This question paper consists of 5 pages, 2 diagram sheets and a 3-page formula sheet.
INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Keep subsections of questions together.
5. RULE OFF across the page on completion of each question.
6. Use ONLY IEC symbols and units throughout.
7. ALL sketches must be neat, made in PENCIL and a ruler, NOT freehand.
8. NO red or green ink may be used.
9. Use \( \pi \) as 3.142 and NOT as \( \frac{22}{7} \).
10. Write neatly and legibly.
QUESTION 1

Indicate whether the following statements are TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (1.1 – 1.10) in the ANSWER BOOK.

1.1 A transducer is an appliance that converts one form of energy to another. (1)
1.2 Resonance in a circuit occurs when $X_L = X_C$. (1)
1.3 An atom is the smallest part of an element that can take part in a normal chemical reaction. (1)
1.4 Power is the rate of doing work. (1)
1.5 The mid-ordinate rule is used to calculate the RMS values of sinusoidal wave forms. (1)
1.6 The ampere meter must always be connected in parallel with the load. (1)
1.7 A synchro-system is the electrical equivalent of mechanical transfer over a long distance. (1)
1.8 A decibel is one tenth of a bel. (1)
1.9 The common collector has a phase shift of 180°. (1)
1.10 A conductor is material that offers a low resistance to electric current. (1)  

QUESTION 2

Refer to FIGURE 1, on the attached DIAGRAM SHEET 1, and calculate the following:

2.1 The total resistance in the circuit (6)
2.2 The total current flow (2)
2.3 The voltage drop across the 20 Ω resistor (4)
2.4 The power consumed by $R_T$ resistor (2)  

[14]
QUESTION 3

Refer to FIGURE 2, on the attached DIAGRAM SHEET 1, and calculate the following:

3.1 The value of the capacitor (2)
3.2 The reactance of the coil (2)
3.3 The impedance (3)
3.4 The total current (2)
3.5 The voltage drop across the resistor (2)
3.6 The phase angle (3) [14]

QUESTION 4

The equation for a certain alternating wave is given by the formula 
\[ e = 300 \sin (51.41 t) \, \text{V} \]. Use the formula to calculate the following:

4.1 The maximum or peak value for voltage (2)
4.2 The average and RMS values (2)
4.3 The form and crest factors (2)
4.4 The frequency of the wave (3)
4.5 The instantaneous value of the voltage 7 and 13 milliseconds after zero (3) [12]

QUESTION 5

5.1 Draw the symbols of the following diodes and state ONE function of each:

5.1.1 Zener diode (3)
5.1.2 Varactor diode (3)

5.2 Draw and label the expected input and output wave forms of the rectifier in FIGURE 3, on the attached DIAGRAM SHEET 2. The transformer is connected to a 220 V/50 Hz. (6) [12]
QUESTION 6

6.1 A voltmeter has a full deflection of 15 mA and an internal resistance of 5 ohms. Calculate the value of the resistor to measure a full scale voltage of 50 V. Draw and label the circuit diagram. (6)

6.2 State TWO advantages of a digital multimeter over an analogue multimeter and THREE uses thereof. (5) [11]

QUESTION 7

7.1 State THREE factors to be considered when selecting a transducer. (3)

7.2 State the difference between the thermocouple and the thermistor. (2)

7.3 Briefly explain, with the aid of a characteristic curve, the operation of the LDR. (5) [10]

QUESTION 8

An electronic network has an output voltage of 2.5 V and an input voltage of 12 V. The input and output impedance is 600 ohms. Calculate the input and output power of the network. (6)

QUESTION 9

9.1 Define Lenz's law. (3)

9.2 Draw a neat labelled diagram of a synchro-system showing the connections for transmitter and receiver to turn in the same direction. (6)

9.3 State TWO advantages of a synchro-system over a mechanical system. (2) [11]

TOTAL: 100
DIAGRAM SHEET 2

Transformer
Transformator
220 V /50Hz

D₁

load/ias

D₂

FIGURE 3
INDUSTRIAL ELECTRONICS N2

FORMULA SHEET

DC THEORY/GS-TEORIE

(i) \[ V = I \times R \]
(ii) \[ R_T = R_1 + R_2 \]
(iii) \[ \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} \]
(iv) \[ P = V \times I \]
(v) \[ P = I^2 \times R \]
(vi) \[ P = \frac{V^2}{R} \]

AC THEORY/WS-TEORIE

(i) \[ t = \frac{1}{f} \]
(ii) \[ e = E_m \sin 2\pi ft \]
(iii) \[ i = I_m \sin 2\pi ft \]
(iv) \[ \theta = 2\pi ft \]
(v) \[ I_{AVE} = \frac{I_1 + I_2 + I_3}{n} \]
(vi) \[ I_{RMS} = \sqrt{\frac{I_1^2 + I_2^2 + I_3^2}{n}} \]
(vii) \[ V_{AVE} = \frac{V_1 + V_2 + V_3}{n} \]
(viii) \[ V_{RMS} = \sqrt{\frac{V_1^2 + V_2^2 + V_3^2}{n}} \]
(ix) \[ V_{AVE} = V_M \times 0.637 \]
(x) \[ V_{RMS} = V_M \times 0.707 \]
(xi) Form factor = \[ \frac{RMS \text{ value}}{AVE \text{ value}} \]

PTO
(xii) Crest factor = \( \frac{\text{Maximum value}}{\text{RMS value}} \)

Kruinfaaker = \( \frac{\text{Maksimum waarde}}{\text{WGK-waarde}} \)

(xiii) \( \omega = 2\pi f \)

(xiv) \( X_C = \frac{1}{2\pi fC} \)

(xv) \( X_L = 2\pi fL \)

(xvi) \( V_T = \sqrt{V_R^2 + V_L^2} \)

(xvii) \( V_T = \sqrt{V_R^2 + V_C^2} \)

(xviii) \( V_T = \sqrt{V_R^2 + (V_L \approx V_C)^2} \)

(xix) \( Z = \sqrt{R^2 + X_C^2} \)

(xx) \( Z = \sqrt{R^2 + X_L^2} \)

(xx) \( Z = \sqrt{R^2 + (X_L \approx X_C)^2} \)

(xxii) \( I_T = \frac{V_T}{Z} \)

(xxiii) \( V_C = I_T \times X_C \)

(xxiv) \( V_R = I_T \times R \)

(xxv) \( V_L = I_T \times X_L \)

(xxvi) \( \theta = \cos^{-1} \left( \frac{R}{Z} \right) \)

(xxvii) \( f_0 = \frac{1}{2\pi \sqrt{LC}} \)

MEASURING INSTRUMENTS/MEETINSTRUMENTEN

(i) \( R_{SH} = \frac{I_M \times R_M}{I_{SH}} \)

(ii) \( R_T = \frac{V_T}{I_M} - R_M \)

TRANSISTORS

(iii) \( I_e = I_c + I_b \)
DECIBEL RATIOS/DESIBELVERHOUDINGS

(iv) \[ N = 10 \log \frac{P_0}{P_1} \]

(v) \[ N = 20 \log \frac{I_0}{I_1} + 10 \log \frac{R_0}{R_1} \]

(vi) \[ N = 20 \log \frac{V_0}{V_1} + 10 \log \frac{R_1}{R_0} \]

If/As \( R_1 = R_0 \)

(vii) \[ \text{then/dan } N = 20 \log \frac{I_0}{I_1} \]

(viii) \[ N = 20 \log \frac{V_0}{V_1} \]

(ix) RESISTANCE

\[ R = \frac{\rho \ell}{a} \]

(x) \[ a = \frac{md^2}{4} \]