Subject Description Form

Subject Code	EIE2100
Subject Title	Basic Circuit Analysis
Credit Value	3
Level	2
Pre-requisite	AP10006 Physics II
Co-requisite/ Exclusion	Nil
Objectives	1. Introduce fundamental circuit theory. 2. Develop ability for solving problems involving electric circuits. 3. Develop skills for experimentation on electric circuits. 4. Impart relevant skills and knowledge for independent learning of other subjects that require such skills and knowledge.
Intended Learning Outcomes	**Upon completion of the subject, students will be able to:** <u>Category A: Professional/academic knowledge and skills</u> 1. Acquire a good understanding of fundamental circuit theory. 2. Solve simple problems in electric circuits. 3. Use suitable instrumentation to carry out experimental investigations to validate the theoretical investigations. <u>Category B: Attributes for all-roundedness</u> 4. Search for useful information in solving problems in electric circuits.
Subject Synopsis/ Indicative Syllabus	**Syllabus:** 1. <u>Basic Concepts of Electricity</u> Static electricity, Conductors, insulators and electron flows. Concept of electric circuits. Voltage, current, and resistances in a practical circuit. 2. <u>DC Circuits</u> Introduction to electric circuits. Kirchhoff's current and voltage laws. Independent and dependent sources. Simple circuits: voltage divider, current divider, series and parallel circuits. Graphs. Trees & Co-trees. Cutsets & loops. Nodal and mesh analyses. Loop and cutset analyses of resistive circuits. Thévenin and Norton theorems. Power dissipation. Source loading and maximum power transfer. 3. <u>Capacitance, Inductance and First Order Transient</u> Constitutive relations of capacitor and inductor. Introduction to time-varying circuits. Simple RC and LC circuits. Important concept of independent state variables. First-order differential equation (with simple solution of exponential form). First order transient analysis. Time-domain solution and transient behaviour of first order circuits. 4. <u>Introduction to Transformers</u> Concept of ideal transformer (assuming sinusoidal voltages and currents). Dot convention. Physical transformer as ideal transformer with leakage and magnetizing inductances. Applications in galvanic isolation and voltage/current level conversion. 5. <u>Steady-state Analysis of AC Circuits</u> Average and rms values. Phasors (rotating vectors). Steady-state analysis of circuits driven by single fixed frequency sinusoidal sources. Impedance and admittance. Euler equation. Analysis approach 1: phasor diagrams for simple circuits. Analysis approach 2: systematic complex number analysis, i.e.,

	same treatment as DC circuits but with complex numbers representing phase and magnitude of AC voltages and currents. Real and reactive powers. Power factor. Simple three-phase circuits. 6. <u>Formulation of State Equations for General Dynamic Circuits</u> Choice of state variables using topological approach. Basic cutsets and loops. Derivation of state equations for general dynamic circuits. 7. <u>Operational Amplifiers</u> Ideal operational amplifier. Defining characteristics (i.e., infinite gain and infinite input resistance). Op-amp circuits: inverting amplifier, non-inverting amplifier, summer, difference amplifier, integrator and differentiator. Applications: instrumentation amplifier; current-to-voltage and voltage-to-current converters. **Laboratory Experiments:** 1. Introduction to laboratory instrumentation / Thévenin and Norton theorems 2. First order transient 3. Use of operational amplifiers.
Teaching/ Learning Methodology	see table below

Teaching and Learning Method	Intended Subject Learning Outcome	Remarks
Lectures, supplemented with interactive questions and answers	1, 2, 4	In lectures, students are introduced to the *knowledge* of the subject, and *comprehension* is strengthened with interactive Q&A.
Tutorials, where problems are discussed and are given to students for them to solve	1, 2, 4	In tutorials, students *apply* what they have learnt in solving the problems given by the tutor.
Laboratory sessions, where students will perform experimental verifications. They will have to record results and write a report on one of the experiments.	2, 3, 4	Students *acquire* hands-on experience in using electronic equipment and *apply* what they have learnt in lectures/tutorials to experimentally validate the theoretical investigations.
Assignments	1, 2, 3, 4	Through working assignments, students will develop a firm understanding and *comprehension* of the *knowledge* taught.

Alignment of Assessment and Intended Learning Outcomes

Specific Assessment Methods/ Task	**% Weighting**	**Intended Subject Learning Outcomes to be Assessed (Please tick as appropriate)**			
		1	**2**	**3**	**4**
1. Continuous Assessment (Total 40%)					
• Assignments	10%	✓	✓		✓
• Laboratory works and reports	10%		✓	✓	✓
• Mid-semester test	10%	✓	✓		✓
• End-of-semester test	10%	✓	✓		✓
2. Examination	60%	✓	✓		✓
Total	100%				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Specific Assessment Methods/Tasks	**Remark**
Assignments	Assignments are given to students to assess their competence level of *knowledge* and *comprehension*. The criteria (i.e. *what* to be demonstrated) and level (i.e. the *extent*) of achievement will be graded according to six levels: (A+ and A), Good (B+ and B), Satisfactory (C+ and C), Marginal (D) and Failure (F). These will be made known to the students before an assignment is given. Feedback about their performance will be given promptly to students to help them improvement their learning.
Laboratory works and reports	Students will be required to perform three experiments and submit a report on one of the experiments. Expectation and grading criteria will be given as in the case of assignments.
Mid-semester test	There will be a mid-semester test to evaluate students' achievement of all the learning outcomes and give feedback to them for prompt improvement. Expectation and grading criteria will be given as in the case of assignments.
End-of-semester test and Examination	There will be an end-of-semester test and examination to assess students' achievement of all the learning outcomes. These are mainly summative in nature. Expectation and grading criteria will be given as in the case of assignments.

Student Study Effort Expected	**Class contact (time-tabled):**	
	• Lecture	24 Hours
	• Tutorial/Laboratory/Practice Classes	15 hours
	Other student study effort:	
	• Lecture: preview/review of notes; homework/assignment; preparation for test/quizzes/examination	36 Hours
	• Tutorial/Laboratory/Practice Classes: preview of materials, revision and/or reports writing	30 Hours
	Total student study effort:	**105 Hours**
Reading List and References	**Textbook:** 1. W.H. Hayt, J.E. Kemmerly and S.M. Durbin, *Engineering Circuit Analysis,* 7^{th} ed., New York: McGraw-Hill, 2006. 2. G. Rizzoni, *Fundamentals of Electrical Engineering*, 1^{st} ed., McGraw-Hill, 2009. **References:** 1. C.K. Tse, *Linear Circuit Analysis,* London: Addison-Wesley, 1998. 2. D.A. Neamen, *Micoelectronics: Circuit Analysis and Design*, Boston: McGraw-Hill, 3^{rd} ed., 2007. 3. R.A. DeCarlo and P.M. Lin, *Linear Circuit Analysis*, 2^{nd} ed., Oxford University Press, 2001. 4. A.H. Robbins and W.C. Miller, *Circuit Analysis: Theory and Practice*, Thomson Learning, 4^{th} ed., 2006.	
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