Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2012

ELECTRICAL TECHNOLOGY MEMORANDUM

MARKS: 200

This memorandum consists of 11 pages.

QUESTION 1: TECHNOLOGY, SOCIETY AND THE ENVIRONMENT

1.1
- A sound knowledge of electronics to ensure the best possible technical design to produce a quality product.√
- A sound knowledge in handling financial matters to ensure a well-run sustainable business. √
- (ANY RELEVANT ANSWER WILL BE ACCEPTED) (2)

1.2
- Switch off all the unused electrical appliances and lights. √
- Do not use your dishwasher, laundry equipment, coffee maker or other home heavy appliance after 7 pm. √
- Use microwave oven to cook small quantities of food. √
- Lower your thermostat a degree or two degrees. √
- (ANY RELEVANT ANSWER WILL BE ACCEPTED) (4)

1.3 Cell phone.√

Positive: Contact with family and friends any time you want.√

Negative: Expose to pornography on phones.√
(ANY RELEVANT ANSWER WILL BE ACCEPTED) (3)

1.4 Communication skill (1)

[10]

QUESTION 2: TECHNOLOGICAL PROCESS

2.1
- Identify the problem. √
- Investigate. √
- Do research. √
- Assess. √
- Process. √
- ANY THREE (3)

2.2 2.2.1 Design and build an electronic warning sign to alert the traffic about cyclists and athletes. √√√ (3)

2.2.2
- The device should be portable. √
- It should be easy to use. √
- It should be easy to maintain. √
- It should flash colourful lights visible to motorists. √ (4)

[10]

QUESTION 3: OCCUPATIONAL HEALTH AND SAFETY

3.1 Safety is the main consideration behind all rules and regulations contained in the CODE of PRACTICE for the wiring of electrical installation. √√ (2)

3.2
- There should be no slippery surface. √
- Tidy workshop. √
- (ANY RELEVANT ANSWER WILL BE ACCEPTED) (2)

3.3
- There should be enough space between the machines. √
- Poorly ventilated work area.√
- (ANY RELEVANT ANSWER WILL BE ACCEPTED) (2)

3.4
- Stand firmly when working with a portable drilling machine. √
- Remove the chuck key from the chuck after loosening or tightening the bit. √ (2)

3.5 Ensure the main supply has been switched off.
Use a wooden or non-conductive object to release/remove him/her from the conductor. √√ (2)

[10]

QUESTION 4: INSTRUMENTS

4.1 8 div = 360º One full cycle
1 div = 45º
The waves are 45º apart
I lags V by 45º√√ (2)

4.2 Volt/div = 10 V
V_{max} = No. of div x volt /div
= 3 x 10√
= 30 V√ (2)

4.3 T = time /div x No. of div√
= 2,5 ms x 8√
= 20 ms√ (3)

4.4 V_{RMS} = 0,707 x V_{max} √
= 0,707 x 30√
= 21,21 V √ (3)

[10]

QUESTION 5: PRINCIPLE OF SINGLE-PHASE GENERATION

5.1
- As the conductor loop is rotated through the magnetic field, each of the two sides of the loop move through the magnetic field cutting the magnetic lines of flux. √
- This action induces an alternating voltage across the conductor loop. √ (2)

5.2 When the loop is perpendicular to the magnetic field. √? (1)

5.3 $i = 12 \sin 314t$

5.3.1 $I_{ave} = 0,637 \times I_{max}$
$= 0,637 \times 12$ √
$= 7,64$ A √ (2)

5.3.2 T = 1,5 ms.
$i = 12 \sin 314t$
$= 12 \sin 314° \times 1,5 \times 10^{-3} \times 57,3$ √√
$= 5,45$ A √ (3)

5.4 5.4.1 230 V rms
$V_{rms} = 0,707 \times V_{max}$
$V_{max} = \frac{230}{0,707}$ √
$= 325,32$ V √ (2)

5.4.2 $V_{ave} = 0,637 \times V_{max}$
$= 0,637 \times 352,32$√
$= 207,23$ V√ (2)

5.4.3 $T = \frac{1}{F}$√
$= \frac{1}{50}$ √
$= 20$ ms√ (3)

[15]

