SUMMARY SHEET

COURSE/SUBJECT TITLE: **Access Diploma in Engineering – Electrical Principles** No: (Syllabus Alternative if appropriate) **XJ0/3/TE/001**

LEVEL: **3** BOARD/EXAMINING BODY: **CERTA**

LECTURERS: **James Irvine BSc CPhys MInstP**

GENERAL APPROACH TO DELIVERY - Special requirement of this subject.
There is a CD-ROM with material for use in this subject

SUMMARY OF LEARNING ACTIVITIES: (These should relate to Schemes of Work activities).

Very Frequent - Approximately every week
Frequent - Approximately 1 - 2 times per month
Occasional - Approximately 1 - 2 times per term
Rare - Less than occasional
Never - Never (just as it says).

	Very Frequent	Frequent	Occasional	Rare	Never		Very Frequent	Frequent	Occasional	Rare	Never
Lectures		✓				Dictation					✓
Video		✓				Group-work		✓			
Class Discussion		✓				Role-play					✓
I.T. Usage		✓				Visits			✓		
Practical Work	✓					Student Seminars			✓		
Individual Research			✓			Field Course					✓
Worksheets Assignments	✓					Other (please state)			Posters cards small whiteboards		

AIMS

- To develop knowledge and understanding of Electrical Engineering.
- To encourage enjoyment and satisfaction in the study of Electrical Engineering.
- To give a flavour of future study in Electrical Engineering, and to give a good basic foundation for that study.
- To promote Electrical Engineering as a possible career choice.
- To prepare students for an A2 examination.

CONTRIBUTION TO THE COLLEGE MISSION

Excellence

The delivery of the course will focus on an outstanding programme of study with a variety of resources and activities designed to prepare students to achieve their maximum potential in the examination

Integrity

The course will be delivered in such a way that students develop a sense of honesty and respect for themselves, their peers, teachers, and resources. A high degree of trust will be delivered and will be expected from all participants.

Commitment

The course will aim to encourage the highest standards of teaching and learning. The care of and nurture of students as individuals will be at the heart of the teaching strategy.

Respect

The course will be delivered in a framework of mutual respect and support. Participants will use expensive and valuable resources and be expected to use resources carefully and for their correct purposes.

Being Supportive

Electrical Engineering will be taught in a dedicated laboratory with a wide range of professional equipment. The room will be maintained as a professional working environment. Health and safety will be a priority at all times, and safe working practices will be expected as a matter of course.

Effectiveness

The course will be supported using high quality resources that represent good value for money.

Enterprise

Forward looking and innovative in our approach to all College activities. New techniques for effective teaching will be tried.

Responsiveness

The course will be responsive to the needs of students, and activities will be modified where necessary to take into account the feelings of students.

ASSESSMENT

Formative assessment will be by question and answer in class. Summative assessments will involve written homework tasks, practical reports, tests, examinations. Feedback will be given as appropriate to the class or to individuals. Extra help will be given to individuals as needed.

Assessment will be more than the minimum guidelines set by the Science Department Assessment Policy. Students will know what assessments there are as these are set out in the notes. Review of progress will be made carried out at the end of each topic.

Formal assessment will be:

- By examination at the end of each semester.
- Internal assessment practical skills.

LEARNING ACTIVITIES

These will consist of a mixture of theory lessons, demonstrations, and practical sessions. Teaching and learning strategies will be differentiated to address different learning styles. Student will not normally be required to copy notes in class as these are given out as hand-outs. However they are encouraged to make their own supplementary notes as appropriate.

As well as teacher exposition, class discussion and problem solving in small groups will form a major part of the course. Students are encouraged at all times to take ownership of the work and to participate actively in all activities. Students will be expected to review their work at the end of each topic. Students will be encouraged to read around the subject over and beyond what is covered in the lessons.

ICT will form an integral part of the delivery of the course.

Provision will be made for gifted and talented students by offering:

- Participation in appropriate master classes, lectures, etc.

