higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

REPORT 191 PROGRAMMES

SYLLABUS

INDUSTRIAL ELECTRONICS

N4

SUBJECT CODE: 8080164

Implementation: May 2024

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Syllabus: Industrial Electronics N4

1. General Aims

To equip students with knowledge and fundamental principles in the electronic industry in order to improve their work skills and further their career prospects.

2. Specific Aims

2.1 The student should obtain a thorough knowledge of principles and practices as applied in the electronics industry.

2.2.1 The teaching of this subject is aimed as an introduction to the application of technological principles and practices such as:

- Power Supplies and Control
- Design procedures
- Process Control
- Amplification

3. Pre-requisite

Student must meet at least one of the following requirements.

3.1 Completed National N3 certificate with Industrial Electronics.
3.2 Passed grade 12 with at least 40% or E symbol in Mathematics or Physical Science or relevant electrical related subjects.
3.3 Completed NC(V) level 4 certificate in Electrical Infrastructure and Construction.
3.4 Passed senior certificate for adult learners with at least 40% or E symbol in Mathematics or Physical Science.
3.5 Any relevant skills programme with at least 120 credits on NQF level 4.

4. Duration

Full-time: 7.5 hours per week. This instructional offering may also be offered in part-time basis.

5. Evaluation

5.1 Evaluation is conducted continuously by means of two formal tests at College level. Student must obtain a minimum ICASS mark of at least 40% in order to qualify to write the final examination and a mark will be calculated together in a ratio of 30:70 to derive the promotion mark. The student must obtain at least 40% on the final examination as pass mark.

The promotion mark will be calculated as follows:
Promotion Mark **= 30%** of (ICASS mark) **+ 70%** of (Exam mark)

5.2 The examination in Industrial Electronics N4 (Engineering Studies - Report 191) will be conducted as follows:

Modules 1 to 7 MARKS: 100

DURATION: 3 HOURS

CLOSED BOOK: Formula sheet is attached to the question paper
Scientific calculators allowed
No programmable calculators allowed
No references allowed.
No external examination papers or memoranda allowed

5.3 **Weighting**:

The following weights are consequently awarded to each category:

Knowledge and Understanding	**Applying**	**Analysing / Syntheses and Evaluating**
30 – 40	45 – 50	10 – 25

6. Learning content

THEORETICAL BACKGROUND

It is essential that this subject should be illustrated and evaluated within the context of practical case studies.

7. Mark allocation in the examination as an indication of the weighting of the different modules

MODULES	WEIGHTING
1. Network Theorems	**20**
2. Alternating Current Theory	**20**
3. Electronic power control	**15**
4. Power Supplies	**15**
5. Amplifiers	**15**
6. Transducers and LCD	**15**
TOTAL	**100**

Module 1: Network Theorems

General a

The student should be able to gain an understanding of theoretical terms and calculations.

LEARNING CONTENT	LEARNING OUTCOMES The student must be able to:
1.1 Kirchhoff's laws	1.1.1 Explain the two laws of Kirchhoff in electrical circuits: - First law (currents law) - Second law (voltage law) Calculate current, voltage and power by using Kirchhoff's laws.
1.2 Superposition Theorem	1.2.1 Briefly explain Superposition Theorem. 1.2.2 Calculate the equivalent resistance, current and voltage by means of the Superposition's Theorem
1.3 Thevenin's Theorem	1.3.1 Briefly explain Thevenin's Theorem. 1.3.2 Calculate the current, voltage and resistance using Thevenin's Theorem. 1.3.3 Draw a neatly labelled circuit diagram of Thevenin's. equivalent circuit.
1.4 Norton's Theorem	1.4.1 Briefly explain Norton's Theorem. 1.4.2 Calculate the current, voltage and resistance using Norton's Theorem. 1.4.3 Draw a neatly labelled circuit diagram of Norton's. equivalent circuit.
1.5 Maximum power transfer theorem using Nodal analysis and Thevenin's equivalent circuits	1.5.1 Briefly explain Maximum Power Theorem. Calculate the current, voltage, resistance and power by using Maximum Power Transfer

Module 2: Alternating Current Theory
General aim

On completion of this module, the student should be able to explain and apply the Alternating Current Theory using Complex numbers.

