Province of the
EASTERN CAPE
EDUCATION

DIRECTORATE SENIOR CURRICULUM MANAGEMENT (SEN-FET)

HOME SCHOOLING SELF-STUDY WORKSHEET ANSWER SHEET

SUBJECT	FITTING & MACHINING	**GRADE**	12	**DATE**	JUNE 2020
TOPIC	SYSTEMS AND CONTROL (DRIVE SYSTEMS)	**TERM 1 REVISION**	(Please tick)	**TERM 3 CONTENT**	(√)

QUESTION 1 Advantages of a belt drive system compared to a chain drive system:

- Silent operation
- Less expensive
- Drive can take place over a longer distance
- No lubrication needed   (ANY 2)

QUESTION 2 Hydraulics:

2.1 Fluid pressure:

$$A_A = \frac{\pi d^2}{4}$$

$$= \frac{\pi (0{,}032)^2}{4}$$

$$= 0{,}8 \times 10^{-3}\, m^2$$ ✓

$$p = \frac{F_A}{A_A}$$ ✓

$$= \frac{120}{0{,}8 \times 10^{-3}}$$

$$= 0{,}1492 \times 10^6\, Pa$$

$$= 0{,}15\, MPa \quad \text{or} \quad 149207{,}76\ Pa$$ ✓

(NO UNIT – NO MARK)

2.2 Diameter of the ram:

$$p = \frac{F_A}{A_A}$$ ✓

$$A_B = \frac{F_B}{p}$$

$$= \frac{18 \times 10^3}{0{,}15 \times 10^6}$$ ✓

$$= 0{,}12\, m^2$$ ✓

OR

$$\frac{F_B}{A_B} = \frac{F_A}{A_A}$$ ✓

$$A_B = \frac{A_A \times F_B}{F_A}$$

$$= \frac{(0{,}8 \times 10^{-3}) \times (18 \times 10^3)}{120}$$ ✓

$$= 0{,}12\, m^2$$ ✓

$$A_B = \frac{\pi d^2}{4}$$ ✓

$$d = \sqrt{\frac{4A}{\pi}}$$

$$= \sqrt{\frac{4 \times 0{,}12}{\pi}}$$ ✓

$$= 0{,}39088\, m$$ ✓

$$= 390{,}88\, mm$$

QUESTION 3

3.1 Fluid pressure:

$$A_B = \frac{\pi D_B^2}{4}$$

$$= \frac{\pi (0,2)^2}{4} \quad \checkmark$$

$$= 31,42 \times 10^{-3} \, m^2 \quad \checkmark$$

$$P = \frac{F_B}{A_B}$$

$$= \frac{15 \times 10^3}{31,42 \times 10^{-3}} \quad \begin{array}{c} \checkmark \\ \checkmark \end{array}$$

$$= 477,40 \times 10^3 \, Pa$$

$$= 477,40 \, kPa \quad \checkmark$$

3.2 Distance 'X':

$$A_A = \frac{\pi D_A^2}{4}$$

$$= \frac{\pi (0,075)^2}{4} \quad \checkmark$$

$$= 4,42 \times 10^{-3} m^2 \quad \checkmark$$

$$V_B = V_A$$

$$A_B \times L_B = A_A \times L_A \qquad \checkmark$$

$$L_B = \frac{A_A \times L_A}{A_B} \qquad \checkmark$$

$$= \frac{(4,42 \times 10^{-3}) \times (0,12)}{(31,42 \times 10^{-3})} \quad \checkmark$$

$$= 16,88 \times 10^{-3} \ m$$

$$= 16,88 \ mm \qquad \checkmark$$

QUESTION 4 Hydraulic symbols: One-way valve

QUESTION 5 Advantages of pneumatics:

- Compressed air is easy and cheap to generate.
- Leakages are not messy – no oil spills.
- Positive and negative pressure can be generated.
- More compact.
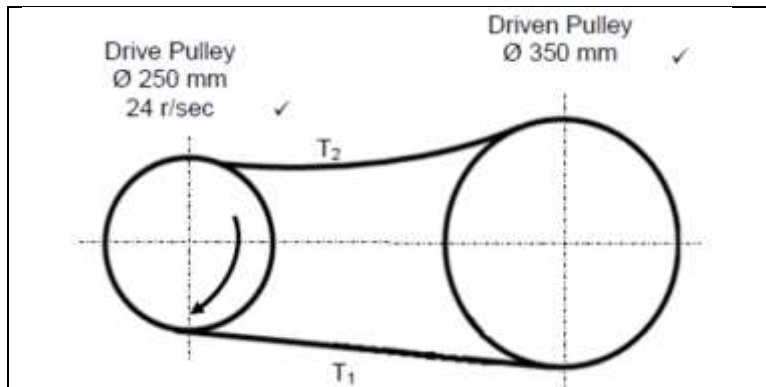- Easily maintain due to fewer working parts.   (ANY 2)