DIFFERENTIATION

A variety of teaching and learning styles will be delivered as a matter of course. These will include (in no particular order):

- **Auditory** – listening to teacher and others.
- **Visual** – demonstrations and videos.
- **Interpersonal** – working in small groups.
- **Intrapersonal** – working on one's own.
- **Kinaesthetic** – practical work.
- **Logical** – working on problems.

This differentiation will be planned in individual lesson plans.

Differentiation by outcome will be planned on this scheme of work under the model of:

- **Access** – the core expectation of material that must be covered for successful study.
- **Progress** – the expectation of students to grasp more difficult concepts
- **Challenge** – encouragement of students to tackle extension tasks appropriate to prepare students for a Grade A.

Internal Assessment

Students will be frequently assessed using the following methods:

- Informal question and answer in class;
- Lesson assessments (classwork to you) which will be marked together and the marks collected;
- Topic Questions (from past papers) which are done as homework;
- Short tests every two weeks;
- Topic Tests;
- Mock examinations.

Students who under-perform will be offered support in workshops. Consistent under-performance due to lack of effort and commitment may lead to students being referred for disciplinary action.

External Assessment

This will be carried out using:

- Examinations at the end of each Semester, in January and June.
- Practical Assessments

KEY SKILLS

All of the material lends itself to key skills in:

- Numeracy – calculations, graphical, and data analysis.
- Communication – in written form, presentation, and oral work.
- ICT – use of computers to design circuits, present work, process data, interactive learning, and presentation.

These skills will be developed as a matter of course.

Personal, Learning, and Thinking Skills (PLTS)

Students will be encouraged to develop their personal, learning, and thinking skills under the following headings:

- Creative thinkers (CT);
- Effective participators (EP);
- Independent enquirers (IE);
- Reflective learners (RL);
- Team workers (TW);
- Self-Managers (SM).

Every Child Matters (ECM)

Outcomes are in the scheme of work:

- Be healthy (BH);
- Stay safe (SS);
- Enjoy and achieve (EA);
- Make a positive contribution(PC);
- Achieve economic well-being (AW).

Skills for Life (S4L)

- Numeracy (N)
- Literacy (L)
- ICT

Skills for the Workplace (STEM)

- Communication and interpersonal skills (CI)
- Problem Solving (PS)
- Using initiative (UI)
- Working to deadlines (WD)
- Organisation (OS)
- Team working (TW)
- Learning and Adaptation (LA)
- Numeracy (N)
- Diversity and Difference (VD)
- Negotiation Skills (NS)

Appropriate activities will be indicated in the scheme of work.

Scheme of Work – Access level 3 Electrical Principles

Course: Access Electrical Principles	Semester 2	Teacher(s): James Irvine

Lesson	Topic/Subject Area	Key Teaching Methods/Learning Activities	Resources [including ILT]	Identify S4L and ECM	Links to skills etc.	Syllabus/Unit [Cross Referenced to Lesson Plan]	Assignment/Assessment Activities / Differentiation
18 Jan 26th 2015 CT01	Students will: Understand and use Kirchhoff's Laws; Understand the concept of internal resistance; Measure internal resistance of a cell; Use Principle of Superposition in Circuit analysis. Internal resistance is an important concept in order to understand Thévenin's Theorem. Practical work will be to measure the internal resistance of a cell. Use Locktronics kit to demonstrate how to tackle a more complex circuit. Extension: Look for some good animations to show the idea of Kirchhoff's Laws	Formal Teaching Practice Questions Practical work Demonstration ICT work	Workbook 7 Bird pp 155 – 162 Practical work sheet *Internal Resistance* Cell, rheostat, ammeter, voltmeter, wires and switch. Demonstration. Locktronics kit, multimeters.	**ECM** Enjoy and achieve Make a positive contribution **PLTS** IE, CT, TW **Employer** Harvesting data Interpreting graphs. Circuit analysis	M, E, ICT, WO, AfL Lab skills	Syllabus 4.1, 4.4 CT_01	Tutorial Questions Manipulation of equations Response to practical. Practical skills assessment Extension: *Web-quest on conductivity* Access: State that all sources have an internal resistance. Progress: Calculate internal resistance. Challenge: Apply Kirchhoff I and II to more complex circuits.

