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higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T630(E)(N12)T
NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

FITTING AND MACHINING THEORY N2

(11022032)

12 November 2014 (Y-Paper)
13:00–16:00

Calculators may be used.

This question paper consists of 9 pages and 1 formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
FITTING AND MACHINING THEORY N2
TIME: 3 HOURS
MARKS: 100

NOTE: If you answer more than the required number of questions, only the required number of questions will be marked. All work you do not want to be marked, must be clearly crossed out.

INSTRUCTIONS AND INFORMATION

1. Answer either QUESTION 1.1 or QUESTION 1.2 and ALL other questions in SECTION A.
 2. Answer only TWO questions from SECTION B.
 3. Read ALL the questions carefully.
 4. Number the answers according to the numbering system used in this question paper.
 5. Write neatly and legibly.
-

SECTION A**QUESTION 1: OCCUPATIONAL SAFETY**

Answer either QUESTION 1.1 or QUESTION 1.2.

- 1.1 State FIVE rules for the safe handling and storage of compressed gas cylinders. [5]

OR

- 1.2 State FIVE precautions to be taken with regard to fire prevention in mines, according to the Minerals Act. [5]

QUESTION 2: COUPLINGS

FIGURE 1 below, shows a sketch of a coupling.

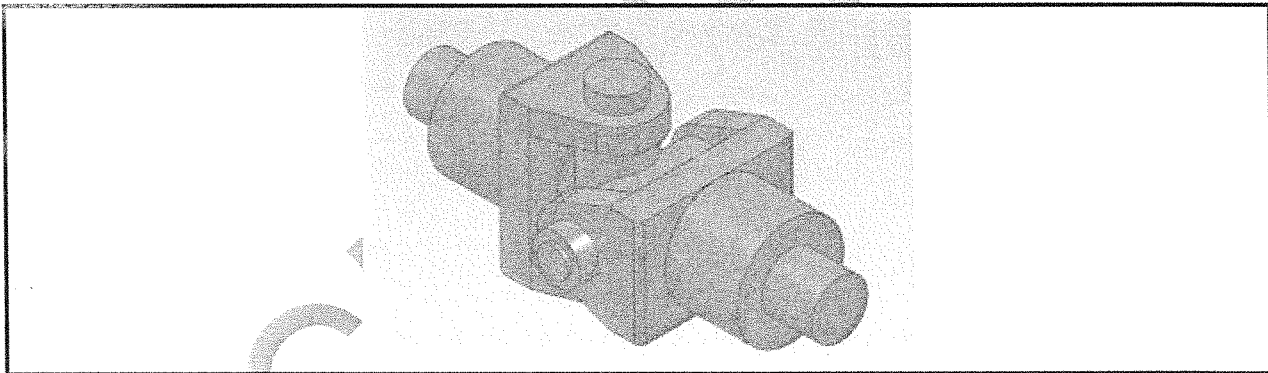


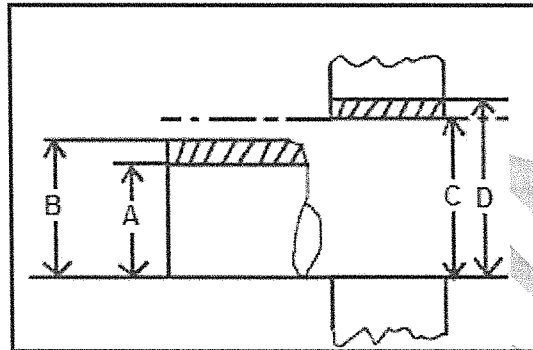
FIGURE 1

- 2.1 Name the type of coupling shown in FIGURE 1. (1)
- 2.2 Describe the conditions under which this coupling may be used. (2)
- 2.3 Does this coupling fall in the group classification of fixed couplings? Write only 'yes' or 'no' and give a reason for your answer. (2)
- [5]

QUESTION 3: LIMITS AND FITS

- 3.1 FIGURE 2 below, shows an example of a clearance fit between a bush and shaft. Labels (A–D) represent various terms associated with limits.