QUESTION 6 Belt drives: Rotation frequency of the drive pulley:

$$N_{DR}D_{DR} = N_{DN}D_{DN} \qquad \checkmark$$
$$N_{DR} = \frac{N_{DN} \times D_{DN}}{D_{DR}} \qquad \checkmark$$
$$= \frac{80 \times 240}{75} \qquad \checkmark$$
$$= 256 \text{ r/min} \qquad \checkmark$$

QUESTION 7 Belt-drive system:

7.1

Drive Pulley
Ø 250 mm
24 r/sec ✓

Driven Pulley
Ø 350 mm ✓

T_2

T_1

7.2 Belt speed:

$$v = \pi Dn \quad \checkmark$$
$$= \pi \times 0,25 \times 24 \quad \checkmark$$
$$v = 18,85 \, \text{m.s}^{-1} \quad \text{OR} \quad 18,85 \, \text{m/s} \quad \checkmark$$

7.3 Power transmitted:

$$P = (T_1 - T_2)v \quad \checkmark \qquad\qquad P = (T_1 - T_2)\pi Dn \quad \checkmark$$
$$= (300 - 120)18,85 \quad \checkmark \qquad = (300 - 120)\pi \times 0,25 \times 24 \quad \checkmark$$
$$= 180 \times 18,85 \quad \checkmark \qquad\qquad = 180 \times 18,85 \quad \checkmark$$
$$= 3393 \, \text{Watt} \qquad\qquad\qquad = 3393 \, \text{Watt}$$
$$= 3,39 \, \text{kW} \quad \checkmark \quad \text{OR} \qquad = 3,39 \, \text{kW} \quad \checkmark$$

QUESTION 8 Gear drive system: Number of teeth on gear C:

$$\frac{N_A}{N_D} = \frac{T_B \times T_D}{T_A \times T_C} \quad \checkmark$$

$$N_A = \frac{T_B \times T_D \times N_D}{T_A \times T_C} \quad \checkmark$$

$$= \frac{80 \times 60 \times 120}{30 \times 40} \quad \checkmark$$

$$= 480 \, \text{r/min} \quad \checkmark$$

QUESTION 9 Gear drives:

9.1 Rotation frequency of the output:

$$\frac{N_A}{N_D} = \frac{\text{Product of Driven gears}}{\text{Product of Driver gears}}$$

$$\frac{N_D}{N_A} = \frac{T_A \times T_C}{T_B \times T_D} \qquad \checkmark$$

$$N_D = \frac{T_A \times T_C \times N_A}{T_B \times T_D} \qquad \checkmark$$

$$= \frac{20 \times 25 \times 3000}{35 \times 30} \qquad \begin{array}{c}\checkmark \\ \checkmark\end{array}$$

$$N_D = \frac{1428,57 \text{ r/min}}{60} \qquad \checkmark$$

$$= 23,81 \text{ r/sec} \qquad \checkmark$$

OR

$$N_B = N_C = 1714,29 \text{r/min}$$

$$N_B \times T_B = N_A \times T_A \qquad \checkmark$$

$$N_B = \frac{N_A \times T_A}{T_B}$$

$$= \frac{3000 \times 20}{35}$$

$$= 1714,29 \text{r/min} \qquad \checkmark$$

$$N_D \times T_D = N_C \times T_C \qquad \checkmark$$

$$N_D = \frac{N_C \times T_C}{T_D}$$

$$= \frac{1714,29 \times 25}{30} \qquad \checkmark$$

$$= \frac{1428,57 \text{r/min}}{60} \qquad \checkmark$$

$$= 23,81 \text{r/sec} \qquad \checkmark$$

5

9.2 Gear ratio:

$$\text{Gear ratio} = \frac{\text{Product of the number of teeth on driven gears}}{\text{Product of the number of teeth on driver gears}} \checkmark$$

$$= \frac{35}{20} \times \frac{30}{25} \checkmark$$

$$= 2,1 : 1 \checkmark$$

QUESTION 10 Work done:

$$\text{Work done} = F \times s \checkmark$$

$$= 250 \times 15$$

$$= 3750 \text{ Joule or N.m} \checkmark$$

6