19 **Feb 2nd** CT02	Students will: Learn about constant voltage and current sources. Work through the steps to produce a Thévenin equivalent Apply Thévenin's Theorem; Work through the steps to produce a Norton equivalent Apply Norton's Theorem. Extension: Devise or research a practical to verify Norton's Theorem	Formal Teaching Practice Questions Demonstration ICT work Practical work	Work book 7 Bird pp 178 – 179 Power supply, Locktronics kit, multimeters	**ECM** Enjoy and achieve Make a positive contribution **PLTS** IE, CT, TW EP **Employer** Use initiative and understanding to devise experiments	M, E, ICT, WO, AfL Lab skills	Syllabus 4.2, 4.3. 4.4 CT_02	Tutorial Questions TMA_02 due in TMA_03 Derivation and use of equations Use of theoretical models TMA_03 Access: State that Thévenin's theorem allows a complex circuit to be considered as a battery in series with an internal resistor. Progress: Find the Thévenin and Norton equivalents for a circuit. Challenge: Devise a practical to verify Norton's Theorem

20 **Feb 9th** CT03	Students will: Understand the concept of power matching. Learn about basic ideal transformers Apply the ideas to transformer matching. Use the transformer matching equation Demonstrate power matching practically. Students will be shown the demountable transformer and all the tricks it can do. Students will do an experiment to measure the power transfer of a single cell. Extension: Research into how load matching is carried out in an audio system.	Formal Teaching Practice Questions Demonstration ICT work Practical work	Work-book 7 Bird pp 175 – 176 pp 284 – 286 Demountable transformer and accessories. Cell, push switch, variable resistor, voltmeter, and ammeter	**ECM** Enjoy and achieve Make a positive contribution **PLTS** IE, CT, TW **Employer** Harvesting data Interpreting graphs. Circuit analysis	M, E, ICT, WO, AfL Lab skills	Syllabus: 4.5 and 4.6 CT_03	Tutorial Questions Numerical skills Practical skills Access: Recognise and use the transformer equation. State that the maximum power transfer happens when the load = internal resistance. Progress: Use the transformer matching equation. Assess the efficiency of the transfer to a load. Challenge: Make links between the observations and Thévenin's Theorem.
Half Term							

21 **Feb** **23rd** RLC01	**Topic 8 RLC Circuits** Students will study: Phasor diagrams Reactance Series and parallel capacitors Series and parallel inductors	Formal teaching ICT work Video-clips Demonstration Group work Support	Bird pp 202 – 204 Notes pp 3 – 19 Demonstration: Series and parallel capacitors.	**ECM** Enjoy and achieve Make a positive contribution **PLTS** CT, SM, EP **Employer** Numeracy,	**KS**: WO M E IT	Syllabus 5.1 RLC_01	Tutorial Questions Numerical skills in standard form. Access: Recall CIVIL Progress: Understand and explain phase relationships. Calculate reactance and impedance. Challenge: Use multiple components in problems.

22 **2nd March** RLC02 RLC03	**Electrical Resonance** Students will: Explain resonance in a mechanical system. Explain that electrical resonance can happen as well. Describe electrical resonance in an LR system, with reference to reactances of capacitors and inductors. Then explain how adding a resistor causes damping of the resonance. Define and use the concept of Q-factor Practical to find resonant frequency	Formal teaching Demonstration ICT work Group work Demonstration Practical	Bird pp 205 – 207 Cross pp 147 – 148 Notes pp 23 – 41 Spring, slotted mass, vibration generator, signal generator 1 μF capacitor, inductor, signal generator, multimeters. .	**ECM** Enjoy and achieve Make a positive contribution Stay safe **PLTS** CT, SM, TW **Employer** Numeracy: interpreting graphs. Harvest data	**KS**: WO M E IT	Syllabus 5.2, 5.3, 5.4 RLC_02	Tutorial Questions Access: Recall that electrical currents can resonate like mechanical systems. Progress: Calculate the resonant frequency using the idea of reactances. Challenge: Derive the equations a resonant circuit