QUESTION 6: RLC CIRCUITS

6.1 Impedance of the circuit is the total opposition a circuit offers to the flow of current. It depends entirely to the frequency of the supply when connected to the alternating voltage supply. √√√ (3)

6.2 6.2.1 Nothing is going to happen as the resistor and the frequency have no relationship. √ (1)

6.2.2 Capacitive reactance will decrease. √ (1)

6.2.3 Inductive reactance will also increase. √ (1)

6.3 6.3.1 $X_L = 2\pi fL$√

$= 2.\pi.50.75.10^{-3}$√

$= 23,56\ \Omega$√

$X_C = \frac{1}{2\pi fC}$ √

$= \frac{1}{2.\pi.50.220.10^{-6}}$ √

$= 14,47\ \Omega$√

$Z = \sqrt{R^2 + (X_L - X_C)^2}$√

$= \sqrt{22^2 + (23,56 - 14,47)^2}$√

$= 23,8\ \Omega$√ (9)

6.3.2 $I = \frac{V}{Z}$√

$= \frac{24}{23,8}$√

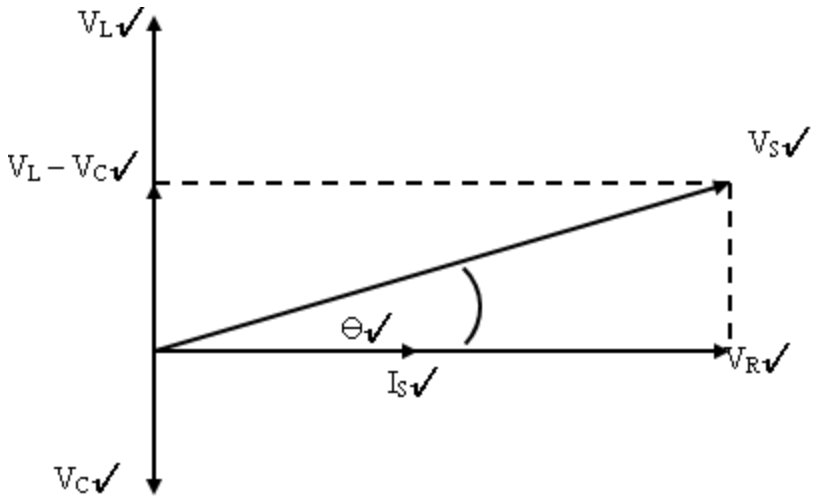
$= 1,01\ A$ √ (3)

6.3.3 $\theta = \cos^{-1}(R/Z)$ √

$= \cos^{-1}(22/23,8)$ √

$= 22,43^{o}$√ (3)

6.3.4



(4)

6.4
- $X_L = X_C$. √
- Impedance is at minimum. √
- Current is at maximum. √

(2)

6.5
- Radio tuning circuit. √
- Filtering circuit. √
- Oscillating circuit. √

(2)

6.6 Yes √

(1)
[30]

QUESTION 7: SEMI-CONDUCTOR DEVICES

7.1
$$\text{Gain} = \frac{\text{Voutput}}{\text{Vinput}} \checkmark$$
$$= \frac{3\text{Vp-p}}{0.02\text{Vp-p}} \checkmark$$
$$= 150 \checkmark$$

(3)

7.2
- Transistor as a switch. √
- Transistor as an amplifier. √

(2)

7.3 The trigger angle (and so the power available to the load) is controlled by R_2. R_1 √and R_2 form a voltage divider which with D1 sets up the necessary triggering potential. √ D_2 is the triggering device which conducts a positive voltage pulse to the gate only once its breakdown voltage of 0.6 V is overcome. √ By varying R_2 the voltage level at the gate of the thyristor will vary, √ so changing the trigger angle and therefore the power available to the lamp, changing the brightness of the lamp. √

(5)
[10]

QUESTION 8: AMPLIFIERS

8.1
- Common Emitter √
- Common Base √
- Common Collector √

(3)

8.2
$$Ic = \frac{Vcc}{Rc}$$
$$Rc = \frac{Vcc}{Ic} \checkmark$$
$$Rc = \frac{24Vdc}{150x10^{-3}} \checkmark$$
$$Rc = 160\Omega \checkmark$$