Identify these terms. Write down the answers next to the letters (A–D) in the ANSWER BOOK.

**FIGURE 2**

(4 × 1)

(4)

- 3.2 A precision running fit between shaft and a sliding bearing is given as:
105H7- g6

What is meant by the following symbols represented by this fit? Write only the answer next to the question number (3.2.1–3.2.4) in the ANSWER BOOK.

3.2.1 The capital letter H

3.2.2 The number 7

3.2.3 The small letter g

3.2.4 The number 6

(4 × 1)

(4)

[8]

QUESTION 4: BEARINGS

- 4.1 List FOUR properties of the materials used for plain bearings. (4)

- 4.2 Give FOUR reasons for the failure of anti-friction bearings. (4)

[8]

QUESTION 5: LUBRICATION AND VALVES

- 5.1 State FIVE factors which must be considered when choosing a lubricant. (5)

- 5.2 Explain the working principles of a ball valve. (3)

[8]

QUESTION 6: PACKING, STUFFING BOXES AND JOINTS AND PIPE SYSTEMS

- 6.1 State FIVE important guidelines to ensure the proper fitting of O-rings and seals in hydraulic systems, in order to prevent premature failure. (5)
- 6.2 Name FOUR common methods of joining steel water pipes. (4)
- [9]

QUESTION 7: PUMPS

- 7.1 Explain the function of a pump. (1)
- 7.2 FIGURE 3, below, shows a sketch of a gear pump where M represents the attachment to the pump motor.

Identify the parts labelled (A–D). Write the answer next the letters (A–D) in the ANSWER BOOK.

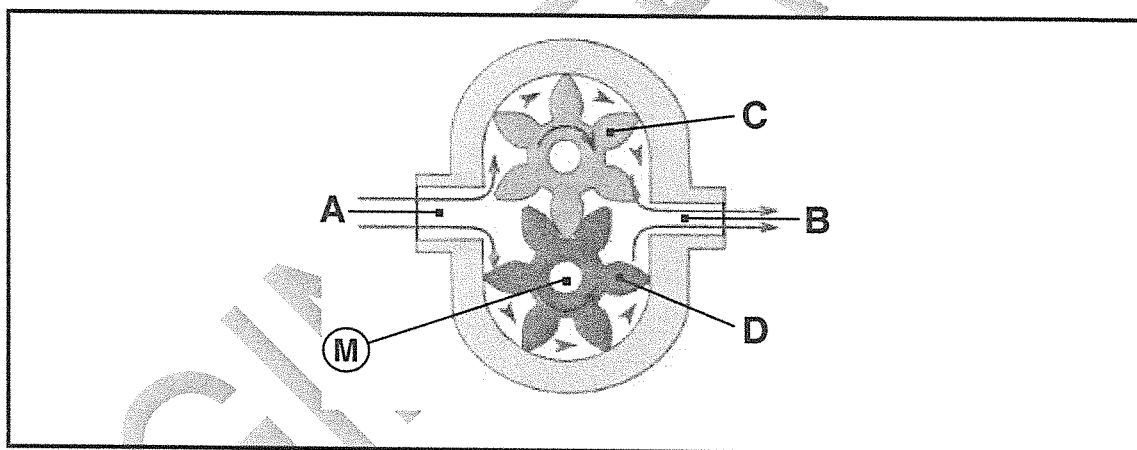


FIGURE 3

(4)
[5]

QUESTION 8: COMPRESSORS

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (8.1–8.7) in the ANSWER BOOK.

- 8.1 Pneumatic tools are tools driven by liquid pressure.
- 8.2 Moisture traps are used on intercoolers and aftercoolers.
- 8.3 The low pressure cylinder is the second stage at which air is drawn in from the high pressure cylinder before being compressed, cooled and stored.
- 8.4 The device used to separate moisture from the air to prevent the presence of water in tools and machinery during pneumatic operation, is called the aftercooler.