23 **March 9th** RLC04 RLC05	**Topic 9 Parallel RL circuits** Students will: Analyse parallel RL circuits; Calculate impedance by using $\left(\frac{1}{Z}\right)^2 = \left(\frac{1}{R}\right)^2 + \left(\frac{1}{X_L}\right)^2$ Calculate phase angle. Consider parallel RC circuits Work out impedance of parallel RC circuit.	Formal teaching Group work Practice Questions	Bird pp 212 – 213 Notes pp 3 – 11 Notes pp 12 – 19	**ECM** Enjoy and achieve Make a positive contribution Stay safe **PLTS** CT, SM, RL **Employer** Numeracy using vector addition.	**KS**: WO M E IT	Syllabus 6.1 6.2 RLC04 RLC05	Tutorial Questions Assessment of technical understanding Access: Recall that $Z = V/I$ Calculate reactance Progress: Use an equation to calculate parallel impedance. Challenge: Carry out more complex calculations, modelling capacitors with leakage current.

24 **Mar 16th** RLC06	**Resonance in Parallel Circuits** Students will: Calculate impedance in different types of circuit. Explain the conditions for resonance. Derive and use equation $$f_0 = \frac{1}{2\pi\sqrt{(LC)}}$$ Explain that this is for a perfect inductor. Recognise graphs Use Q-factor $$Q = \frac{2\pi f L}{R}$$ Challenge: Derive and use $$f = \frac{1}{2\pi}\sqrt{\left(\frac{1}{LC} - \frac{R^2}{L^2}\right)}$$	Formal teaching Group work Practice questions Practical to investigate RLC circuit	Bird pp 216 – 223 Notes pp 27 – 41	**ECM** Enjoy and achieve Make a positive contribution Stay safe **PLTS** CT, SM, EP IE, RL **Employer** Numeracy skills	**KS**: WO M E IT	Syllabus 6.2, 6.3, 6.4, 6.5, and 6.6 RLC06	Tutorial Questions Access: Calculate reactance and impedance. Explain that resonance occurs when $X_L = X_C$ Progress: Use equation to find resonant frequency. Use the equation for the Q factor Challenge: Derivation of equations.

25 Mar 23rd RLC07	Students will: Verify the equation $f_0 = \frac{1}{2\pi\sqrt{(LC)}}$	Group work Assessed Practical	Signal generator Inductor Capacitor Multimeters Resistance box	**ECM** Enjoy and achieve Make a positive contribution **PLTS** IE, SM, RL **Employer** Data harvesting	**KS**: WO M E IT	Syllabus 6.4 and 6.5	Tutorial Questions Access: Harvest data Progress: Plot graphs. Challenge: Interpret and evaluate data

26 **Mar 30th** TPS01	**Topic 10 3-phase supply** Students will: Recognise 3 phase supplies. Draw 3-phase sinusoidal waveforms Explain how 3-phase arises Recognise star and delta wiring Explain how for a star system: $V_P = \frac{V_L}{\sqrt{3}}$ Explain for a delta system $I_L = \sqrt{3} I_P$ Consider the components of the national grid Challenge Carry out calculations for unbalanced loads	Formal teaching Group work Practice Questions	Bird pp 258 – 263 Notes pp 3 – 25	**ECM** Enjoy and achieve Make a positive contribution Stay safe **PLTS** IE, CT, EP **Employer** Numeracy skills Technical writing	**KS**: WO M E IT AfL	Syllabus 7.1 and 7.2 TPS01	Tutorial Questions Numerical work Access: Recall that national grids use 3-phas transmission. Explain the reasons for this. Recognise star and delta configurations Progress: Use equations to work out currents and voltages for star and delta configurations in balanced circuits Challenge: Calculate the resultant current if the circuit is unbalanced.
Easter Holidays							