(3)

8.3
$$Xc = \frac{1}{2\pi fC} \checkmark$$
$$C = \frac{1}{2\pi fXc} \checkmark$$
$$= \frac{1}{2\pi\ 100 \times 33} \checkmark$$
$$= 48{,}23 \times 10^{-6}$$
$$= 48{,}23\ \mu f \checkmark$$

(4)
[10]

QUESTION 9: TRANSFORMERS

9.1
- Instrument transformer √
- Power transformer √

(2)

9.2 9.2.1 Transformer may be overloaded. √√ (2)

9.2.2
- Oil √
- Air √
- Water√

(3)

9.2.3
$I_P = S / V_P$√
$= 1\ 100\ 000 / 11000$√
$= 100$ A√

(3)

9.2.4 $I_S = \frac{I_P.V_P}{V_S}$ √

$= \frac{100 \times 11000}{230}$ √

$= 4\,782{,}61$ A√ (3)

9.3
- Shell type √
- Core type √ (2)

[15]

QUESTION 10: POWER SUPPLY

10.1
- Transformer √
- Rectifier √
- Smoothing √
- Regulation √ (4)

10.2 Smoothing the ripples from the rectifier. √√ (2)

10.3 As the input voltage rises above the Zener breakthrough voltage, √ the internal resistance of the Zener will lower and allow current to pass through it. √This will result in more current flowing into the base of the transistor, √ causing its internal resistance to lower and as a result thereof the voltage over the transistor will lower as well, √thus resetting the output voltage. √ (5)

10.4 10.4.1 Electrolytic capacitor √ (1)

10.4.2 Photo-diode √ (1)

10.5 Full Wave Rectification Half wave Rectification

(2)

[15]

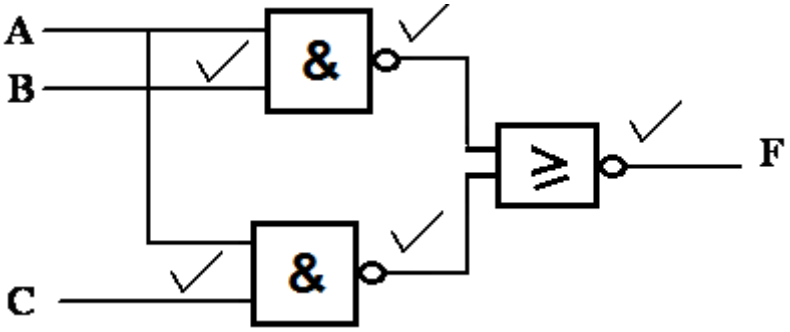
QUESTION 11: LOGIC CIRCUITS

11.1 11.1.1 NAND Gate √ (1)

11.1.2 NOR Gate √ (1)

11.1.3 NOT Gate √ (1)

11.2



$$F = \overline{\overline{A.B} + \overline{A.C}}$$ (5)

11.3

$$F = A.B + A.C$$
$$= \overline{\overline{A.B}}.\ \overline{\overline{A.C}}\ \checkmark$$
$$= A.B.A.C\ \checkmark$$
$$= A.B.C\ \checkmark$$ (4)

11.4 11.4.1 **1√** (1)

11.4.2 **1√** (1)

11.4.3 **1√** (1)

11.5
- Alarm Systems √
- Computers √ (2)

11.6 11.6.1 X + Y (1)

11.6.2 1 (1)

11.6.3 X (1)

[20]

QUESTION 12: PROTECTIVE DEVICES

12.1 12.1.1 Live in terminal √ (1)

12.1.2 Live out terminal √ (1)

12.1.3 Trip switch √ (1)

12.1.4 Moving contact √ (1)

12.2 12.2.1 40 A √ (1)

12.2.2 20 A √ (1)

12.3 The function of an earth-leakage relay unit is to automatically disconnect an installation or circuit from the supply in the event of a leakage of 20 mA or more flowing to earth. √√ (2)

12.4 Advantages of a circuit-breaker compared to that of a fuse:

- In the event of an overload or fault, all poles of the circuit are positively disconnected. √
- The devices are also capable of remote control by push-buttons, by under-voltage release coils, or by earth-leakage relay trip coils. √ (2)

