig word.
- 6.4.3 Die draairigting van die indeksplaat. (10)
- 6.5 'n Sy- en vlakfrees het 'n diameter van 80mm met 'n primêre vryloophoek van 5° op die snyer tande. Bereken die posisie van die tandstut wanneer elk van die volgende slypwieltipes gebruik word om die snyer skerp te maak.
- 6.5.1 'n Koniese slyp wiel met 'n diameter van 120 mm.
- 6.5.2 'n Skyfslyp wiel met 'n diameter van 150 mm. (6)

[35]

TOTAAL: 200

QUESTION 6

- 6.1 The sketch below shows a line diagram of a hydraulic press. Calculate the
- 6.1.1 load that can be lifted by the ram.
- 6.1.2 distance the load will move upwards when the plunger moves 12 mm downwards. (12)



- 6.2 Calculate the indexing for 150 divisions. (4)
- 6.3 Mention THREE functions of a milling machine dividing head. (3)
- 6.4 A circular disc must be divided into 137 divisions. Use differential indexing and calculate the following. Choose 140 divisions.
- 6.4.1 The necessary indexing
- 6.4.2 The change gears needed
- 6.4.3 The rotational direction of the index crank (10)
- 6.5 A side and face milling cutter has a diameter of 80 mm with a primary clearance angle of 5° on the cutter teeth. Calculate the position of the tooth rest when using each of the following grinding wheel types to sharpen this cutter:
- 6.5.1 A cup wheel with a diameter of 120 mm.
- 6.5.2 A disc wheel with a diameter of 150 mm. (6)

[35]

TOTAL: 200

INLIGTINGSBLAD**1. Tandratte vir freemasjien**

Standaard- en spesiale tandratte.

24 (twee hiervan); 28; 32; 40; 44; 46; 47; 48; 52; 56; 58; 64; 68; 70; 72; 76; 84; 86 en 100 tande.

2. Indeksplaat vir freemasjien

24; 25; 28; 30; 34; 37; 38; 39; 41; 42; 43; 46; 47; 49; 51; 52; 54; 57; 58; 59; 62 en 66 gate.

3. Formules

$$3.1 \quad \text{Spanning} = \frac{F}{A}$$

$$3.2 \quad \text{Dwarsdeursnee-oppervlakte van soliede silinder} = \frac{\pi D^2}{4}$$

$$3.3 \quad \text{Dwarsdeursnee-oppervlakte van hol silinder} = \frac{\pi(D^2 - d^2)}{4}$$

$$3.4 \quad \text{Vloeistofdruk in 'n hidrouliese pers: } \frac{F1}{A1} = \frac{F2}{A2}$$

Volume van vloeistof deur plunjer verplaas = volume deur suier verplaas
volume = area x L

3.5 Reguitanderat:

$$3.5.1 \quad \text{SSD} = Tm$$

$$3.5.2 \quad \text{add} = m$$

$$3.5.3 \quad \text{ded} = 1,157m$$

$$3.5.4 \quad \text{Vryruimte} = 0,157m$$

$$3.5.5 \quad \text{BD} = \text{SSD} + 2 \text{ add}$$

$$3.5.6 \quad T = \frac{\text{SSD}}{m}$$

$$3.5.7 \quad \text{BD} = m(T + 2)$$

$$3.5.8 \quad m = \frac{\text{BD}}{T + 2}$$

INFORMATION SHEET

1. Gears for milling machine

Standard and special gear wheels.

24 (two of); 28; 32; 40; 44; 46; 47; 48; 52; 56; 58; 64; 68; 70; 72; 76; 84; 86 and 100 teeth.

2. Index plate for milling machine

24; 25; 28; 30; 34; 37; 38; 39; 41; 42; 43; 46; 47; 49; 51; 52; 54; 57; 58; 59; 62 and 66 holes.

3. Formulae

3.1 Stress = $\frac{F}{A}$

3.2 Cross-sectional area of solid cylinder = $\frac{\pi D^2}{4}$

3.3 Cross-sectional area of hollow cylinder = $\frac{\pi(D^2 - d^2)}{4}$

3.4 Fluid pressure in a hydraulic press: $\frac{F1}{A1} = \frac{F2}{A2}$

Volume of fluid displaced by plunger = volume displaced by piston
 volume = area x L

3.5 Spur gears:

3.5.1	PCD	=	Tm
3.5.2	add	=	m
3.5.3	ded	=	1,157m
3.5.4	Clearance	=	0,157m
3.5.5	OD	=	PCD + 2 add
3.5.6	T	=	$\frac{PCD}{m}$
3.5.7	OD	=	m (T + 2)
3.5.8	m	=	$\frac{OD}{T + 2}$

$$3.5.9 \text{ Koord-addendum} = m + \left[\frac{mT}{2} \left(1 - \cos \frac{90^\circ}{T} \right) \right]$$

$$3.5.10 \text{ Koorddikte} = mT \sin \frac{90^\circ}{T}$$

$$3.5.11 \text{ Sirkelsteek} = \pi m$$

3.6 Heliese tandratte

$$3.6.1 \text{ SSD} = Tm_w$$

$$3.6.2 \text{ add} = m_n$$

$$3.6.3 \text{ ded} = 1,157 m_n$$

$$3.6.4 \text{ Vryruimte} = 0,157 m_n$$

$$3.6.5 \text{ BD} = \text{SSD} + 2 \text{ add}$$

$$3.6.6 \text{ T} = \frac{\text{SSD}}{m_w}$$

$$3.6.7 m_n = m_w \cos \theta$$

3.6.8 Getal tande gemerk op die freessnyer:

$$\text{Getal} = \frac{T}{(\cos \theta)^3}$$

$$3.6.9 \text{ Koord-addendum} = m_n + \left[\frac{m_n T}{2} \left(1 - \cos \frac{90^\circ}{T} \right) \right]$$

