

LEVEL 4 ASSESSMENT SPECIFICATION

Student name:	Tyler Holmes	Student ID number:	
Programme:	HNC Electrical/Electronic Engineering & Instrumentation Engineering		
Module:	Electrical Principles		
Module code:	PCEE4001	Contribution to Overall Module Assessment (%):	100%
Lecturer:	Jason Pointer	Internal Verifier:	Nigel Richards
Assignment Title:	Electrical Principles	Word count (or equivalent):	2000
Submission deadline:	15/01/25	Return date of provisional marks & written feedback:	29/01/25
Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark: Work which is submitted up to 1 week late will be capped at 40% for the first attempt and will be awarded a mark of 0% for re-assessment. Late submission penalties may be lifted only if there is an approved extenuating circumstances claim. Work submitted more than 1 week late will be considered as a non-submission and will not be marked. The work may be considered as a submission for reassessment if offered by an Examining Board or if there is an approved extenuating circumstances claim.		
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.		

Module Learning Outcomes (from module syllabus)

1. Produce routine solutions to typical electrical problems.
2. Relate and apply basic electrical theory to collected data.

STUDENT FEEDBACK FORM

This section details the *extent* to which the assessment criteria are demonstrated by you, which in turn determines your mark. The marks available for each category of skill are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

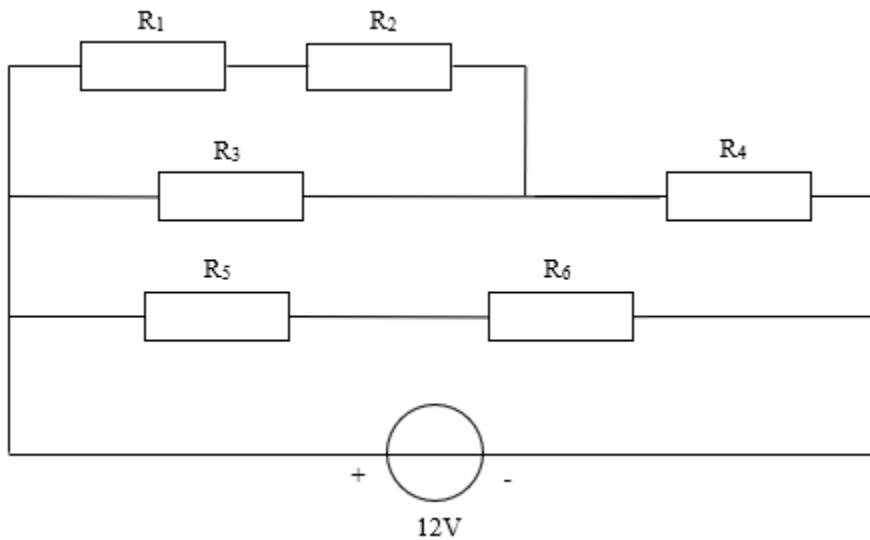
Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills	10	1.5
Little or no evidence of reading and reliance on inappropriate sources. Referencing conventions used incoherently or largely absent.		
2. Knowledge and Understanding Skills	40	24.4
Task 1 achieved 62%. Task 2 achieved 60%, Task 3 achieved 60%. Task 4 achieved 62%. Generally competent knowledge of the basic underlying concepts and principles of the work required for subjects covered in each task. Showed a very good understanding of the calculated requirements and design work.		
3. Cognitive and Intellectual Skills	10	0
Task 1 achieved 0%. Task 4 achieved 0%. No evaluation of test results.		
4. Practical Application Skills	30	12.5
Task 1 achieved 0%. Task 4 achieved 83%. An excellent application of practical work for Task 4, very good use of the test equipment to obtain all of the required results. There are no test results for task 1.		
5. Transferable Skills for Life and Professional Practice	10	4.5
Mostly ordered presentation and structure, and is for the most part clearly expressed.		

Assessment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)	Late Submission Penalties (tick if appropriate)		43%
	Up to 1 week late (40% Max)		
	Over 1 week late (0%)		

HNC Electrical/Electronic Engineering & Instrumentation Engineering

Electrical Principles Assignment 1

Task 1



Below shows the workings out and calculations for this circuit diagram above, Including:

- total resistance, R_T
- supply current, I
- current in each resistor
- the p.d. value across each resistor

and power dissipation in each resistor.

