UNIT 402 PRINCIPLES OF ELECTRICAL/ELECTRONIC ENGINEERING

Lesson 1 & 2: DC Networks

Suggested Teaching Time: 2 hours approx.

Learning Outcome: Be able to apply electrical theorems to solve DC network problems

Topic	Suggested Teaching	Suggested Resources
Electrical theorems and DC network problems	**Introduction** into the unit – contents, aims & objectives and assessment structure. Assess any prior knowledge. This unit should adopt a practical approach wherever possible, to support and develop the learners understanding through linking theory and practice. Computer simulation and analysis of circuits should be encouraged. 3.1 Explain, and demonstrate common methods of resolving DC network problems using electrical theorems using; **Ohm's law**; **Kirchhoff's** current and voltage laws; **Thévenins theorem**; **Norton's theorem**; **Maximum power transfer theorem**. 3.2 Use electrical theorems to solve problems involving d.c networks. Having been exposed to the respective network theorems the learner should apply these theorems to a range problems, before applying a practical understanding by validating the results through simulation or circuit fabrication and measurement. Recap on the session to confirm the learners understanding.	**Books:** Hughes, T., *Electrical and Electronic Technology*, 10th Edn 2008, Revised by J. Hiley, K. Brown, I. MacKenzie-Smith. Pearson Prentice Hall. ISBN 978-0-13-206011-0 Bird, J., *Electrical and Electronic Principles and Technology*, 4th Ed 2010, Newnes. ISBN 978-0-08-089056-2 **Simulation software:** Multisim /Proteus etc. Test equipment and components

Lesson 3 & 4: understand basic electromagnetic theory **Suggested Teaching Time: 2** hours approx.

Learning Outcome: Understand basic electromagnetic theory

Topic	Suggested Teaching	Suggested Resources
Basic electromagnetic theory	Start the session with a recap on previous session outcomes. Undergoing cyclic magnetisation 1.1 The learner is expected to explain the relationship between common electromagnetic units of measurement through investigation or simple demonstrations and calculations of **Magnetomotive force** (m.m.f); **Magnetic field strength**; **flux density**; **total flux; reluctance** 1.2 explain the occurrence of **Coercivity**; **remanence**; **saturation**; and **permeability** in relation to the behaviour of various magnetic materials undergoing cyclic magnetisation. 1.3 explain the relationship between the shapes of hysteresis loops of **Magnetically soft** and **Magnetically hard** materials and their application in magnetic and electromagnetic circuits. 1.4 explain electromagnetic behaviour laws. **Faraday's law**; **Lenz's law**; **Flemings rule.** Recap on learning outcomes at the end of the session.	**Book:** Bird, J., *Electrical Circuit Theory and Technology*, 4th Edn 2010, Newnes. ISBN 978-1-85617-770-2 **Websites**: phys.thu.edu.tw/~hlhsiao/mse-web_ch20.pdf http://info.ee.surrey.ac.uk/Workshop/advice/coils/mu

Lesson 5: Solve design problems using magnetic circuit theory **Suggested Teaching Time:** 2 hours approx.

Learning Outcome: Be able to solve design problems using magnetic circuit theory

Topic	Suggested Teaching	Suggested Resources
Design problems and magnetic circuit theory	Start the session with a recap on previous session outcomes and apply the theories covered to solve a series of design problems. 2.1 Assess the reluctance of magnetic materials 2.2 Calculate the inductance of magnetic circuits using applied variables **m.m.f,** circuit dimensions and **permeability** 2.3 Solve values relating to magnetic circuit operation. **Magnetic field strength**; **flux density**; **total flux** Recap on learning outcomes at the end of the session.	**Books:** Bird, J., *Electrical Circuit Theory and Technology*, 4th Edn 2010, Newnes. ISBN 978-1-85617-770-2.

Lesson 6 & 7: Understand how to analyse RLC circuits

Suggested Teaching Time: 2 hours approx.

