Unit 66: Electrical, Electronic and Digital Principles

Unit code: T/601/1395

QCF level: 5

Credit value: 15

Aim

This unit aims to develop learners' understanding of the electrical, electronic and digital principles needed for further study of electro-mechanical systems.

Unit abstract

This unit brings together the differing aspects of electrical, electronic and digital principles.

Learners will start by analysing series and parallel LCR circuits using complex notation and evaluating the effects on a circuit's performance by changes in impedance.

Learners will then use different circuit theorems to evaluate currents and voltages in electrical circuits. They will also consider the conditions for maximum power transfer and impedance watching.

The differing types and classes of operation of electronic amplifiers are analysed and evaluated before some are designed and tested then compared with theoretical results.

Finally, learners will investigate digital electronic device families and the design and testing of digital circuits.

Learning outcomes

On successful completion of this unit a learner will:

1 Be able to apply complex notation in the analysis of single phase circuits

2 Be able to apply circuit theory to the solution of circuit problems

3 Understand the operation of electronic amplifier circuits used in electro-mechanical systems

4 Be able to design and test digital electronic circuits used in electro-mechanical systems.

Unit content

1 **Be able to apply complex notation in the analysis of single phase circuits**

Series and parallel LCR circuits: voltage, current and power with sine wave signals; conditions for resonance eg frequency response, impedance, Q factor; complex notation

Circuit performance: tolerancing; effect of changes in component values

2 **Be able to apply circuit theory to the solution of circuit problems**

Circuit theorems: Norton; Kirchhoff; Thevenin; superposition; maximum power

Circuit analysis: mesh; nodal; maximum power transfer; impedance matching

3 **Understand the operation of electronic amplifier circuits used in electro-mechanical systems**

Single- and two-stage transistor amplifiers: class of operation eg A, B, AB and C; analysis of bias; DC conditions; AC conditions; coupling; input impedance; output impedance; frequency response

Design, test and evaluate: a single-stage amplifier to a given specification; compare measured and theoretical results

4 **Be able to design and test digital electronic circuits used in electro-mechanical systems**

Digital electronic devices: logic families eg TTL, LS-TTL and CMOS; comparison between families; circuits integration; identification of digital circuits in electro-mechanical systems

Combinational circuits: simplification methods; truth tables; single gate solutions; circuit simulation; testing

Design and test: circuit designed should be bread-boarded or simulated using an appropriate computer software package

Learning outcomes and assessment criteria

Learning outcomes On successful completion of this unit a learner will:	Assessment criteria for pass The learner can:
LO1 Be able to apply complex notation in the analysis of single phase circuits	1.1 solve problems involving LCR circuits 1.2 evaluate the effects on circuit performance of changes in values of impedances
LO2 Be able to apply circuit theory to the solution of circuit problems	2.1 solve problems using circuit theorems to calculate currents and voltage in circuits 2.2 analyse circuits including the value of circuit loads which produce maximum power
LO3 Understand the operation of electronic amplifier circuits used in electro-mechanical systems	3.1 analyse the operation of single- and two-stage amplifiers 3.2 evaluate the performance of single- and two-stage amplifiers 3.3 design and evaluate a single-stage transistor amplifier 3.4 compare measured results with theoretical calculations
LO4 Be able to design and test digital electronic circuits used in electro-mechanical systems	4.1 evaluate digital electronic device families 4.2 design combinational and sequential digital electronic circuits 4.3 test digital circuits by construction or by computer simulation.

Guidance

Links

This unit can be linked with *Unit 58: Microprocessor Systems.*

Essential requirements

Centres will need to provide access to appropriate laboratory test equipment, such as signal generators, oscilloscopes, power supplies and test meters, together with prototype boards and digital circuit trainers.

Appropriate software packages (for example circuit simulators such as PSpice, Tina Pro, or Electronics Workbench) will also need to be used to enable modelling and rapid prototyping, and to provide confirmation of experimental results.

Employer engagement and vocational contexts

Delivery would benefit from visits to local engineering companies that use a wide range of electro-mechanical systems. Delivery will also be helped by visits from guest speakers with relevant industrial experience.