1.) TOTAL RESISTANCE.

$$R_1 = 680 \Omega \quad R_2 = 180 \Omega \quad R_3 = 330 \Omega \quad R_4 = 560 \Omega \quad R_5 = 1K \Omega \quad R_6 = 330 \Omega$$

$$R_{12} = 680 + 180 = 860 \Omega$$

$$R_{123} = \frac{1}{R_{12}} + \frac{1}{R_3} = R_{123} = \frac{1}{860} + \frac{1}{330} = 0.00419$$

$$R_{123} = \frac{1}{0.00419} = 238.5 \Omega$$

$$R_{1234} = R_{123} + R_4 \\ = 238.5 + 560 \\ = 798.5 \Omega$$

$$R_{56} = 1000 + 330 \\ = 1330 \Omega$$

$$\frac{1}{R_t} = \frac{1}{R_{1234}} + \frac{1}{R_{56}} = \frac{1}{R_t} = \frac{1}{798.5} + \frac{1}{1330} = 0.0020039 \\ = \frac{1}{R_t} = \frac{1}{0.0020039} = 498.89 \Omega$$

2.) SUPPLY CURRENT.

$$I = \frac{V}{R_t}$$

$$\text{SUPPLY VOLTAGE} = 12V \quad \text{TOTAL RESISTANCE} = 498.94 \Omega$$

$$I_{\text{supply}} = \frac{12}{498.94}$$

$$= 0.02406 A = 24.06 \text{ mA}$$

CURRENT IN EACH RESISTOR.

$$V_{1234} = V_{56} = I \times R_t \quad V = 12 \rightarrow I = \frac{V}{R} = I_{1234} = \frac{12}{798.5} = 15.08 \text{ mA}$$

$$V_{1234} = V_{56} = 12V$$

$$I_{56} = \frac{12}{1330} = 9.02 \text{ mA}$$

$$I_5 = I_6 = I_{56} = 9.02 \text{ mA}$$

$$I_{12} = I_{1234} \times \frac{R_3}{R_{12} + R_3} = 15.03 \times \frac{330}{560 + 330} = 4.17 \text{ mA}$$

$$I_1 = I_2 = I_{12} = 4.17 \text{ mA}$$

$$I_3 = I_{1234} - I_{12} = 15.03 - 4.17 = 10.86 \text{ mA}$$

$$I_4 = 15.03 \text{ mA}$$

POWER DISSIPATION.

$$V_1 = I_1 \times R_1 = 4.17 \times 680$$

$$= 0.00417 \times 680 = 2.84 \text{ V}$$

$$V_2 = I_2 \times R_2 = 0.00417 \times 680 = 0.75 \text{ V}$$

$$V_3 = I_3 \times R_3 = 0.01086 \times 330 = 3.59 \text{ V}$$

$$V_4 = I_4 \times R_4 = 0.01503 \times 560 = 8.42 \text{ V}$$

$$V_5 = I_5 \times R_5 = 0.00902 \times 1000 = 9.02 \text{ V}$$

$$V_6 = I_6 \times R_6 = 0.00902 \times 330 = 2.98 \text{ V}$$

$$P = V \times I$$

1.) R_1

$$P_1 = V_1 \times I_1 = 2.84 \times 0.00417 = 0.0118 \text{ W} = 11.8 \text{ mW}$$

$$P_2 = V_2 \times I_2 = 0.75 \times 0.00417 = 0.0031 \text{ W} = 3.1 \text{ mW}$$

$$P_3 = V_3 \times I_3 = 3.59 \times 0.01086 = 0.039 \text{ W} = 39 \text{ mW}$$

$$P_4 = V_4 \times I_4 = 8.42 \times 0.01503 = 0.1265 \text{ W} = 126.5 \text{ mW}$$

$$P_5 = V_5 \times I_5 = 9.02 \times 0.00902 = 81.4 \text{ mW}$$

$$P_6 = V_6 \times I_6 = 2.98 \times 0.00902 = 26.9 \text{ mW}$$

No measured results or comments.

