Subject Description Form

Subject Code	EE2901S
Subject Title	Basic Electricity and Electronics
Credit Value	3
Level	2
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	1. To introduce students to the fundamental principles and analysis techniques for studying and operating basic electrical and electronic devices and circuits. 2. To introduce students to the appropriate skills and tools for experimenting with basic electrical and electronic devices and circuits.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Describe the fundamental principles and analysis techniques for studying and operating basic electrical and electronic devices and circuits. b. Use the appropriate skills and tools for experimenting with basic electrical and electronic devices and circuits.
Subject Synopsis/ Indicative Syllabus	**DC Electrical Circuits** ***Fundamentals*** — How electricity works. Electromechanical analogies. Common Prefixes. Atoms and atomic structure. Basic electric quantities: charge, potential, current, voltage, power, and energy. Resistance, Ohm's law, and resistors. Resistors in series and parallel. Sign convention. Practical, ideal, independent, and dependent voltage and current sources. Voltage and current dividers. Use of basic test meters: voltmeters, ammeters, ohmmeters, and multimeters. ***Analysis*** — Lumped circuit elements. Network description: branch, node, loop, and mesh. Kirchhoff's voltage and current laws. Tellegen's theorem. Mesh-current and node-voltage methods. Thévenin's and Norton's theorems. Loading effect and maximum power transfer. **AC Electrical Circuits** ***Fundamentals*** — The war of the currents. AC versus DC. Time-dependent, periodic, and sinusoidal signals. Sinusoidal sources. Worldwide mains electricity. Peak, average, and root-mean-square values. Inductors and capacitors. Sinusoidal steady-state analysis by time-domain method. Complex number. Euler's identity. Phasors and phasor diagrams. Impedance and admittance. Sinusoidal steady-state analysis by phasor–impedance method. ***Power*** — Power, energy, and electricity bill. Instantaneous and average powers. Power in resistive, inductive, capacitive, and complex loads. Complex power and power factor. Power generation, transmission, and distribution. Three-phase power basics. Single (split)-phase three-wire source. Star (wye)-connected three-phase four-wire source. Star–star and star–delta source–load connections. Star–delta transformations. **Electromagnets and Transformers** ***Electromagnets*** — Basic principles of electromagnetics: Ørsted's, Ampère's, Faraday's, and Lenz's laws. Magnetomotive force. Magnetic flux. Reluctance. Inductance. Magnetic field energy. Electromagnetic analogies. Sinusoidal steady-state analysis of electromagnetic structures by magnetic equivalent circuit method.

Transformers and Transformer Circuits — Self- and mutual inductances. Dot conversion. Ideal transformers. Step-up, step-down, and impedance transformers. Sinusoidal steady-state analysis of transformer circuits.

Semiconductor Devices and Circuits

Diodes and Diode Circuits — Semiconductor basics: intrinsic and extrinsic semiconductors, electrons and holes, doping, donors and acceptors, n-type and p-type semiconductors. P–N junction diodes: basic structure, symbol, depletion region, barrier potential, forward bias, reverse bias, ideal current–voltage characteristics, ON and OFF states, ideal diode equation, breakdown characteristics, Zener diodes. Diode circuits: ideal and practical diode assumptions, analysis of basic and specific diode circuits.

Transistors and Transistor Circuits — Bipolar junction transistors (BJTs): transistor basics, basic structures, symbols, BJTs as electric switches and amplifiers, modes of operation, input and output characteristics. BJT circuits: DC equivalent circuits, DC analysis, load line, Q-point, DC biasing schemes.

Laboratory Experiments *(Two of the following)*:

1. EE2901S-E01: DC Circuit Analysis.
2. EE2901S-E02: Diode Circuit Analysis.
3. EE2901S-E03: Electromagnet and Transformer Analysis.

Teaching/Learning Methodology

Teaching/Learning Methodology	Outcome	
	a	b
Lecture	✓	
In-class Practice	✓	
Assignment	✓	
Laboratory		✓

Lecture: Students are introduced to the knowledge of the subject, and their comprehension is strengthened with interactive Q&A (outcome a).

In-class Practice: Students apply what they have learned in solving the problems in the class (outcome a).

Assignment: Students further test and develop their understanding and comprehension of the knowledge through after-class exercises (outcome a).

Laboratory: Students acquire hands-on/simulated experience using the appropriate electrical and electronic devices and test equipment in circuits, apply what they have learned in the class to experimentally validate the theoretical investigations, and develop the experimental log and report writing skills (outcome b).

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended learning outcomes to be assessed	
		a	b
Continuous Assessment	50%	✓	✓
Examination	50%	✓	
Total	100%		

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

	Overall Assessment: $0.5 \times$ Continuous Assessment + $0.5 \times$ End of Subject Examination Continuous Assessment covers all intended learning outcomes a and b, while Examination involves intended learning outcome a. Continuous Assessment (50%) contains Assignment (16%), Test (18%), and Laboratory (16%), aiming to provide timely feedback to students on various topics of the syllabus, including assignment works, laboratory skills, use of the appropriate electrical and electronic devices and test equipment in circuits, analysis and presentation of the experimental results, etc. Examination (50%) is a three-hour, closed-book, end-of-subject written examination, aiming to assess students' overall understanding and ability to apply the fundamental principles and analysis techniques.	
Student Study Effort Expected	Class contact:	
	▪ Lecture	30 Hrs.
	▪ In-class Practice	3 Hrs.
	▪ Laboratory	6 Hrs.
	Other student study efforts:	
	▪ Self-study	41 Hrs.
	▪ Assignment	12 Hrs.
	▪ Laboratory Log and Report	8 Hrs.
	Total student study effort	100 Hrs.
Reading List and References	**Textbooks:** 1. Giorgio Rizzoni and James Kearns, *Principles and Applications of Electrical Engineering*, 6th Edition, Boston: McGraw-Hill Higher Education (2018). 2. Donald A. Neamen, *Microelectronics: Circuit Analysis and Design*, 4th Edition, Boston: McGraw-Hill Higher Education (2010). **Reference books:** 1. W. H. Hayt, J. E. Kemmerly, and S. M. Durbin, *Engineering Circuit Analysis,* 8th Edition, New York: McGraw-Hill (2012). 2. A. H. Robbins and W. C. Miller, *Circuit Analysis: Theory and Practice*, 5th Edition, Thomson Learning (2013). 3. R. A. DeCarlo and P. M. Lin, *Linear Circuit Analysis*, 2nd Edition, Oxford University Press (2001).	