Learning Outcome: Understand how to analyse RLC circuits

Topic	Suggested Teaching	Suggested Resources
Analysing RLC circuits	Start the session with a recap on previous session outcomes. 5.1 Explain how to represent differing types of R, L and C circuits using **phasor diagrams** for **Series**; **parallel**; **series-parallel** combinations. This might offer the opportunity to undertake a series of lab experiments to measure and evaluate the results against expected calculations. 5.2 Explain how the conditions of **resonance** for RLC circuits are derived from **Series**; **parallel** combinations. 5.3 Explain **power factor** relationships using **phasor diagrams** and calculations involving: **Real power**; **Reactive power**; **Apparent power.** Recap on learning outcomes at the end of the session.	**Books:** Hughes, T., *Electrical and Electronic Technology*, 10th Edn 2008, Revised by J. Hiley, K. Brown, I. MacKenzie-Smith. Pearson Prentice Hall. ISBN 978-0-13-206011-0 Bird, J., *Electrical and Electronic Principles and Technology*, 4th Ed 2010, Newnes. ISBN 978-0-08-089056-2

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Lesson 8 & 9: Complex notation theory & analysis of single-phase AC networks

Suggested Teaching Time: 2 hours approx.

Learning Outcome: Be able to use complex notation theory in the analysis of single-phase AC networks

Topic	Suggested Teaching	Suggested Resources
Complex notation theory and analysing single-phase AC networks	Start the session with a recap on previous session outcomes related to ac theory before introducing the learner to Imaginary numbers that are covered within the engineering maths unit j = √-1; real and imaginary parts of a complex number. 4.1 Explain the properties of R, L and C circuits by performing calculations and phaser representation of **XL**, **XC**, **ZR**, **ZL**, **ZC.** 4.2 Explain the representation of series R, L and C circuits through the evaluation of **complex impedance** and **complex admittance.** 4.3 Evaluate complex variables in operations using complex conjugates involving **Addition**; **subtraction**; **multiplication**; **division.** 4.4 Convert electrical values between **polar** and **rectangular** form. 4.5 Evaluate power using relationships. ***P=Re[VI*]*** and **Q=Im[VI*]** Recap on learning outcomes at the end of the session.	**Books:** Hughes, T., *Electrical and Electronic Technology*, 10th Edn 2008, Revised by J. Hiley, K. Brown, I. MacKenzie-Smith. Pearson Prentice Hall. ISBN 978-0-13-206011-0 Bird, J., *Basic Engineering Mathematics* 5th Ed, Newnes. ISBN-13: 978-1856176972 Websites: http://www.electronics-tutorials.ws/accircuits/complex-numbers.html Simulation software, or Test equipment and components

Lesson 10 & 11: Analyse RLC circuits

Suggested Teaching Time: 2 hours approx.

Learning Outcome: Be able to analyse RLC circuits

Topic	Suggested Teaching	Suggested Resources
Analysing RLC circuits	Start the session with a recap on previous session outcomes. Tuned Circuits - consisting of inductive and capacitive circuits. Resonance in series and parallel R-L-C circuits, Q-factor and bandwidth. Characteristics of admittance, conductance etc. as a function of frequency. Analysis of loading on the parameters which give resonance. 6.1 Produce plots of the **frequency responses** of tuned RLC circuits through physical measurement or simulation. 6.2 Solve problems involving resonance in RLC circuits **Quality factor**; **bandwidth**; **impedance.** 6.3 Solve problems relating to **power-factor** improvement. **Series**; **parallel** Recap on learning outcomes at the end of the session.	**Books:** Hughes, T., *Electrical and Electronic Technology*, 10th Edn 2008, Revised by J. Hiley, K. Brown, I. MacKenzie-Smith. Pearson Prentice Hall. ISBN 978-0-13-206011-0 Bird, J., *Electrical and Electronic Principles and Technology*, 4th Ed 2010, Newnes. ISBN 978-0-08-089056-2 **Simulation software:** Multisim /Proteus etc. Test equipment and components

Lesson 12 & 13: Modelling two-port networks

Suggested Teaching Time: 2 hours approx.