- 8.5 Pistons and piston-rings are used in reciprocating compressors.
- 8.6 Start and stop control is operated on a compressor by a thermostat.
- 8.7 The air receiver is used for storing compressed air under high pressure until it is ready for use.

(7 × 1)

[7]

QUESTION 9: V-BELT, GEAR AND CHAIN DRIVES

- 9.1 Explain the principles of the following concepts with regards to gear drives:

9.1.1 Velocity ratio

(1)

9.1.2 Mechanical advantage

(1)

- 9.2 State THREE advantages that V-belt drives have over chain drives.

(3)

[5]

TOTAL SECTION A:**60**

SECTION B

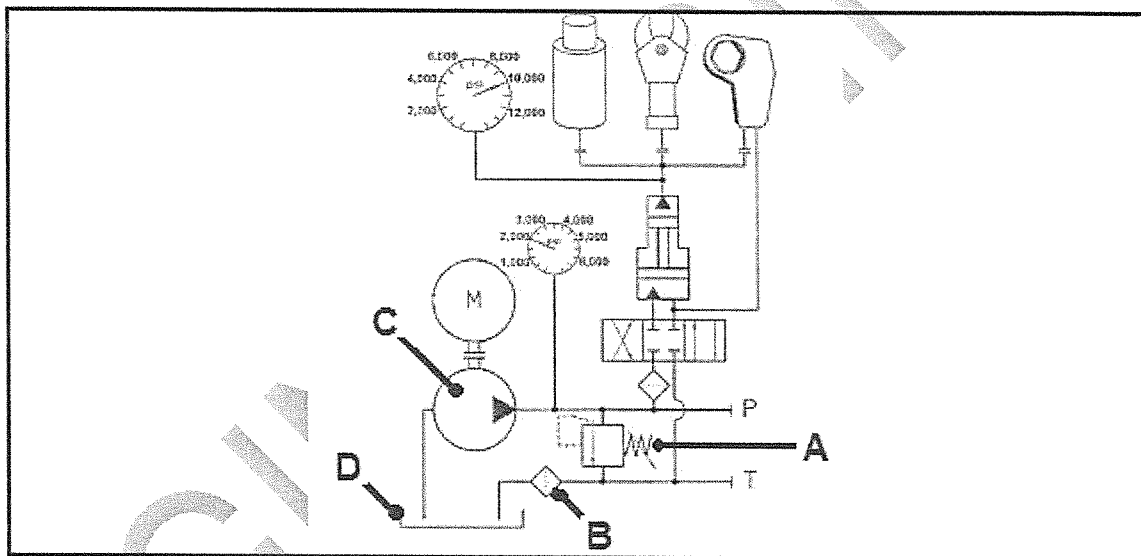
Answer only TWO questions from this section.

QUESTION 10: PNEUMATICS AND HYDRAULICS

10.1 Give the TWO scientific factors responsible for the force and speed in the actuator within a pneumatic system. (2)

10.2 FIGURE 4 shows a hydraulic circuit.

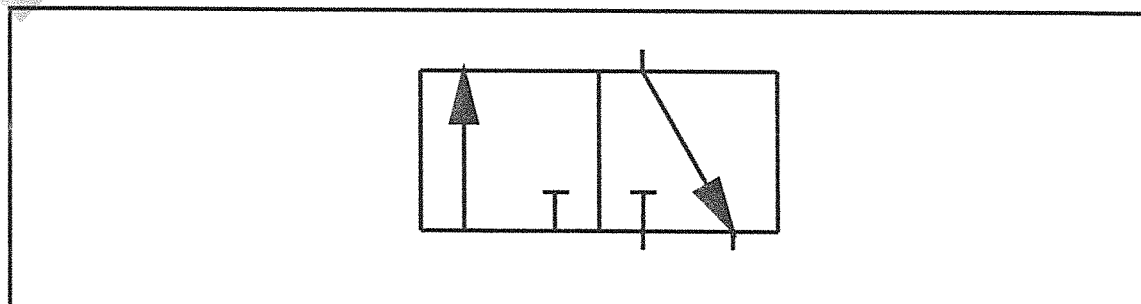
Identify the parts labelled (A–D). Write the answer next the letters (A–D) in the ANSWER BOOK.

