Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2011

ELECTRICAL TECHNOLOGY MEMORANDUM

MARKS: **200**

This memorandum consists of 10 pages.

QUESTION 1: TECHNOLOGY, SOCIETY AND THE ENVIRONMENT

1.1
- Switch off all the unused electrical appliances as well as the lights. ✓
- Do not use your dishwasher, laundry equipment, coffee maker or other heavy home appliance after 7 pm. ✓
- Use the microwave oven to cook small quantities of food. ✓
- Lower your geyser thermostat. ✓

(ANY RELEVANT ANSWER WILL BE ACCEPTED) (4)

1.2 Yes, ✓ I should wear latex glove every time I help a bleeding person. ✓ (2)

1.3
- 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. ✓✓ (4)

[10]

QUESTION 2: TECHNOLOGICAL PROCESS

2.1
- Identify the problem. ✓
- Investigate. ✓
- Research. ✓
- Access. ✓
- Process. ✓ (5)

2.2 2.2.1 A gang raided his workshop at his home and has taken all his testing instruments. Mr. Mbhuda now finds it extremely difficult to do fault finding on the appliances and is not in a financial position to buy test instruments. ✓✓✓ (3)

2.2.2 I am going to design a device that will solve the problem of Mr. Mabhuda and that device will be a continuity tester. ✓✓ (2)

[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. ✓✓ (2)

3.2
- There should be no slippery surface. ✓
- There must be no horse play in the workshop. ✓ (2)

3.3
- There should be enough space between the machines. ✓
- Work area must be properly ventilated.✓ (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 3.5.1 CO_2 ✓ (1)

3.5.2 Foam ✓ (1)
[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. ✓ (3)

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

5.3 5.3.1 I_{ave} = 0,637 x I_{max}
= 0,637 x 12✓
= 7,64 Amps✓ (2)

5.3.2 T = 1,5 ms.
i = 12 sin 314t
= 12 sin 314 x 1,5 x10^{-3} x 57,3✓✓
= 5,45 Amps✓ (3)

5.4 5.4.1 230 V rms
Vrms = 0,707 x Vmax✓
Vmax = $\frac{230}{0,707}$ ✓
= 325,32 V✓ (2)

5.4.2 Vave = 0,637 x Vmax
= 0,637 x 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 resistor and frequency has no relationship. ✓ (1)

6.2.2 Capacitive reactance will decrease. ✓ (1)

6.2.3 Inductive reactance will increase. ✓ (1)

6.3 6.3.1 $X_L = 2\pi fL$✓
$= 2.\pi.50.75.10^{-3}$✓
= 23,56 Ω✓

$X_C = \frac{1}{2\pi fC}$ ✓

$= \frac{1}{2.\pi.50.220.10^{-6}}$✓
= 14,47 Ω✓

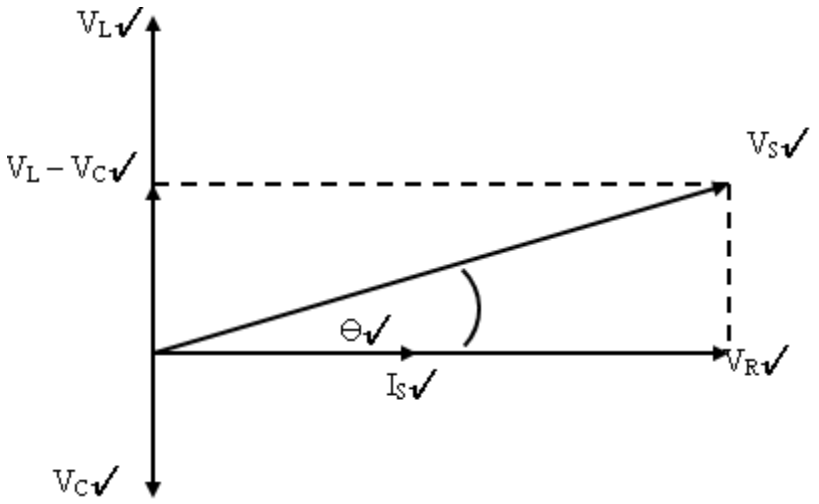
$Z = \sqrt{R^2 + (X_L - X_C)^2}$✓

$= \sqrt{22^2 + (23,56 - 14,47)^2}$✓
= 23,8 Ω✓ (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 No ✓ (1)

[30]

QUESTION 7: SEMI-CONDUCTOR DEVICES

7.1 This is two transistors connected together so that the current amplified by the first transistor is amplified further by the second transistor. The overall current gain is equal to the two individual gains multiplied together. ✓✓✓ (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 D_1 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 8.1.1
- Common Emitter ✓
- Common Base ✓
- Common Collector ✓ (3)