$$3.6.10 \text{ Koorddikte} = m_n T \sin \frac{90^\circ}{T}$$

$$3.6.11 \text{ Styging van heliks} : \ell = \pi \times \text{SSD} \times \cot \theta$$

of

$$\ell = \frac{\pi \times \text{SSD}}{\tan \theta}$$

$$3.6.12 \text{ Helikshoek} : \tan \theta = \frac{\pi \times \text{SSD}}{\ell}$$

$$3.6.13 \text{ Sirkelsteek} = \pi m_n$$

3.6.14 Styging van freesmasjien = Verdeelkop-verhouding x leiskroef-steek

$$3.6.15 \text{ Wisselratte nodig} \quad \frac{Dr}{G} = \frac{L}{\ell}$$

$$3.5.9 \quad \text{Chordal addendum} = m + \left[\frac{mT}{2} \left(1 - \cos \frac{90^\circ}{T} \right) \right]$$

$$3.5.10 \quad \text{Chordal width} = mT \sin \frac{90^\circ}{T}$$

$$3.5.11 \quad \text{Circular pitch} = \pi m$$

3.6 Helical gears

$$3.6.1 \quad \text{PCD} = Tm_w$$

$$3.6.2 \quad \text{add} = m_n$$

$$3.6.3 \quad \text{ded} = 1,157 m_n$$

$$3.6.4 \quad \text{clearance} = 0,157 m_n$$

$$3.6.5 \quad \text{OD} = \text{PCD} + 2 \text{ add}$$

$$3.6.6 \quad T = \frac{PCD}{m_c}$$

$$3.6.7 \quad m_n = m_c \cos \theta$$

3.6.8 Number of teeth marked on the milling cutter;

$$\text{Number} = \frac{T}{(\cos \theta)^3}$$

$$3.6.9 \quad \text{Chordal addendum} = m_n + \left[\frac{m_n T}{2} \left(1 - \cos \frac{90^\circ}{T} \right) \right]$$

$$3.6.10 \quad \text{Chordal thickness} = m_n T \sin \frac{90^\circ}{T}$$

$$3.6.11 \quad \text{Lead of helix} : \ell = \pi \times \text{PCD} \times \cot \theta$$

or

$$\ell = \frac{\pi \times \text{PCD}}{\tan \theta}$$

$$3.6.12 \quad \text{Helix angle} : \tan \theta = \frac{\pi \times \text{PCD}}{\ell}$$

$$3.6.13 \quad \text{Circular pitch} = \pi m_n$$

3.6.14 Lead of milling machine = Dividing head ratio x pitch of leadscrew

$$3.6.15 \quad \text{Change gears required} \frac{Dr}{G} = \frac{L}{\ell}$$

3.7 Indeksering:

3.7.1 Eenvoudige indeksering = $\frac{40}{N}$

3.7.2 Hoek indeksering = $\frac{\theta}{9^\circ}$

3.7.3 Differensiaal-indeksering = $\frac{Dr}{G} = \frac{(A - N)}{A} \times \frac{40}{1}$

3.7.4 Tandstang:

Indeksering =

$$\frac{\text{Verdeelkop - verhouding}}{\text{Leiskroef - steek}} \times \frac{\text{Tandstang - steek}}{\text{Ratverhouding}}$$

3.8 Slyp van freessnyer-tande:

3.8.1 Gewone slypwiël : Oorstelling = $R \sin \theta$.

3.8.2 Komvormige slypwiël: Oorstelling = $r \sin \theta$.

3.9 Grafiese oplossing van statiese balansering:

Uit-balans-uit-effek = Massa X afstand wat massa van middelpunt van vlakplaat af

3.10 Beitelhoeke vir die sny van vierkantige skroefdrade:

3.10.1 Helikshoek: $\tan \eta = \frac{\text{Styging}}{\pi D_m}$

3.10.2 Ingryphoek = $90^\circ - (\text{Helikshoek} + \text{Vryloophoek})$

3.10.3 Nasleefhoek = $90^\circ + (\text{Helikshoek} - \text{Vryloophoek})$

3.7 Indexing:

$$3.7.1 \quad \text{Simple indexing} \quad = \quad \frac{40}{N}$$

$$3.7.2 \quad \text{Angular indexing} \quad = \quad \frac{\theta}{9^\circ}$$

$$3.7.3 \quad \text{Differential indexing} \quad = \quad \frac{Dr}{G} = \frac{(A - N)}{A} \times \frac{40}{1}$$

3.7.4 Rack:

$$\text{Indexing} \quad = \quad \frac{\text{Dividing head ratio}}{\text{Pitch of lead screw}} \times \frac{\text{Pitch of rack}}{\text{Gear ratio}}$$

3.8 Grinding of milling cutter teeth:

3.8.1 Disc grinding wheel: Offset = R sin θ.

3.8.2 Cup wheel: Offset = r sin θ.

3.9 Graphical solution of static balancing:

Out-of-balance effect = Mass X distance of mass from centre of face plate.

3.10 Tool angles for cutting square threads:

$$3.10.1 \quad \text{Helix angle: } \tan \eta \quad = \quad \frac{\text{Lead}}{\pi D_m}$$

3.10.2 Leading tool angle = 90° - (Helix angle + Clearance angle)

3.10.3 Following tool angle = 90° + (Helix angle - Clearance angle)