**FIGURE 4**

10.3 State THREE main functions of oil in a hydraulic flow system. (4)

10.4 State TWO functions of the reservoir. (3)

10.5 Answer the following questions based on the valve as shown in FIGURE 5 below. (2)

**FIGURE 5**

10.5.1 How many ports are indicated in FIGURE 5 above?

10.5.2 How many switching positions are indicated?

10.5.3 Is this valve normally open or normally closed?

10.5.4 What is the name of this valve?

(4 × 1) (4)

10.6 Make neat freehand sketches of the symbols representing the following pneumatic components:

10.6.1 Pressure source

10.6.2 Compressor

10.6.3 Air receiver

10.6.4 Pneumatic motor (half-rotation)

10.6.5 Dryer

(5 × 1) (5)

[20]

QUESTION 11: CENTRE LATHE

11.1 Name the THREE basic instructional forms applicable to a CNC lathe.

(3)

11.2 A spindle with a taper of 1 in 14 is to be turned to the dimensions given in FIGURE 6 below.

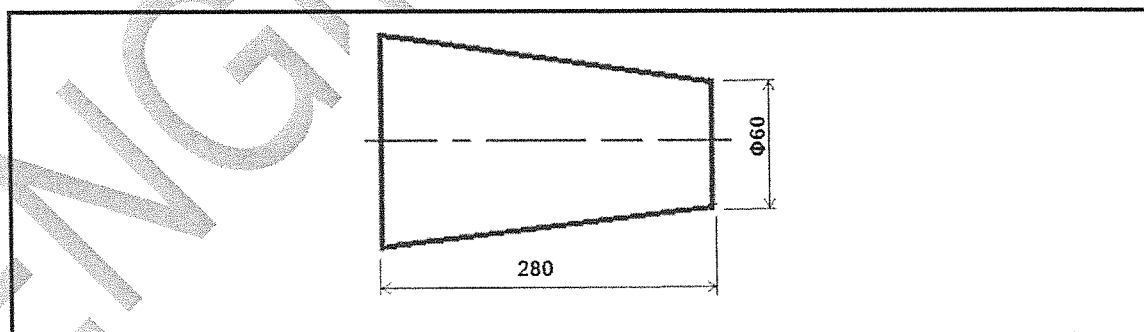


FIGURE 6

11.2.1 Calculate the amount of tailstock set-over.

(2)

11.2.2 Calculate the included angle of the tapered portion in degrees and minutes.

(3)

11.3 A carbon steel pin with a diameter of 10 mm is to receive a finishing cut on a centre lathe. The cutting speed for carbon steel is 56,55 m/min.

Calculate the speed, in revolutions per minute, that you would set as the lathe's rotational speed.

(3)

11.4 Steadies are important accessories to a centre lathe.

11.4.1 State TWO uses of lathe steadies (2)

11.4.2 Name the steady, which is mounted to the lathe-bed. (1)

11.4.3 Name the steady, which is mounted to the lathe-saddle. (1)

11.5 A two-start square thread of 10 mm pitch, has to be machined on a round shaft with an outside diameter of 70 mm. Assume the clearance angle to be 3° .

Calculate the following:

11.5.1 The helix angle (θ) of the thread (3)

11.5.2 The lead angle of the cutting tool (1)

11.5.3 The following angle of the cutting tool (1)

[20]

QUESTION 12: MILLING MACHINES AND SURFACE GRINDERS

12.1 Name the THREE types of indexing as performed on a milling machine. (3)

12.2 A work piece must have 13 gear-teeth machined on its circumference.

12.2.1 What type of indexing would you perform on this gearblank? (1)

12.2.2 Give a reason for the answer in QUESTION 12.2.1. (2)

12.2.3 Calculate the required indexing, using a Cincinnati dividing head as shown in the TABLE below.

The Cincinnati dividing head											
Side 1	24	25	28	30	34	37	38	39	41	42	43
Side 2	46	47	49	51	53	54	57	58	59	62	66