8.2 8.2.1 $I_c = \frac{V_{cc}}{R_c}$

$R_C = \frac{V_{cc}}{I_C}$ √

$R_c = \frac{24\ V_{dc}}{150x10^{-3}}$√

$R_C = 160\ \Omega$√ (3)

8.3 $X_c = \frac{1}{2\Pi fC}$√

$C = \frac{1}{2\Pi XfC}$√

$C = \frac{1}{2\Pi\ 100\ x\ 33}$√

$C = 48{,}23x10^{-6}$

$C = 48{,}23\ \mu f$√ (4)

[10]

QUESTION 9: TRANSFORMERS

9.1 It is used to lower or raise the voltage with the corresponding increase or decrease the current. **✓✓** (2)

9.2 9.2.1 Transformer may be overloaded. **✓✓** (2)

9.2.2 Oil, **✓** Air**✓** and Water**✓** (3)

9.2.3 $I_p = \frac{S}{V_p}$√

$I_p = \frac{1\ 100\ 000}{11\ 000}$√

$I_p = 100\ A$√ (3)

9.2.4 $I_s = \frac{I_p V_p}{V_s}$√

$I_s = \frac{100\ x\ 11\ 000}{230}$√

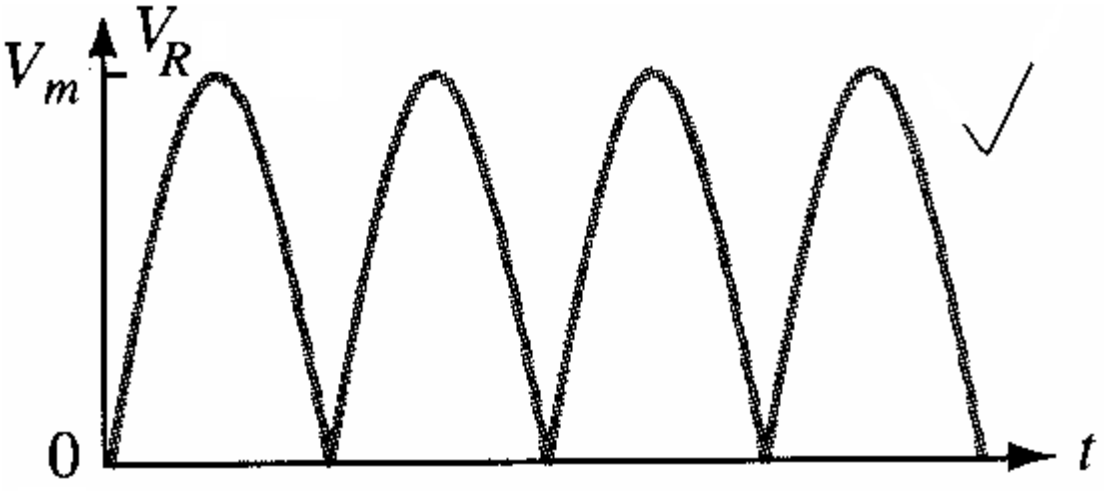
$I_s = 4\ 782{,}61\ A$√ (3)

9.3
- Shell type **✓**
- Core type **✓** (2)

[15]

QUESTION 10: POWER SUPPLY

10.1
- Transformer ✓
- Rectifier ✓
- Smoothing ✓
- Regulation ✓\ (4)

10.2 

(1)

10.3 Smoothing the ripples from the rectifier. ✓✓ (2)

10.4 10.4.1 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. ✓ (2)

10.5 10.5.1 Capacitor ✓ (1)

10.5.2 Photo-diode ✓ (1)

10.6 Full Wave Rectification ✓ Half wave Rectification ✓

(4)

[15]

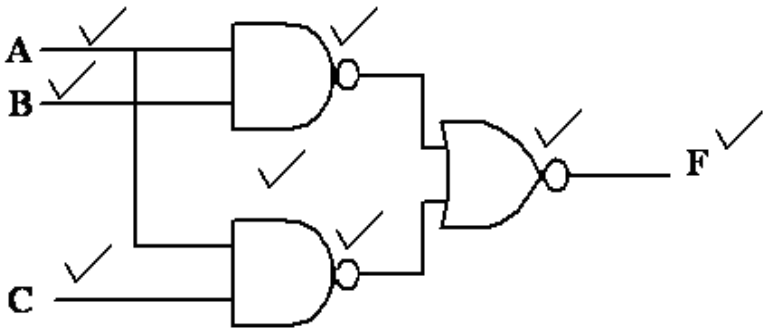
QUESTION 11: LOGIC CIRCUITS

11.1 11.1.1 NAND Gate ✓ (1)