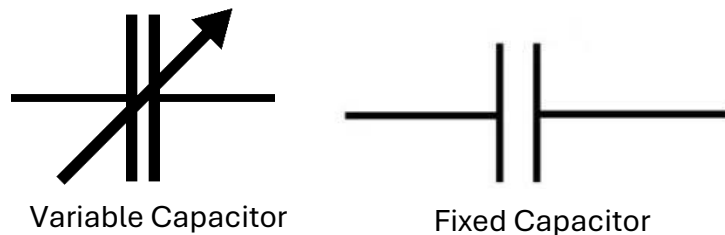
Task 2 – Capacitors

A Capacitors main function is to store and release electrical energy. This component is constructed by two plates which are separated by a nonconductive material, commonly known as an insulator, this is called a dielectric. When voltage is applied across the two plates, an electrical field will begin to form, this causes a positive charge to build up on one side of the plate and negative charge to build up on the other. This stored energy can be quickly released if needed. Capacitors are found in nearly every electrical piece of equipment, they have a crucial role in the protection of electrical equipment from voltage spiking, power factor correction, and a large role in AC and DC motors. Typically, you'll find that the largest capacitors used reach 10,000+ μF , this would be in applications like power supplies, motor starters etc. The smaller scale capacitors

range from 1pF to 1nF, and you'd find them in high frequency circuits, and radios. Industrial scale equipment may require several thousand μF to ensure consistent performance. ✓

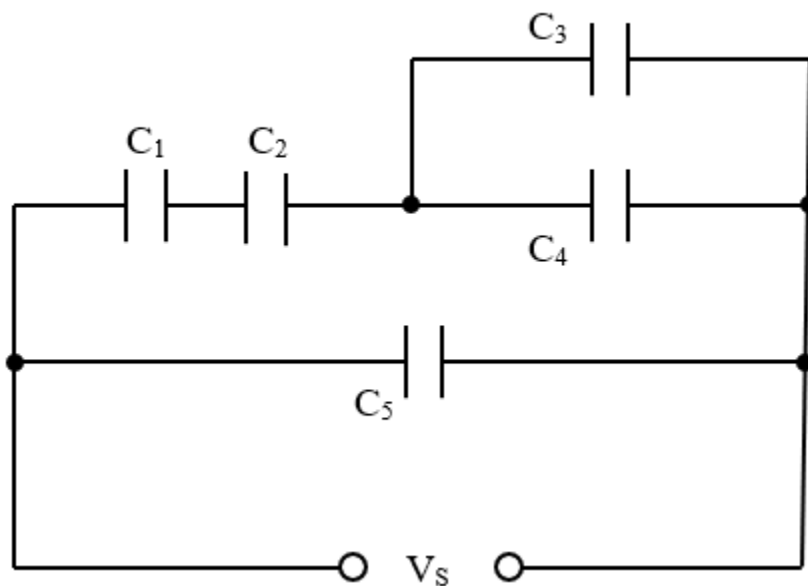
Measured in Farads, capacitance is what indicates how much charge a capacitor can store for the given voltage. You'll find there are two types of capacitors variable and fixed, variable capacitors allow for their capacitance to be adjusted where required, great for fine tuning equipment and circuits, whereas you'll find fixed (capacitors) in equipment that may require a more consistent performance such as a power supply and motor circuits. ✓

The diagrams below show how the two types appear on a schematic diagram.



(*List of available capacitors and materials*)

Figure 2.



$C_1 = 220 \mu\text{F}$ $C_3 = 43 \mu\text{F}$ $C_5 = 33 \mu\text{F}$

$C_2 = 150 \mu\text{F}$ $C_4 = 37 \mu\text{F}$ $V_s = 25 \text{ V}$

$$a) C_{12} = \frac{C_1 \times C_2}{C_1 + C_2} = \frac{220 \times 150}{220 + 150} = 89.19 \mu F$$

$$C_{34} = \frac{C_3 \times C_4}{C_3 + C_4} = \frac{48 \times 27}{48 + 27} = 70 \mu F$$

$$C_{1234} = \frac{C_{12} \times C_{34}}{C_{12} + C_{34}} = \frac{89.19 \times 70}{89.19 + 70} = 39.22 \mu F$$