TABLE

(3)

12.3 Grinding wheels have markings for identification purposes.

List FIVE factors by which you would identify a grinding wheel. (5)

12.4 State FOUR advantages of using milling cutters with coarse teeth. (4)

12.5 Name TWO types of milling processes. (2)

[20]

TOTAL SECTION B: 40
GRAND TOTAL: 100

FITTING AND MACHINING THEORY N2

FORMULA SHEET

$$f = ft \times T \times N$$

$$S = \frac{\pi DN}{60}$$

$$S = \pi DN$$

$$\frac{40}{N}$$

$$\frac{N}{9^\circ}$$

$$\text{Set-over} = \frac{D-d}{2} \times \frac{\text{length of workpiece}}{\text{length of taper}}$$

$$\tan \frac{\theta}{2} = \frac{X}{L}$$

$$\text{Leading angle} = 90^\circ - (\text{Helix angle} + \text{clearance angle})$$

$$\text{Following angle} = 90^\circ + (\text{Helix angle} - \text{clearance angle})$$

$$\text{Lead} = \text{No of starts} \times \text{pitch}$$



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MARKING GUIDELINE

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12 NOVEMBER 2014

This marking guideline consists of 9 pages.

√ = ½ mark

✓ = 1 mark

SECTION A**QUESTION 1**

- 1.1
- Do not allow cylinders to slide or come into contact with sharp edges. They may be rolled but not dragged.
 - Do not drop cylinders or allow them to come into violent contact with each other or with other hard objects.
 - Never load or offload cylinders by mean of electromagnetic cranes or chain-slings. A cage or lifting basket, made especially for the task, should be used.
 - Do not tamper with the safety devices found on the valves.
 - Do not use cylinders as roller beds for moving heavy articles.
 - Use a special cylinder trolley or hand truck, where possible.
 - Mark empty cylinders by using chalk or other marking material to distinguish between them and others which are full.
 - Always handle cylinders as if they are full.
 - Remove pressure regulators and equipment and replace valve guards before transporting cylinders.
 - Use warm, not boiling water, to free frozen valves as the fusible plug on acetylene cylinders melts at boiling point.

(Any 5 × 1)

[5]**OR**

- 1.2
- No person should leave any naked light or flame on or near any combustible material or inflammable substance.
 - No combustible waste material must be stored in the vicinity of any installed electrical appliance or heating apparatus.
 - No welding, flame-cutting or flame heating must take place unless fire extinguishers have been provided.
 - No person is allowed to smoke or carry an open light in any cage, skip or any other conveyance in any shaft.
 - Calcium carbide is not to be taken underground unless it is in a lamp or water-tight container approved by the manager.
 - All machinery must be constructed, installed, operated and maintained so as to prevent dangerous heating

(Any 5 × 1)

[5]**QUESTION 2**

- 2.1 Universal coupling (1)
- 2.2 This coupling connects two shafts ✓ whose axes are at an angle, other than 180°, with each other. ✓ (2)
- 2.3 No. ✓ It accommodates self alignment group. ✓ (2)

[5]

QUESTION 3

- | | | | |
|-----|--|---------|-----|
| 3.1 | A – Low limit of shaft
B – Higher/Upper limit of shaft
C – Lower limit of bush
D – High/Upper Limit of bush | (4 × 1) | (4) |
| 3.2 | 3.2.1 H = tolerance of hole

3.2.2 7 = grade or degree of tolerance on hole

3.2.3 g = tolerance of shaft

3.2.4 6 = grade or degree of tolerance on shaft | (4 × 1) | (4) |
| | | | [8] |

QUESTION 4

- | | | | |
|-----|---|-------------|-----|
| 4.1 | <ul style="list-style-type: none">• Load Capacity• Corrosion resistance• Thermal conductivity• Fatigue strength• Embedded ability• Compatibility• Conformability• Cost | (Any 4 × 1) | (4) |
| 4.2 | <ul style="list-style-type: none">• Insufficient lubrication• Drying-up of grease• Oil-pollution• Insufficient bearing clearance• Flat on rolling element/s• Shaft out of roundness• Over-lubrication• Foaming oil• Rotating journal sleeve• Bearing slips on shaft• Incorrect assembly• Excessive bearing clearance | (Any 4 × 1) | (4) |
- [8]**

