Higher Nationals

Assignment #1 Brief – BTEC (RQF)

Higher National Diploma in ENGINEERING

Student Name /ID Number	
Unit Number and Title	Unit 52: Further Electrical, Electronic and Digital Principles
Academic Year	2020 - 2021
Unit Assessor	Akina Gordon
Assignment Title	Mathematical techniques and circuit theorems for electrical systems.
Issue Date	Wednesday 19th May, 2021
Submission Date	Tuesday 29th June, 2021
IV Name	Devanand Mastay
Date	13th May, 2021

Submission Format:
The submission is in the form of an individual written report. This should be written in a concise, formal business style, using single spacing, and font size 12.
Unit Learning Outcomes:
LO 1: Use appropriate mathematical techniques to solve a range of electrical and electronic problems. **LO 2:** Apply appropriate circuit theorems to solve problems in electrical networks.

Assignment Brief and Guidance:

SECTION 1 – YOU MUST PRODUCE BASIC SOLUTIONS TO THE FOLLOWING ELECTRICAL AND ELECTRONIC PROBLEMS:

1. (a) The current in an electric circuit is represented by I=7+j3 and the voltage is V=200+j4. Produce the impedance as a complex number.

   (b) A circuit draws a current of 15A at a voltage of 220V and its p.f is 0.8 lagging. Produce a solution for the active power and reactive power.

   (c) An ac load takes 3kW of power from a 110V supply at 60Hz. The current is 50A. Produce a solution for the power factor and the size of a capacitor required to correct it.

2. Clear logical steps must be shown for the following:
   (a) Using the impedance in part 1(a), provide the resistance and reactance for that electric circuit.

   (b) Using the active power and reactive power in part 1(b), provide the apparent power for that circuit.

   (c) Using nodal analysis in Figure 1, provide the equations to find the voltage at each node of the circuit. Let Node 2 be the reference and thus $V_2=0$.

3. Provide clear justifications and explanation of each step used in each method, by applying an accurate approach to solving:
   (a) The voltages in the equations obtained for the nodal analysis in part 2(c).

   (b) The current flowing in each branch of the circuit for the mesh analysis in Figure 2.

SECTION 2 – YOU MUST APPLY APPROPRIATE CIRCUIT THEOREMS TO SOLVE THE FOLLOWING PROBLEMS:

4. (a) Provide phasor solutions for the resulting current, I, in a faulted three-phase system, which is the sum of the current in the red phase $I_R=150\sin(\omega t)$, the yellow phase $I_Y=40\sin(\omega t+90^o)$ and the blue phase $I_B=90\sin(\omega t+180^o)$.

   (b) Assuming the sources are ideal and using superposition theorem in Figure 3, provide the value of the current in R_L due to the DC source.

5. (a) Using the solution in part 4(b) and by providing the value of the current in R_L due to the AC source, state the total current in the resistor R_L.

   (b) Use Thevenin's theorem to find the voltage for the circuit external to R_L in Figure 4.

6. Provide clear justifications and explanation of each step used in each method, by applying an accurate approach to:
   (a) Evaluate the impedance for the circuit external to R_L in Figure 4, using Thevenin's theorem.

   (b) Draw the Norton equivalent circuit, if $I_N=6<0°$mA and $Z_N=200\Omega+j350\Omega$.

Assignment Brief and Guidance (continued):

Figure 1

Figure 2

Figure 3

Figure 4

Learning Outcomes and Assessment Criteria			
Learning Outcome	Pass	Merit	Distinction
LO1 Use appropriate mathematical techniques to solve a range of electrical and electronic problems.	**P1** Produce basic solutions to electrical and electronic problems to a satisfactory standard, but with some misunderstandings. *[Question 1]*	**M1** Provide reasoned solutions to problems, showing a logical approach and using a range of mathematical methods. *[Question 2]*	**D1** Apply an accurate approach to problem-solving with clear justification of methods used with a high standard of explanation for each method. *[Question 3]*
LO2 Apply appropriate circuit theorems to solve problems in electrical networks.	**P2** Use electrical network theory to provide solutions to a satisfactory standard, with some level of ambiguity and errors. *[Question 4]*	**M2** Apply electrical network theory and provide accurate solutions to problems, showing a logical approach. *[Question 5]*	**D2** Evaluate electrical theory by using a variety of mathematical and other methods to produce accurate solutions with clear justification of methods used. *[Question 6]*