LEARNING CONTENT	LEARNING OUTCOMES The student must be able to:
2.1 RLC circuits	2.1.1 Apply the information given in RL, RC, RLC series or parallel circuits to calculate: Voltage, current, inductive reactance, capacitive reactance, impedance, phase angle and frequency. - Draw a neatly labelled phasor and impedance diagram
	2.1.2 Analyse phasor and impedance diagrams to calculate: Voltage, current, inductive reactance, capacitive reactance and impedance.
2.2 Resonance circuits	2.2.1 Explain the following terms: - Resonance frequency - Dynamic Impedance - Bandwidth - Quality factor
	2.2.2 Calculate the resonance frequency, bandwidth and quality factor for parallel and series RLC circuits. 2.2.3 Draw neatly labelled characteristic curves for the resonance frequency, bandwidth and quality factor in parallel and series RLC circuits.
2.3 Dynamic impedance	2.3.1 Calculate the dynamic impedance in LC parallel circuits.
2.4 Complex Numbers (j notation)	2.4.1 Apply the information given in RLC series or parallel circuits using complex numbers to calculate: Voltage, current, inductive reactance, capacitive reactance, impedance, phase angle and frequency. 2.4.2 Draw a neatly labelled phasor diagram.

Module 3: Electronic Power Control

General aim

On completion of this module the student should have an understanding of electronic power control circuits.

LEARNING CONTENT	LEARNING OUTCOMES The student must be able to:
3.1 Semiconductor diode	3.1.1 Calculate the diode's forward current, reverse saturation current and forward voltage drop using diode equation. 3.1.2 Calculate the forward resistance of the diode.
	3.1.3 List different types of diodes and their applications. 3.1.4 Describe the operating principles and the uses of the following diodes:Zener, Schottky, Avalanche, Gunn, Tunnel, Varactor, and Junction diode. 3.1.5 Draw neatly labelled characteristic curves of the following diodes, Tunnel, Varactor, Schottky, Avalanche, Gunn, Zener, and Junction diode.
	3.1.6 Draw a neatly labelled circuit diagram of Zener voltage regulator. 3.1.7 Calculate the current, voltage and resistance values Zener voltage regulator
3.2 Electronic Power Control	3.2.1 Draw a neatly labelled characteristic curve and describe the operating principle of the following Power control devices: - SCR - DIAC - TRIAC - QUADRAC - LASCR
	3.2.2 Draw a neatly labelled block diagram and describe the operating principle of: - An open loop system - A closed loop system

Module 4: Power Supplies

General aim

On completion of this module the student should be able to understand various types of transformers and the application thereof.

LEARNING CONTENT	LEARNING OUTCOMES The student must be able to:
4.1 Transformers	4.1.1 Identify different components of a DC power supply with the aid of a neatly labelled sketch
	4.1.2 List and explain the operating principles of the following types of transformers with the aid of a neatly labelled circuit diagram - Step down - Step up - Centre-tap - Multiple winding - Autotransformer - Isolation transformer - Power transformer - Instrument transformer - Current transformer - Potential/ voltage transformer - Audio frequency transformer
4.2 Transformer ratios	4.2.1 Explain in words and by calculating the following transformer ratios: - Turns ratios - Voltage ratio - Current ratio 4.2.2 Use the information given for a transformer to calculate the current, voltage or turns on the primary and secondary windings.
4.3 Transformer ratings	4.3.1 Calculate KVA rating of the transformer.
4.4 Rectification	4.4.1 Explain the term rectification 4.4.2 Describe the operating principles of half and full wave rectifiers. 4.4.3 Draw neatly labelled circuit diagrams and show input and output waveforms of the following rectifiers: - Half- wave rectifier - Full- wave (center- tap and bridge) rectifier 4.4.4 Utilise the information given for different rectifier

	circuits to calculate: • Average or DC values • RMS values • Efficiency • Ripple factor • PIV value.
4.5 Filter circuits	4.5.1 Briefly describe in words the basic operation of filter circuits. 4.5.2 Draw neatly labelled circuit diagrams of the following filter circuits: - Capacitor filter - RC filter - LC filter 4.5.3 Utilise the information given for different filters to calculate: • Average/DC values • RMS values • Efficiency • The ripple factor.