QUESTION 5

- 5.1
- Speed between moving parts
 - Operating temperature
 - Load on bearing
 - Cost of lubricant
 - Environment
 - Clearance between the two components

(Any 5 × 1) (5)

- 5.2 A ball valve consists of a ball with a hole through it. ✓ When the opening in the ball coincides with that of the pipeline, the fluid will flow. ✓ If the handle is turned through 90° to the pipeline, no flow will take place. ✓

(3)
[8]**QUESTION 6**

- 6.1
- Clean all surfaces.
 - Ensure the correct seal is used.
 - Ensure no damage while installing seal.
 - Lubricate the seal before installing.
 - Use a protective sheath over a threaded section to protect the seal.
 - Always tighten up lightly in the beginning for squaring up the seal.

(Any 5 × 1) (5)

- 6.2
- Screwed
 - Welded
 - Flanged
 - Bell and spigot
 - Butt and strap joint
 - Threaded union

(Any 4 × 1) (4)
[9]**QUESTION 7**

- 7.1 A pump is used to transfer fluids or liquids from one place to another.

OR

A pump is used to move fluids or liquids from a low level to a higher level.

(1)

- 7.2
- A – Inlet
 - B – Outlet
 - C – Driven gear
 - D – Driver gear

(4 × 1) (4)
[5]

QUESTION 8

- 8.1 False
- 8.2 True
- 8.3 False
- 8.4 True
- 8.5 True
- 8.6 False
- 8.7 True

(7 × 1) [7]


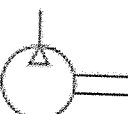

QUESTION 9

- 9.1.1 Velocity ratio is the relationship between the speeds of the drive gear to the speed of the driven gear OR the number of teeth of the driven gear to the number of teeth on the drive gear. (1)
- 9.1.2 Mechanical advantage is the resultant effect between two meshing gears and can be obtained by varying the velocity ratio between them. (1)
- 9.2
 - Slip will take place when overloaded whereas in chain drives the chain may break.
 - No lubrication required in belt drives whereas chain drives require lubrication.
 - Requires little attention as compared to chain drives.
 - Cheaper maintenance than chain drives.
 - Not as costly as chain drives,
 - Can operate over longer distances.

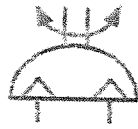
(Any 3 × 1) (3)
[5]**TOTAL SECTION A: 60**

SECTION B

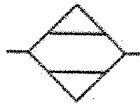
QUESTION 10

- | | | | |
|------|--|-------------|-----|
| 10.1 | <ul style="list-style-type: none"> • Pressure • Volume | | (2) |
| 10.2 | A – Regulator or safety valve
B – Filter
C – Pump
D – Tank or reservoir | (4 × 1) | (4) |
| 10.3 | <ul style="list-style-type: none"> • Transmits energy or power • Lubricates • Prevents corrosion • Removes dirt • Cools | (Any 3 × 1) | (3) |
| 10.4 | <ul style="list-style-type: none"> • Storage of hydraulic fluid • Dissipates heat generated in the system • Separates air from oil • Allows contaminants to settle to the bottom | (Any 2 × 1) | (2) |
| 10.5 | 10.5.1 3
10.5.2 2
10.5.3 Normally closed – return to tank
10.5.4 3/2 Directional control valve | (4 × 1) | (4) |
| 10.6 | 10.6.1 
10.6.2 
10.6.4  | | |

10.6.4



10.6.5

(5 × 1) (5)
[20]**QUESTION 11**

- 11.1
- G – Commands
 - M – Commands
 - Positional data

(3)