11.1.2 NOR Gate ✓ (1)

11.1.3 NOT Gate ✓ (1)

11.2



$$F = \overline{\overline{A} + B + B.C}$$ (8)

11.3

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

$$= \overline{\overline{A.B}.\overline{C.D}} \checkmark$$

$$= A.B.A.C \checkmark$$

$$= A.B.C \checkmark$$ (4)

11.4 11.4.1 **1 ✓** (1)

11.4.2 **1 ✓** (1)

11.4.3 **1 ✓** (1)

11.5
- Alarm Systems ✓
- Computers ✓ (2)

[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)

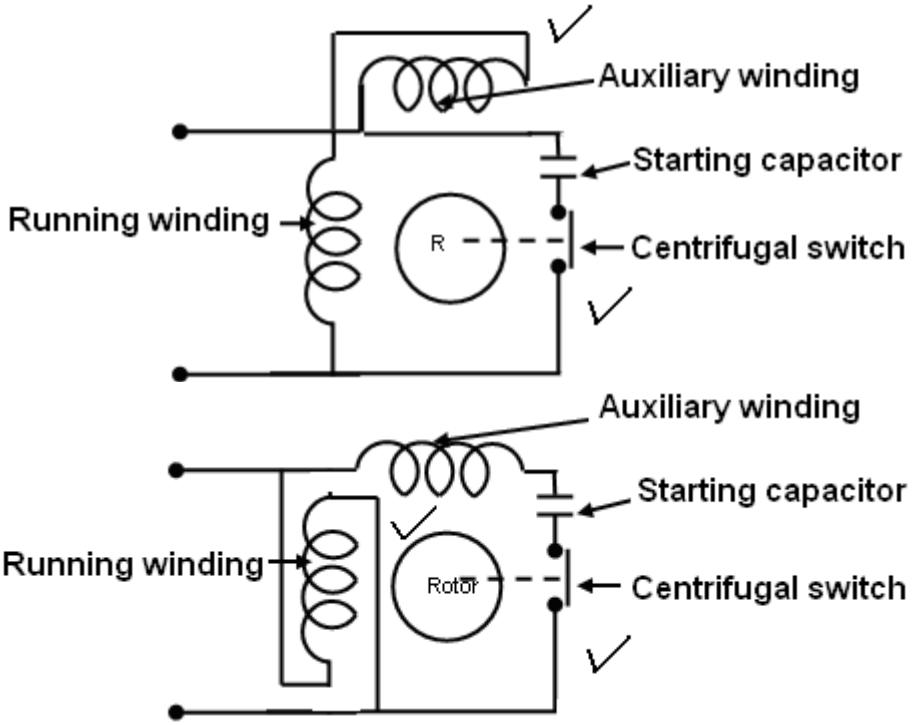
13.2 Capacitor-start induction motor ✓ (1)

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 not been created. ✓✓ (2)

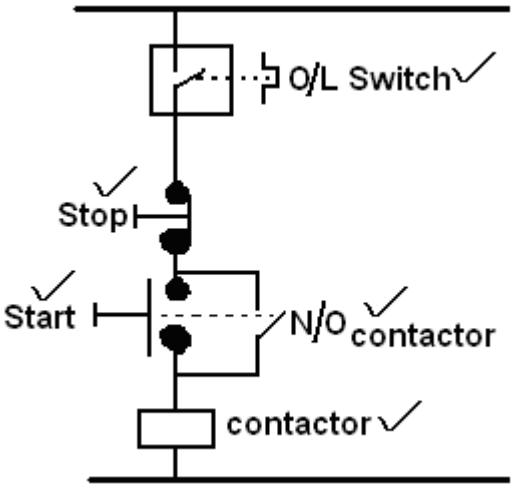
13.6



(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



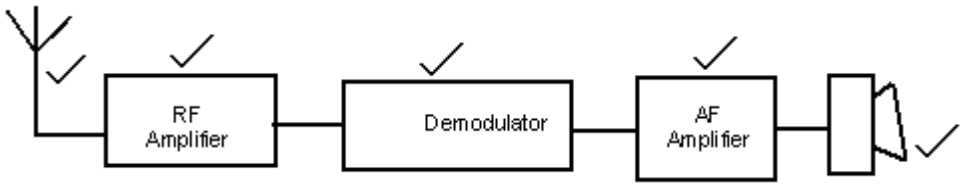
(5)
[25]

QUESTION 14: ELECTRONIC COMMUNICATION

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

14.2 There are no interferences. ✓ (ANY POSSIBLE ANSWER) (2)

14.3



Loudspeaker ✓ (6)
[10]

TOTAL: 200