$$C_T = C_{1234} + C_5 = 39.22 + 33 \mu F = 72.22 \mu F$$

$$b) Q_T = C_T \times V = 72.22 \times 25 = 1805.2 \mu C$$

$$c) Q_5 = C_5 \times V = 825 \mu C$$

$$Q_3 = C_3 \times V_3 = 48 \times 14.02 = 602.86 \mu C$$

$$Q_{1234} = Q_T - Q_5 = 980.2 \mu C$$

$$Q_4 = C_4 \times V_4 = 27 \times 14.02 = 378.54 \mu C$$

$$Q_1 = Q_2 = Q_{1234} = 980.2 \mu C$$

$$V_1 = \frac{Q_1}{C_1} = \frac{980.2}{220} = 4.45 V$$

You must include all units.

$$C_1 \quad 220$$

$$V_2 = \frac{Q_2}{C_2} = \frac{980.2}{150} = 6.53 V$$

$$C_2 \quad 150$$

$$V_3 = V_4 = V - (V_1 + V_2) = 25 - (4.45 + 6.53) = 14.02 V$$

$$d) W_1 = \frac{1}{2} \times C_1 \times V^2 = 2173.27 mJ$$

$$e) \frac{1}{2} \times C_T \times V^2 = \frac{1}{2} \times 72.22 \times 25^2 = 22568.75 \mu C$$

$$W_2 = \frac{1}{2} \times C_2 \times 6.53^2 = 3193.06 mJ$$

$$W_3 = \frac{1}{2} \times C_3 \times 14.02^2 = 4226.04 mJ$$

$$W_4 = \frac{1}{2} \times C_4 \times 14.02^2 = 2653.56 mJ$$

$$W_5 = \frac{1}{2} \times C_5 \times 25^2 = 10312.5 mJ$$

Task 3 - Magnetism

1. Permanent magnets are one of the main ways to create a magnetic field, the second being when you have current flowing through a conductor. Magnetic fields will always follow the same set of principles:

- They always form a complete closed loop
- They have elastic-like properties in the sense that they will always return to their natural shape and orientation when distorted
- The lines of force radiate from the North Pole to the South Pole in the space surrounding the magnet
- These lines of force will never cross no matter how distorted they become

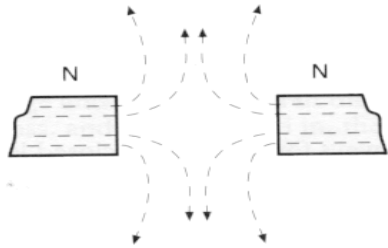
- Like poles will repel and unlike poles will attract each other.

Two like poles colliding is almost the same as two waves crashing into each other where they try to meet and end up colliding and bending back on themselves just like the figure below.

All About Circuits (n.d.) *Electromagnetism*. Available at:

<https://www.allaboutcircuits.com/textbook/direct-current/chpt-14/electromagnetism/>

(Accessed: 16 January 2025).



2.

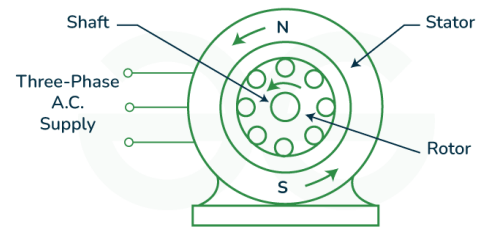
2.a) $250 \text{ mm} \times 140 \text{ mm}$ TOTAL FLUX = $150 \mu\text{Wb}$
 $0.25 \text{ m} \quad 0.14 \text{ m}$ $B = \frac{\Phi}{A} = \frac{150 \times 10^{-6}}{0.035} = 4.28 \text{ mT}$
 $A = L \times W = 0.25 \times 0.14 = 0.035 \text{ m}^2$

b) $B = 2 \text{ T}$ $\Phi = 630 \text{ mWb}$ AREA OF CIRCLE = πr^2 $r^2 = \frac{A}{\pi} = r = \sqrt{\frac{315 \times 10^{-3}}{\pi}} = 0.316 \text{ m}$
 $B = \frac{\Phi}{A} = \frac{\Phi}{\frac{A}{B}} = \frac{630 \times 10^{-3}}{315 \times 10^{-3}} = 2 \text{ T}$ $\pi = 3.14$

