Province of the
EASTERN CAPE
EDUCATION

DIRECTORATE SENIOR CURRICULUM MANAGEMENT (SEN-FET)

HOME SCHOOLING SELF-STUDY WORKSHEET ANSWER SHEET

SUBJECT	POWER SYSTEMS	**GRADE**	12	**DATE**	JUNE 2020
TOPIC	THREE – PHASE TRANSFORMERS AND MOTORS & STARTERS	**TERM 1 REVISION**	(Please tick)	**TERM 2 CONTENT**	(√)

QUESTION 1

1.1 The main function of a transformer is to step up✓or step down the voltage ✓

1.2

- Size
- Frequency
- Windings ratio
- Voltage
- Power factor (Any 3)

1.3

The transfer of mmf through a transformer is constant. ✓ An increase in load will increase the mmf of the secondary side. ✓ The mmf on the primary side will increase by the same amount. ✓As the voltage is fixed by the supplier, only the primary current can increase. ✓

1.4

Since the oil is a dielectric, a non–conductor of electricity, ✓it improves the electrical insulation between the windings and the case. ✓It also helps to provide cooling ✓and prevents the formation of moisture on the windings.✓

1.5

- Copper losses.
- Iron losses.
- Eddy current losses.
- Hysteresis. (Any 3)

1.6.1

$$I_L = \frac{P}{\sqrt{3}\, V_L\, Cos\ \theta} \checkmark$$

$$= \frac{85\,000}{\sqrt{3}\times 450 \times 0.8} \checkmark$$

$$= 136{,}32\ A \checkmark$$

1.6.2

$$S = \sqrt{3}.\ V_L.I_L$$

$$= \sqrt{3} \times 450 \times 136{,}32$$

$$= 106{,}25\ kVA$$

1.6.3

$$V_{ph} = \frac{V_L}{\sqrt{3}}$$

$$= \frac{450}{\sqrt{3}} \checkmark$$

$$= \ 259{,}81\ V \checkmark$$

$$I_p = \frac{V_p \times I_s}{V_S} \checkmark$$

$$= \frac{13\ 800 \times 136{,}32}{259{,}81} \checkmark$$

$$= 7\ 240{,}74\ A$$

QUESTION 2

- 2.1
  - Squirrel cage induction motors are very popular, because they are rugged dependable and economical ✓
  - They are cheaper ✓
  - Require less care and maintenance ✓
  - They have high starting torque
  - Easy to change direction of rotation
  - They have a better cooling system. (Any 3)

2.2

An induction motor can be used as an induction generator ✓

Fans and water pump ✓

It can be unrolled to form a linear induction motor which can directly generate linear motion.

(Any 2)

2.3

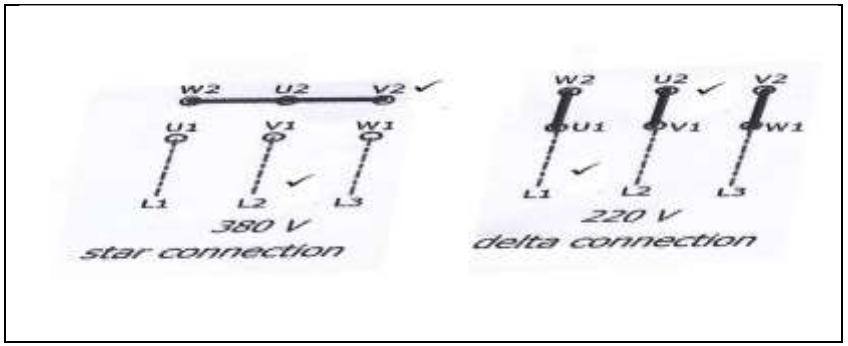
$n_s = \frac{60 \times f}{p}$ ✓

$\frac{48\ poles}{3\ phase} = 16\ poles\ per\ phase = 8\ pole\ pairs\ per\ phase$ ✓

$n_s = \frac{60 \times 50}{8}$ ✓

$= 375\ r.p.m$✓

2.4



2.5 By swopping any two supply lines, the direction of rotation can be reversed.

2.6

- Voltage
- Current
- Frequency
- Phase (Any 1)

2.7 At starting, the induced emf in the rotor bars, being short-circuited will be very high due to the full rated supply line voltage applied to the motor windings. □ The peak starting current can be up to six times the full load current. □The motor windings can be damaged by the high current. □Starters therefore reduce the starting voltages across the windings to protect them.

2.8 Such a low reading indicates a short circuit between the U and W coils. □ The reading should not be less than 1 MΩ. □□The motor should not be activated.□

2.9 The reading must be very high up - to infinity □ but not less than 1 MΩ for a motor in good condition.

2.10

$$Slip = \frac{n_s - n_r}{n_r} \times 100\% \checkmark$$

$$= \frac{3\,600 - 3\,384}{3\,600} \times 100\% \checkmark$$

$$= 6\% \checkmark$$

2.11

$$Efficiency(\eta) = \frac{input - losses}{input} \times 100\% \checkmark$$

$$= \frac{25\,000 - 2\,200}{25\,000} \times 100\% \checkmark$$

$$= 91{,}2\% \checkmark$$

2.12

$$P = \sqrt{3} V_L I_L \cos\theta\eta \checkmark$$
$$= \sqrt{3} \times 415 \times 20 \times 0{,}8 \times 0{,}9 \checkmark$$
$$= 10{,}35\ kW \checkmark$$