Subject Description Form

Subject Code	EE3001 / EE3001A
Subject Title	Analogue and Digital Circuits
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite for EE3001: EE2002 and EE2003 Pre-requisite for EE3001A: EE2002A and EE2003A
Objectives	1. To familiarise students with the characteristics and operation of analogue and digital circuits for analysis and design purposes. 2. To enable students to understand the common techniques used in circuit design for combinational and sequential logic circuits. 3. To provide an appreciation of advantages and limitations of different classes of power amplifiers. 4. To enable students to analyse the operation principles of different A/D and D/A approaches and match their properties to serve the purposes of different applications. 5. To enable students to appreciate the limitations of circuit design.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Design basic digital combinational and sequential circuits. b. Given the requirements of an application, justify the use of suitable A/D or D/A converters and elaborate on the advantages and limitations of the selection. c. Compare the characteristics and operation of different classes of power amplifiers. d. Analyse operation of digital circuits and diagnose faults with basic equipment in the laboratory.
Subject Synopsis/ Indicative Syllabus	**Digital Circuits** 1. ***Digital system fundamentals*****:** Boolean algebra, number systems and codes used in digital systems logic gates and their characteristics, truth tables. 2. ***Analysis and synthesis of combinational circuits*****:** Simplification techniques, Don't care terms, Karnaugh maps. Implementation of large scale circuits. Static and dynamic hazards. 3. ***Digital integrated circuits*****:** Digital IC families: TTL, CMOS, structure of basic logic gates (TTL, CMOS, NMOS, PMOS, transfer gate logic, wire AND logic), input and output V-I characteristics; transfer characteristics, switching thresholds, noise margins, power dissipation of logic gate, propagation delay, rise time, fall time. ***Sequential circuits*****:** Typical structure, operation, design and applications of flip-flops. Design and analysis of synchronous sequential circuits; states and state variable: structures of registers, counters and memory units (ROM, RAM, Flash, Programmable Logic Array, FPGA). Design of asynchronous circuits, state machines, flow tables, stable and unstable states. **Analogue Circuits** 4. ***Large-signal transistor circuits*****:** Classification of power amplifiers; analysis of efficiency, power dissipation and distortion of class A, B, AB, C and D amplifiers. 5. ***Signal conversion*****:** Voltage comparator. Sample & hold circuits. A/D and D/A converters: Weighted-resistor D/A converter; R-2R Ladder D/A converter; Parallel-comparator A/D converter; Dual slope A/D converter; Successive-approximation A/D converter;

Laboratory Experiments:
1. EE3001-E01: Design of 2-bit Seven Segment Decoder and Ripple Counter.
2. EE3001-E02: Analog-to-Digital (ADC) and Digital-to-Analog (DAC) Converter.

Teaching/Learning Methodology

The main teaching methods used to convey the basic concepts and fundamental theories are lectures and tutorials. The assignments and laboratory sessions are used to help the students to have an in-depth understanding of the fundamentals of analogue and digital circuits and apply the fundamental theory and knowledge learned to practice.

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Assignments	✓	✓	✓	
Lectures	✓	✓	✓	
Tutorials	✓	✓	✓	
Experiments	✓		✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed			
		a	b	c	d
1. Examination	60%	✓	✓	✓	
2. Quizzes/Mid-term test(s)	18%	✓	✓	✓	
3. Assignments	12%	✓	✓	✓	
4. Lab Reports	10%	✓	✓		✓
Total	100%				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
It is a fundamental circuit design subject. The outcomes on concepts, design and applications are assessed by the usual means of examination and test whilst those on analytical skills, problem-solving techniques and practical considerations of circuit design, as well as technical reporting, are evaluated by experiments, and the reports.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	33 Hrs.
▪ Laboratory	6 Hrs.
Other student study effort:	
▪ Laboratory preparation/report	10 Hrs.
▪ Self-study and assignments	56 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Textbooks:
1. Thomas L. Floyd, "Digital fundamentals", 11th Edition, Prentice Hall, 2015
2. Donald A. Neamen, "Microelectronics: Circuit Analysis and Design", 4th Edition, Boston: McGraw-Hill, 2010.

Reference books:
1. M.M. Mano, "Digital Design: With an Introduction to the Verilog HDL", 6th Edition, Prentice Hall, 2017
2. J.F. Wakerly, "Digital Design: Principles and Practices, 5th Edition, Pearson, 2018