3. A magnetic field is generated when an electromagnet provides a flow of current through a coil of wire. The strength of the magnetic field is proportional to the current and number of turns in the coil. As soon as the current flow stops the magnetic field will collapse. An electromagnet is comprised of a ferrous material like iron that is wound with wire around the core in loops. The magnetic field distribution is that of a regular permanent magnet with field lines that stem from the north pole and loop back to the south pole. The strength of the magnet is dependent on the amount of coil windings on the core, or the current being pushed through the conductor itself, as well as the positioning, closer to the poles will mean a stronger push/pull.

The right-hand screw rule explains the direction of the magnetic field in something like an electromagnet. Imagine holding a straight conductor or coil, pointing your right-hand thumb in the direction of the current flow, then wrapping your fingers around said conductor would indicate the direction of the magnetic field lines around the wire. In a coil of wire, when your fingers curl around the coil in the same direction of the flow of current, your thumb will naturally point towards the north pole of the electromagnet.

4. Induction motors work by the application of electromagnetic induction which generates torque, when a three phase AC signal is supplied to the stator windings in a motor, a rotating magnetic field is produced, written as RMF. This action induces currents in the rotor, without any actual physical connection creating a secondary magnetic field that interacts with the stator field, this causes the rotor to turn.



The stator, stationary part hence the name, is made up of laminated cores with windings wrapped around it, this is directly connected to the AC supply to produce the rotating magnetic field. The rotor, which is the rotating part, can be found in 2 forms, squirrel cage or a wound rotor, these two just determine the all-around build of the motor and are easy to tell apart. The small air gap in-between allows for the magnetic flux to transfer and of course the rotor to turn smoothly. There is a list of ways to reduce power loss in an induction motor:

- The lamination of the core reduces current losses by minimizing circulating currents within the core.
- Efficient cooling, squirrel cage motors have fins that are used to dissipate heat build up, systems like this can help reduce resistive losses and prevent overheating.
- Bearing maintenance can minimize friction and mechanical losses and should be done regularly.
- Maintaining a consistent supply voltage can ensure that currents don't become unbalanced, an unbalanced supply will reduce overall efficiency no matter the other factors that you adjust.

Duke Electric (n.d.) *All about induction motors: Types & applications*. Available at:

<https://www.dukeelectric.com/blog/all-about-induction-motors-types-applications/> (Accessed: 16 January 2025).

5.

5. a) 800 TURN COIL (N) $L = 3 \text{ H}$ $I = 1.5 \text{ A}$ $L = \frac{N^2 \mu_0 \mu_r A}{l}$ $\phi = \frac{L \times I}{N} = \frac{56 \text{ mWb}}{800} = 7 \times 10^{-5} \text{ Wb}$
 $E = \frac{-N d\phi}{dt} = \frac{-800 \times 5.6 \times 10^{-3}}{25 \times 10^{-3}} = 179.2 \text{ V}$
 No workings
 $L \times I = 56 \text{ mWb}$
 5.6 mWb

b. i) $L = 12 \text{ cm}$ $H = 7 \text{ cm}$ $B = 1.5 \text{ T}$ $r = \omega r = \left(\frac{1400}{60} \times 2\pi \right) \times \frac{12 \times 10^{-2}}{2} = 3.56 \text{ m/s}$
 $\downarrow$
 MAX VOLTAGE WHEN $\theta = 90^\circ \rightarrow \sin 90^\circ = 1$
 $E = 2 \times 80 \times 1.5 \times 12 \times 10^{-2} \times 3.56 = 102.52 \text{ V}$
 correct method wrong value.

(ii) WHEN $E = 80 \text{ V}$ $r = \frac{E}{2NB\omega} = \frac{80}{2 \times 80 \times 1.5 \times 12 \times 10^{-2} \times 2\pi \times 60} = 2.7 \text{ m/s}$
 $\omega = \frac{v}{r} = \frac{2.7}{7 \times 10^{-2}} = 38.57 \text{ rad/s}$
 $\text{SPEED} = 111.08 \times \frac{60}{2\pi} = 1060.73 \text{ rev/min}$
 Correct method.

