Province of the
EASTERN CAPE
EDUCATION

DIRECTORATE SENIOR CURRICULUM MANAGEMENT (SEN-FET)

HOME SCHOOLING SELF-STUDY WORKSHEET

<table>
<tr><td>SUBJECT</td><td>POWER SYSTEMS</td><td>GRADE</td><td>12</td><td>DATE</td><td>JUNE 2020</td></tr>
<tr><td>TOPIC</td><td>THREE – PHASE TRANSFORMERS AND MOTORS & STARTERS</td><td>TERM 1 REVISION</td><td>()</td><td>TERM 2 CONTENT</td><td>(√)</td></tr>
<tr><td>TIME ALLOCATION</td><td>2 hrs.</td><td colspan="4" rowspan="2"><u>TIPS TO KEEP HEALTHY</u>

1. WASH YOUR HANDS thoroughly with soap and water for at least 20 seconds. Alternatively, use hand sanitizer with an alcohol content of at least 60%.
2. PRACTICE SOCIAL DISTANCING – keep a distance of 1m away from other people.
3. PRACTISE GOOD RESPIRATORY HYGIENE: cough or sneeze into your elbow or tissue and dispose of the tissue immediately after use.
4. TRY NOT TO TOUCH YOUR FACE. The virus can be transferred from your hands to your nose, mouth and eyes. It can then enter your body and make you sick.
5. STAY AT HOME.</td></tr>
<tr><td>INSTRUCTIONS</td><td>As you go through and work out the answers to this revision material, pay special attention to the way in which questions are asked on a particular content aspect.</td></tr>
</table>

QUESTION 1

1.1 Refer to the losses that occur in transformers and answer the questions

that follow.

1.1.1 Name TWO types of losses that occur in transformers.
1.1.2 State TWO factors that may contribute to the excessive heating of transformers.
1.2 Describe how electromotive force (EMF) is induced in the secondary windings of transformers.
1.3 Explain why the following are important for effective and efficient use of transformers:
1.3.1 Cooling methods.
1.3.2 Protective devices
1.4 A 10 kVA star-delta transformer has primary and secondary line voltages of 6 kV and 500 V respectively.

Given:

S = 10kVA

V_{LS} = 500 V
V_{LP} = 6KV
pf = 0.97

Calculate:

1.4.1 Secondary line current

1.4.2 Transformer ratio

1.4.3 Input power if the power factor is 0,97

1.4.4 Efficiency of the transformer if the total loss is 80 W

1.5 Explain, with a reason, whether the secondary line current in QUESTION 1.4.1 is higher or lower than the primary line current.

QUESTION 2

2.1 List THREE external conditions that may cause transformer failure.

2.2 Explain what would happen if an earth fault occurs in one of the three phases of a protected transformer.

2.3 Describe how an increase in the load would affect the magneto motive force in the primary windings.

2.4 Name TWO types of cooling methods for a dry transformer.

2.5 State why the output power of a transformer is slightly less than the input power.

2.6 Describe the construction of a three-phase core-type transformer.

2.7 A star-delta connected transformer has 600 turns in the primary windings and 80 turns in the secondary windings. The transformer is connected to a 6 kV supply.

Given:

N_p = 600 turns
N_s = 80 turns
$V_{L(P)}$ = 6kV

Calculate the:

2.7.1 Turns ratio

2.7.2 Primary phase voltage

2.7.3 Secondary phase voltage

2.7.4 Secondary line voltage

2.8 With reference to Faraday's law, describe how mutual induction occurs in a transformer.

QUESTION 3

3.1 Define the term synchronous speed of the motor.

3.2 Give the reasons why the following tests are conducted:

3.2.1 Continuity test

3.2.2 Insulation resistance test

3.3 Describe the operation of the squirrel-cage induction motor.

3.4 Refer to FIGURE 1 below and answer the questions that follow.

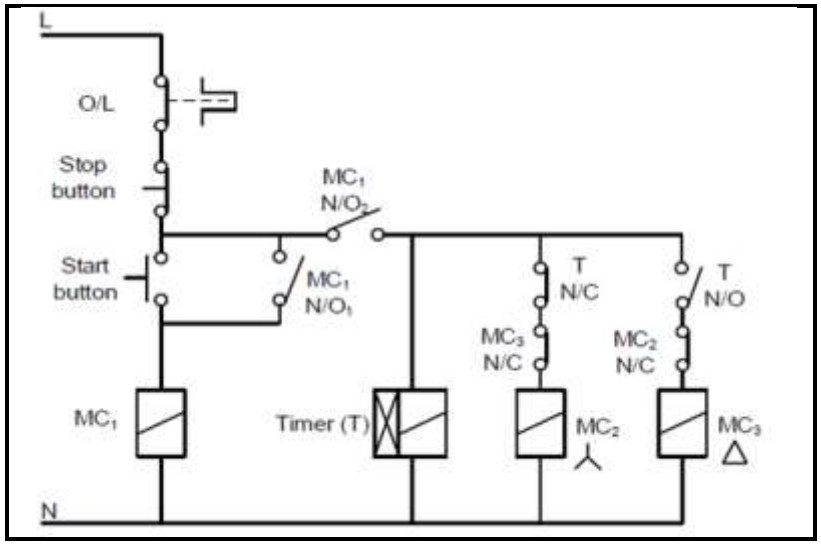

FIGURE 1: STAR – DELTA CONTROL CIRCUIT

3.4.1 Identify the interlocking contacts.

3.4.2 Explain why MC_1 (N/O_1) is connected in parallel with the start button.

3.4.3 Describe the operation of the star-delta control circuit.

3.5 A three-phase motor with 18 poles is supplied from a 380 V/50 Hz supply.

Given:

V_L	=	380 V
f	=	50 Hz
Number of poles	=	18

Calculate the:

3.5.1 Synchronous speed in r/min

3.5.2 Percentage slip if the rotor speed is 955 r/min

QUESTION 4

4.1 List THREE electrical inspections that need to be carried out on a three-phase motor before commissioning it.

4.2 Describe why it is necessary to have protective devices as part of motor

control.

4.3 Study FIGURE 2 below and answer the questions that follow.

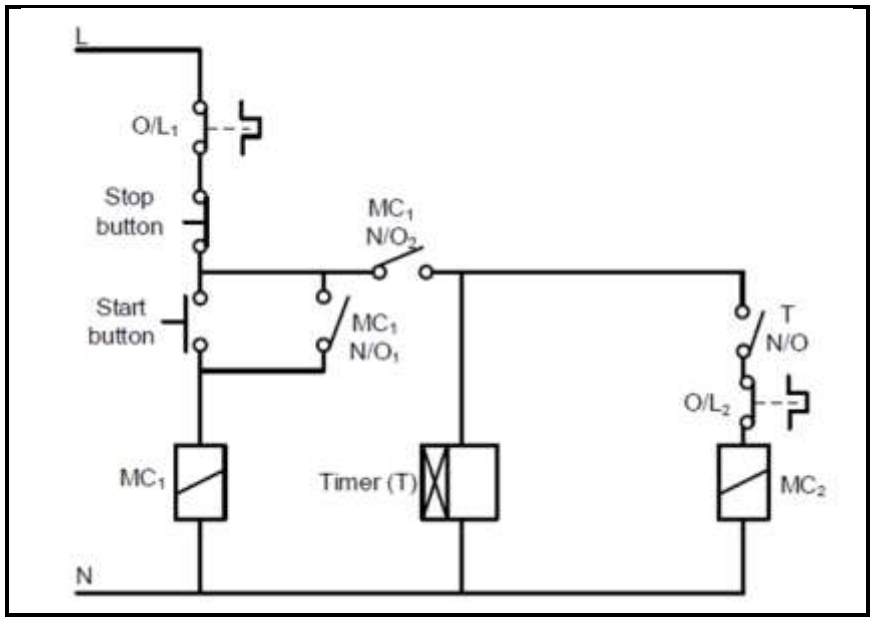

FIGURE 2: CONTROL CIRCUIT

4.3.1 Identify the motor starter in FIGURE 2.

4.3.2 Describe what would happen to contactor MC1 if contact MC1 N/O1

was faulty and permanently closed.

4.3.3 Describe the starting sequence of the control circuit.

4.3.4 Describe the main function of contactor MC1.

4.4 Explain why the starting current is reduced in a star-delta motor starter.

4.5 A 16 kW three-phase star-connected motor with 12 poles, is connected across a 380 V/50 Hz supply and draws a phase current of 29 A with a power factor of 0,85.

Given:

Number of poles	=	12
Cos θ	=	0.85
P_{OUT}	=	16 kW
V_L	=	380 V
I_{PH}	=	29 A
f	=	50 Hz

Calculate the:

4.5.1 Apparent power.

4.5.2 Synchronous speed.

4.5.3 Percentage slip if the rotor speed is 1 400 r/min.