Topic	Suggested Teaching	Suggested Resources
Analysing electrical systems when modelled as two-port networks	Start the session with a recap on previous session outcomes. 7.1 explain the parameters used in two-port models **Z (impedance model)**; **Y (admittance model)**; **h (hybrid model)**; **g (inverse hybrid model).** 7.2 explain the deriving of input and output equations for parameter models at, **Low frequency**; **mid-band**; **high frequency.** Recap on learning outcomes at the end of the session.	**Books:** Hughes, T., *Electrical and Electronic Technology*, 10th Edn 2008, Revised by J. Hiley, K. Brown, I. MacKenzie-Smith. Pearson Prentice Hall. ISBN 978-0-13-206011-0 Bird, J., *Electrical and Electronic Principles and Technology*, 4th Ed 2010, Newnes. ISBN 978-0-08-089056-2

Lesson 14 & 15: Modelling two-port networks

Suggested Teaching Time: 2 hours approx.

Learning Outcome: Be able to analyse electrical systems when modelled as two-port networks

Topic	Suggested Teaching	Suggested Resources
Analysing electrical systems when modelled as two-port networks	Start the session with a recap on previous session outcomes. 8.1 Convert circuit values using parameters from different models: **Z** (impedance model); **Y** (admittance model); **h** (hybrid model); **g** (inverse hybrid model). 8.2 Solve problems involving gain of two-port model networks to **Low frequency**; **mid-band**; **high frequency**. Recap on learning outcomes at the end of the session.	**Books:** Bird, J., *Electrical and Electronic Principles and Technology*, 4th Ed 2010, Newnes. ISBN 978-0-08-089056-2

UNIT 402 PRINCIPLES OF ELECTRICAL/ELECTRONIC ENGINEERING

Lesson 14 & 15: Modelling two-port networks

Suggested Teaching Time: 2 hours approx.

Learning Outcome: Be able to analyse three-phase circuits

Topic	Suggested Teaching	Suggested Resources
Analysing three-phase circuits	Start the session with a recap on previous session outcomes Three-Phase Circuits - Basic circuit analysis for star/delta connected balanced and unbalanced systems. Star/delta, delta/star transforms. 9.1 Illustrate three-phase systems using **phasor diagrams** Involving **line values** (voltage and current); **phase values** (voltage and current); **power and power-factor correction.** 9.2 Solve problems in **balanced three-phase loads.** 9.3 Analyse methods of three-phase power measurement for different systems. **Balanced**; **unbalanced**; **star**; **delta.** Recap on learning outcomes at the end of the session.	**Books:** Hughes, T., *Electrical and Electronic Technology*, 10th Edn 2008, Revised by J. Hiley, K. Brown, I. MacKenzie-Smith. Pearson Prentice Hall. ISBN 978-0-13-206011-0 **Websites:** http://www.electronics-tutorials.ws/dccircuits/dcp_10.html

Lesson 16 & 17: Solve transient response of first-order circuits **Suggested teaching time:** 2 hours approx.

Learning Outcome: Be able to solve the transient response of first-order circuits

Topic	Suggested Teaching	Suggested Resources
Solving transient response of first-order circuits	Start the session with a recap on previous session outcomes. 10.1 Produce graphs of growth and decay of **transient** components in voltages and currents circuits containing RL and RC. The learner should be exposed to taking physical signal measurements to support their theoretical understanding. 10.2 Solve problems relating to time and steady state values of circuits **Time constant**; **rise-time** and **fall-time** in circuits comprising of **RL** and **RC** combinations. Again this task lends itself to a practical investigation to underpin their solutions. Recap on learning outcomes at the end of the session.	**Books:** Hughes, T., *Electrical and Electronic Technology*, 10th Edn 2008, Revised by J. Hiley, K. Brown, I. MacKenzie-Smith. Pearson Prentice Hall. ISBN 978-0-13-206011-0 Bird, J., *Electrical and Electronic Principles and Technology*, 4th Ed 2010, Newnes. ISBN 978-0-08-089056-2 Simulation software: Multisim /Proteus etc. Test equipment and components