Module 5: Amplifiers

General aim

On completion of this module the students should understand the principles and properties of amplifiers.
To understand the basics and the benefits of amplifiers.

LEARNING CONTENT	LEARNING OUTCOMES **The student must be able to:**
5.1 Transistors	5.1.1 Explain in words what you understand by the component called transistors. 5.1.2 Explain in words the operating principle of a transistor and the construction of transistor amplifier configurations (CE, CB and CC) by means of afully labelled sketch. 5.1.3 Explain the various operating points within the limits of operation of a transistor. 5.1.4 Analyse the DC load line of a common emitter amplifier. 5.1.5 Explain in words the term Quiescent point (Q-point) and List the factors that affect the stability of the Q point. 5.1.6 Explain the different coupling methods used in amplifiers. *Range: Resistance-capacitance, transformer and direct coupling*. 5.1.7 List the advantages, disadvantages and applications of the different coupling methods used in amplifiers. 5.1.8 Describe the operation and characteristics of class A, B, AB, and C amplifiers. 5.1.9 Explain the operation and list the advantages of a class B push-pull amplifier. 5.1.10 Distinguish between positive and negative feedback amplifiers. 5.1.11 Explain and compare the different types of feedback connections *Range: Voltage-series, voltage-shunt, current-series, and current-shunt feedback connection.* • List and explain the two types of transistor gains. • Draw a labelled static/dynamic characteristics curve of a transistor. • Utilise the information given in CE, CC, and CB transistor circuit to calculate the following: • Static/dynamic Current gain • Static/dynamic Voltage gain • Static/dynamic Power gain 5.1.12 Utilise the information given in an amplifier circuit to calculate the following in decibels: • Power gain • Current gain • Voltage gain 5.1.13 List different types of push-pull amplifiers and their advantages/disadvantages.

	5.1.14 Draw neatly labelled circuit diagrams of push-pull amplifiers and show their input and output waveforms. 5.1.15 Describe the operation of the common emitter amplifier used in class A and B modes. 5.1.16 Explain the difference between class A, class B and class AB of amplifiers. 5.1.17 Describe the operating principle of class A, class B and class AB amplifiers. 5.1.18 List the advantages and disadvantages of non-complementary class B push-pull amplifier and symmetrical push-pull class AB amplifier. 5.1.19 Draw neatly labelled circuit diagrams of non-complementary class B, symmetrical push-pull class AB, complementary-symmetry push-pull class B, complementary symmetry push-pull class AB and the cross over distortion. 5.1.20 Describe the operating principle of non-complementary class B, symmetrical push-pull class AB, complementary-symmetry push-pull class B, complementary symmetry push-pull class AB and the cross over distortion. 5.1.21 Draw a neatly labelled circuit diagram of h parameter equivalent circuit for a common base and common emitter circuits.
5.2 Operational Amplifiers	5.2.1 List the properties, characteristics and advantages of operational amplifier. 5.2.2 Calculate the gain and draw the neat, labelled circuit diagrams with the associated input and output waveforms for an operational amplifier used as: - An inverting amplifier - Non-inverting amplifier - An adder/ summing amplifier - A differentiator - An integrator - A comparator

Module 6: Transducers and LCD

General aim

On completion of this module the student should be able have an understanding transducers and test equipment's used in electronic industry.

LEARNING CONTENT	LEARNING OUTCOMES **The student must be able to:**
6.1 Transducers	6.1.1 Explain the operating principles and list the applications of the following resistive transducers: • Potentiometer • Strain gauge • Thermistor
	6.1.2 Explain the operational principles and list the applications of the following capacitive transducers: • Pressure • Liquid level
	6.1.3 Explain the operating principles and applications of the following inductive transducers: • Differential transformer • Tacho-generator
	6.1.4 Describe the operating principles, circuit diagramand applications of the following photo-electric transducers: • Light dependent resistor • Photodiode • Phototransistor
6.2 Introduction to LCD	6.2.1 Define the term LCD 6.2.2 List application/uses of LCD 6.2.3 List different types of LCD