27 **Apr 20th** TPS02	**Power in 3-phase circuits** Students will: Recognise and use for a star circuit: $P = 3V_{\mathrm{P}}I_{\mathrm{P}}\cos\phi$ Recognise and use for a delta circuit: $P = \sqrt{3}\,V_{\mathrm{L}}I_{\mathrm{L}}\cos\phi$ Recognise the apparent power (S), the true power (P) and the reactive power (Q) and use $\cos\phi = \frac{P}{S}$ To work out the power factor.	Formal teaching Group work Practice Questions	Bird pp 263 – 265 Notes pp 28 – 38	**ECM** Enjoy and achieve Make a positive contribution **PLTS** IE, CT, EP **Employer** Numeracy skills Technical description	**KS**: WO M E IT AfL	Syllabus 7.3 and 7.4 TPS_02	Tutorial Questions Access: Recall that a delta circuit transfers more power. Explain the advantages of three-phase power. Progress: Use equations to work out power. Work out phase angles for electric motors. Challenge: Show how watt-meters can be used to show the power of a device.

Lesson	Topic/Subject Area	Key Teaching Methods/Learning Activities	Resources [including ILT]	Identify S4L and ECM	Links to work experience and/or vocational relevance	Syllabus/Unit [Cross Referenced to Lesson Plan]	Assignment/Assessment Activities/Extension Differentiation
28 **27th** RT01	**Topic 11 DC Transients** **DC transients with capacitors** Students will: Recognise graphs for capacitor charge and discharge. State that the graphs are exponential. Use $\tau = RC$ for time constant. Recognise and use the equation $$V = V_0 e^{-t/RC}$$ For discharge. And for charge: $$V = V_0\left(1 - e^{t/RC}\right)$$ Verify the exponential discharge.	Group work Practical work Formal Teaching	Notes pp 3 – 13 Bird pp 231 – 237 Capacitor 2200 mF Resistor 47 k Voltmeter 2-way switch 6 V battery pack. Stopwatch	**ECM** Enjoy and achieve Make a positive contribution **PLTS** CT, EP, TW **Employer** Numeracy skills Data harvesting Graphical interpretation	M, E, WO, AfL	Syllabus 8.1, 8.2, 8.3, and 8.4 RT_01	Tutorial Questions. Practical skills. Use of numerical skills Access State that capacitors charge up exponentially. Recall the time constant as time taken for the voltage to fall to 37 % of its value. Progress: Use equation to work out values for voltage when discharging or charging

30 11th May RT_02	**DC Transients with inductors** Students will: Recall that inductors cause reactive effects. Recognise the time constant and use the equation $\tau = \frac{L}{R}$ Recognise that there is a reverse voltage or back EMF that is given by: $V = V_0 e^{-t/\tau}$ Recognise the inductive rise in current as: $I = I_0\left(1 - e^{-t/\tau}\right)$ Measure transients with a data logger	Group work Formal Teaching Practical work ICT work	Bird pp 237 – 241 Notes pp 16 – 25 Inductors, laptop, data-logger voltage sensor and software.	**ECM** Enjoy and achieve Make a positive contribution **PLTS** CT, EP, TW **Employer** Data harvesting and interpretation of data from graphs	WO, M, E Lab skills	Syllabus 8.3, 8.5, 8.6, and 8.7 RT_02	Tutorial Questions Observation of practical skills, presentation of data in tables and graphs. Data processing from graphs Access: Recall that inductors are electromagnetic devices. Recall that reactance increases as frequency increases. Progress: Recognise and use the reactance equation. Interpret data from graphs. Challenge: Derive the inductor equation

31 **18th May**	Catch up week Practice practical assessment.	Group work Formal Teaching Practical work ICT work		**ECM** Enjoy and achieve Make a positive contribution **PLTS** CT, EP, TW **Employer** Data harvesting and interpretation of data from graphs	WO, M, E Lab skills		Observation of practical skills, presentation of data in tables and graphs. Data processing from graphs Access: Recall that inductors are electromagnetic devices. Recall that reactance increases as frequency increases. Progress: Recognise and use the reactance equation. Interpret data from graphs. Challenge: Derive the inductor equation
32	Semester 2 Examination						

You can find an Excel version of the blank Scheme of Work here , but not there.