11.2 11.2.1

$$\begin{aligned} \text{Set-over} &= \frac{\text{length of workpiece}}{2} \times \text{Ratio} \\ &= \frac{280}{2} \times \frac{1}{14} \checkmark \\ &= 10 \text{ mm} \checkmark \end{aligned}$$

(2)

11.2.2 $\tan \frac{\theta}{2} = \frac{0,5}{14} \checkmark$

$$\frac{\theta}{2} = \tan^{-1} 0,0357 \checkmark$$

$$\frac{\theta}{2} = 2,045^\circ \checkmark$$

$$\theta = 4,09^\circ \checkmark$$

$$\theta = 4^\circ 5,4' \checkmark$$

(3)

11.3 $S = \pi DN$

$$N = \frac{S}{\pi D} \checkmark$$

$$= \frac{56,55}{\pi \times 0,01} \checkmark$$

$$= 1800 \text{ rev/min} \checkmark$$

(3)

- 11.4 11.4.1
- To support long and slender work-pieces between the lathe spindle and tail-stock.
 - To reduce unnecessary vibration or chatter, thus ensuring a better finish.
 - To support work-pieces against the pressure of heavy machining.
 - To maintain concentricity of long work-pieces while machining.

(Any 2 × 1) (2)

11.4.2 Travelling (1)

11.4.3 Fixed (1)

11.5 11.5.1 $Lead = No. of starts \times Pitch$
 $= 2 \times 10$
 $= 20 mm \quad \checkmark$

$$Pitch\ diameter = OD - \frac{1}{2} \times Pitch$$

$$= 70 - \frac{1}{2} \times 10 \quad \checkmark$$

$$= 65 mm \quad \checkmark$$

$$\tan \theta = \frac{Lead}{Pitch\ circumference}$$

$$= \frac{20}{\pi \times 65} \quad \checkmark$$

$$= 0,0797 \quad \checkmark$$

$$\therefore \theta = \tan^{-1} 0,0797$$

$$= 5,59^\circ \quad \checkmark \quad (3)$$

11.5.2 Leading angle $= 90^\circ - (\text{helix angle} + \text{clearance angle})$
 $= 90^\circ - (5,59 + 3^\circ) \quad \checkmark$
 $= 81,41^\circ \quad \checkmark \quad (1)$

11.5.3 Following angle $= 90^\circ - (\text{helix angle} + \text{clearance angle})$
 $= 90^\circ + (5,59 - 3^\circ) \quad \checkmark$
 $= 92,59^\circ \quad \checkmark \quad (1)$

[20]

QUESTION 12

- 12.1
- Rapid Indexing
 - Simple Indexing
 - Angular Indexing
 - Differential Indexing
- (Any 3 × 1) (3)
- 12.2
- 12.2.1 Simple indexing (1)
- 12.2.2 The number of teeth is easily divisible into 40 ✓ with a remainder
divisible into one of the Cincinnati hole circles. ✓ (2)
- 12.2.3
- $$\frac{40}{N} = \frac{40}{13} = 3\frac{1}{13} \quad \checkmark$$
- $$= 3 \text{ turns and } \frac{1}{13} \text{ of a turn} \quad \checkmark$$
- $$\frac{1}{13} \times \frac{3}{3} = \frac{3}{39} \quad \checkmark$$
- Required indexing = 3 turns of crank & 3 holes in a 39 hole circle
✓ (3)
- 12.3
- Abrasive type
 - Grade of wheel
 - Bonding material
 - Grain size
 - Structure
- (5)
- 12.4
- Less power consumption.
 - Easy to sharpen.
 - Cheaper to manufacture.
 - Chattering is reduced.
- (4)
- 12.5
- Gang
 - Straddle
 - Slab
 - Slotting
 - Up-cut
 - Down-cut
 - Gear-cutting
 - Spiral or Helical milling
 - End-milling
- (Any 2 x 1) (2)
- [20]**
- TOTAL SECTION B: 40**
GRAND TOTAL: 100