[10]

QUESTION 13: OPERATING PRINCIPLES OF SINGLE-PHASE MOTORS

13.1 13.1.1 Running windings √ (1)

13.1.2 Auxiliary winding √ (1)

13.1.3 Starting capacitor √ (1)

13.1.4 Centrifugal switch √ (1)

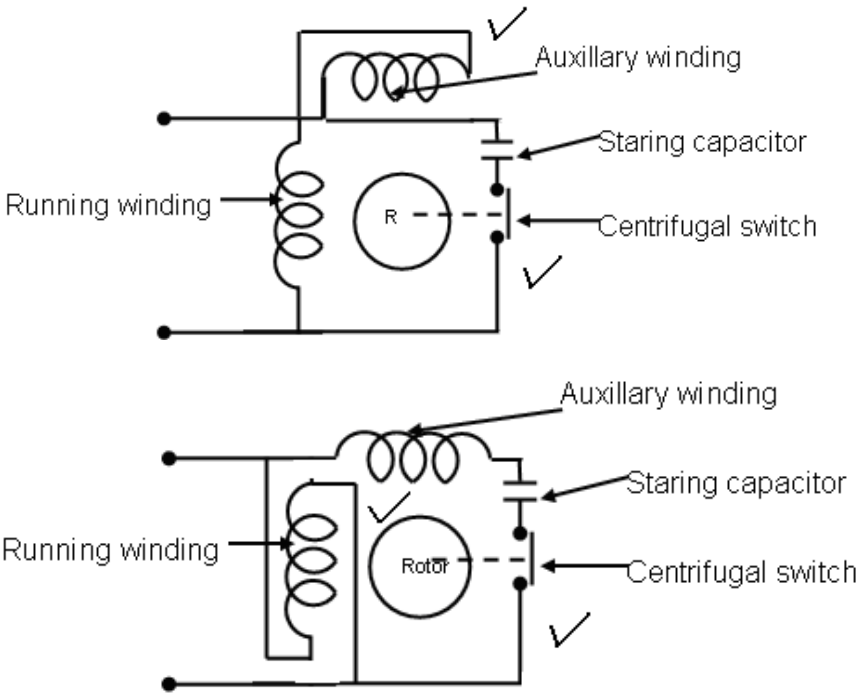
13.2 Capacitor-start induction motor √ (1)

13.3 To open up at about 75% of operating speed and remove the starting capacitor and starting winding from the supply. √√ (2)

13.4 Where a good starting torque is required √√ i.e. motors that will start under load. √ (3)

13.5 The motor will not automatically start because the two phase effect has no been created. √√ (2)

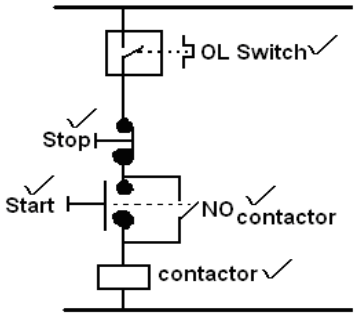
13.6



(4)

13.7 The two capacitors create a phase shift between the current in the main winding and the current in the starting winding. √√ This in turn creates a two phase effect in the stator which created a rotating magnetic field that is required to start the motor. √√ (4)

13.8



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[25]

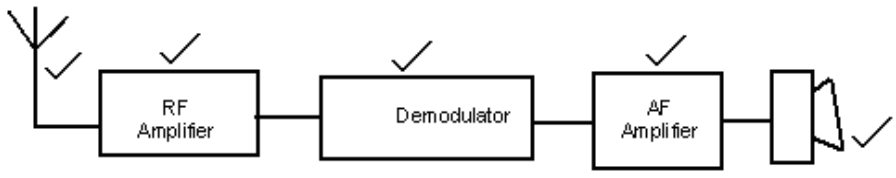
QUESTION 14: ELECTRONIC COMMUNICATION

14.1 Modulation is the process of combining the information with the carrier wave. √√ (2)

14.2 Yes (1)

14.3 The capacitor is acting as a filter, removing the RF and producing an audio signal on the output. √ (2)

14.4



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[10]

TOTAL: 200