Task 4 – AC Circuits

1.

Values for Task 4.

Student Number	Maximum Voltage (V)	Frequency (Hz)	Phase Angle ($^\circ$)
5	20	60	26

4.

1. a) $V_{\text{rms}} = \frac{V_{\text{max}}}{\sqrt{2}} = \frac{20}{\sqrt{2}} = 14.14 \text{ V}$

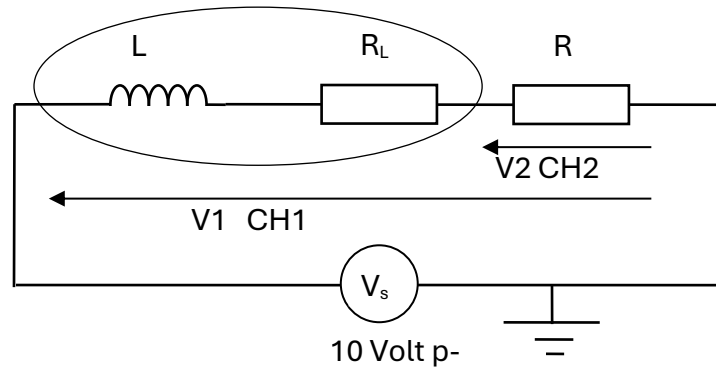
b) $\omega = 2\pi f = 2\pi \times 60 = 376.99 \text{ rad/s}$

c) $V(t) = V_{\text{max}} \sin(\omega t + \phi)$
 AT $t = 0$: $V(0) = 20 \sin(26^\circ) = 20 \times 0.4384 = 8.77 \text{ V}$

d) SOLVE FOR t : $\omega t + 26^\circ = 90^\circ$
 $t = \frac{(90 - 26)}{\omega} = \frac{64^\circ \times \frac{\pi}{180}}{376.99} = 1.117 \times 10^{-3} = 1.117 \text{ ms}$
 well done

2.

1. Below is a RL circuit:



$L = 4.7\text{mH}$, $R = 33\Omega$, $R_L = ?\Omega$ (measure this value)

Measure and record the value of each of the component.

$L = \dots\dots\dots 4.54\dots\dots\dots$ $R = \dots\dots\dots 32.6\dots\dots\dots$ $R_L = \dots\dots\dots 12.5\dots\dots\dots$

units

3. Produce a table of measurements as shown below:

Frequency (f)	CH1 (V)	CH2 (V)	Time (micro s)	Phase
(kHz)	<i>pk to pk</i> Voltage	<i>pk to pk</i> Voltage	Difference (between peaks) (T2-T1)	Angle (°)
1	5.545	3.202	91.39	32.90
2	6.726	2.8	73.14	52.66
3	7.681	2.416	51.86	56.01
4	8.271	2.086	43.79	63.06
5	8.681	1.832	38.69	69.64
6	8.999	1.614	32.31	69.79
7	9.271	1.433	29.55	74.47
8	9.362	1.288	27	77.76
9	9.537	1.179	23.81	77.14

4. Produce a table of calculations as shown below:

Frequency (kHz)	Reactance (Ω)	Total Resistance (Ω)	Impedance (Ω)	Current (A)	Phase Angle ($^\circ$)
1	28.53	45.1	53.36	0.187	32.31
2	57.05	45.1	72.72	0.138	51.67
3	85.58	45.1	96.73	0.103	62.21
4	114.10	45.1	122.69	0.082	68.43
5	142.63	45.1	149.59	0.067	72.45
6	171.15	45.1	177.00	0.056	75.24
7	199.68	45.1	204.71	0.049	77.27
8	228.21	45.1	232.62	0.043	78.82
9	256.73 /	45.1 /	260.66 /	0.038 /	80.04 /

The reactance at 1kHz was calculated by using the following formula

$$X_L = 2\pi fL$$

$$2\pi \times 1 \times 4.54 = 28.53 \Omega$$

L = 4.54 referring to component values that were measured previously, 1 is taken from the Frequency range we were using. This method was then repeated by substituting the other frequency values to get the Reactance.

What about the other calculations?

No comments

No reference list