

**GAUTENG DEPARTMENT OF EDUCATION  
SENIOR CERTIFICATE EXAMINATION**

**OCTOBER / NOVEMBER 2005  
OKTOBER / NOVEMBER 2005**

**TECHNIKA (ELECTRICAL) SG**

**TIME: 3 hours**

**MARKS: 200**

**REQUIREMENTS:**

- An approved calculator and drawing instruments

**INSTRUCTIONS:**

- Answer ALL the questions.
- Sketches and diagrams must be clear and neat.
- Formulae and calculations must be clear.
- Formulae and calculations must be shown where applicable.
- A list of formulae, which may be used when applicable, is given on the last page of this examination paper.

**QUESTION 1  
ELECTRICAL CURRENT THEORY**

- 1.1 A resistor of 47  $\Omega$ , an inductor of 10 mH and a capacitor of 100  $\mu\text{F}$  is connected in series with a supply of 50 V/50 Hz.

Calculate

- |       |                                                      |     |
|-------|------------------------------------------------------|-----|
| 1.1.1 | the total current of the circuit.                    | (8) |
| 1.1.2 | the phase angle between the current and the voltage. | (4) |
| 1.1.3 | the potential difference across each component.      | (6) |
| 1.1.4 | the power factor of the circuit.                     | (3) |
| 1.1.5 | Draw the phasor diagram (not to scale).              | (5) |

- 1.2 A parallel circuit consists of three branches. In the one branch is a resistor of 120  $\Omega$ . In the other, is a coil with an inductance of 27 mH and in the last branch, a capacitor with a value of 50  $\mu\text{F}$ . The circuit is supplied by 40 V/50 Hz.

Calculate

- |       |                                                      |      |
|-------|------------------------------------------------------|------|
| 1.2.1 | the total current flow in the circuit.               | (13) |
| 1.2.2 | the phase angle between the current and the voltage. | (4)  |
| 1.2.3 | Draw a phasor diagram (not to scale).                | (5)  |

**[48]**

**QUESTION 2**  
**SINGLE AND THREE-PHASE SYSTEMS**

- 2.1 Explain how a three-phase alternating current wave can be generated by a simple three-phase generator. Illustrate your answer with suitable sketches and waveforms. (5)
- 2.2 A three-phase star generator generates 380 V across each phase. Calculate the resulting line voltage between L1 and L2. (3)
- 2.3 Draw a phasor diagram of the voltages of a three-phase alternating current system. (3)
- [11]**

**QUESTION 3**  
**TRANSFORMERS**

- 3.1 The rating of a three-phase transformer is 300 kVA. The secondary phase voltage is 220 volt when connected in star.
- Calculate
- 3.1.1 the secondary line voltage. (2)
- 3.1.2 the maximum allowable secondary phase current. (5)
- 3.1.3 the maximum power output if the power factor is 0,8. (3)
- 3.2 Name TWO losses that occur in transformers. (4)
- 3.3 Use THREE single-phase transformers and connect them in delta-star. (6)
- [20]**

**QUESTION 4**  
**ALTERNATING CURRENT MOTORS**

- 4.1 The end connectors of the stator windings of a three-phase motor are usually brought out to the connecting block as shown in **Figure 4.1**. Show in your answer book, how the motor will be connected in delta and in star. Draw the connecting block for each connection. (10)

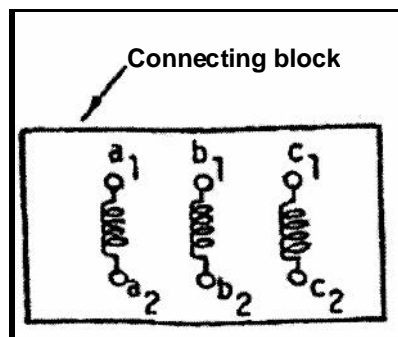


Figure 4.1

- 4.2 Explain the term **synchronous speed** when referring to alternating current motors. (3)
- 4.3 How can the direction of rotation be reversed in a capacitor-start motor? (2)
- 4.4 What is the purpose of the second capacitor in a capacitor-run motor? (3)
- 4.5 Sketch labelled diagrams to represent the following single-phase motors:
- 4.5.1 Capacitor-start-and-run motor (5)
- 4.5.2 Shaded-pole motor (5)
- [28]**

### QUESTION 5 SEMICONDUCTORS

- 5.1 Explain, with the aid of sketches, the basic working principles of the SCR (Silicon control rectifier). **[10]**

### QUESTION 6 AMPLIFIERS

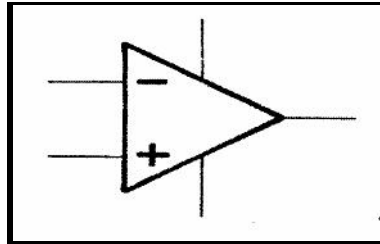
- 6.1 Draw a circuit diagram of a common-emitter amplifier. Briefly explain the purpose of each component. (10)
- 6.2 Explain what is meant by the following classifications of amplifiers:
- 6.2.1 Class A amplifier
- 6.2.2 Class C amplifier (10)
- [20]**

### QUESTION 7 SWITCHING AND CONTROL CIRCUITS

- 7.1 Draw a neat, labelled circuit diagram of a simple transistor shunt regulator. Use an NPN transistor. (10)
- 7.2 Draw a neat, labelled circuit diagram that makes use of a triac to obtain lamp dimming. Show all relevant wave forms. (10)
- [20]**

**QUESTION 8  
OPERATIONAL AMPLIFIERS**

- 8.1 Label the sketch below. (5)



- 8.2 Sketch a neat, labelled circuit diagram that makes use of an operational amplifier that changes a square wave to a sawtooth wave. Show all relevant waveforms. (5)

[10]

**QUESTION 9  
OSCILLATORS**

- 9.1 Sketch the circuit diagram and explain the working principle of the Colpitts-oscillator. [8]

**QUESTION 10  
COMPUTER PRINCIPLES**

- 10.1 Sketch a neat, labelled logic gate-circuit using the following Boolean algebra expression and sketch the truth table in your answer book.

$$F = (\bar{A} B C + A \bar{B} C + \bar{A} \bar{B} C) \quad (6)$$

- 10.2 Do the following calculations:

10.2.1  $10011_2 + 1101_2$  (3)

10.2.2  $100101_2 - 1111_2$  (4)

- 10.3 Draw a logic symbol by using the truth table below.

A	B	F
0	0	0
0	1	0
1	0	0
1	1	1

(3)  
[16]

**QUESTION 11**  
**MEASURING INSTRUMENTS**

- 11.1 Draw a neat, labelled sketch of an energy meter. (8)
- 11.2 Name an important item found in the first-aid kit in a workshop, when considering the HI virus. (1)
- [9]**

**TOTAL: 200**