Subject Description Form

Subject Code	EIE3305
Subject Title	Integrated Analogue and Digital Circuits
Credit Value	3
Level	3
Pre-requisite	EIE2100 Basic Circuit Analysis EIE2102 Basic Electronics EIE3100 Analogue Circuit Fundamentals
Co-requisite/ Exclusion	Nil
Objectives	To develop an in-depth understanding of the design principles and applications of integrated analogue and digital circuits.
Intended Subject Learning Outcomes	**Upon completion of the subject, students will be able to:** Category A: Professional/academic knowledge and skills 1. An understanding of the fundamental principles and applications of digital logic circuits. 2. An ability to design periodic signal generators from digital logic circuits. 3. An understanding of filter design principles and circuit technologies. 4. An ability to apply theory and realize analog filter circuits. 5. An understanding of output stage design of analog circuits. 6. An overview of advanced logic circuit families. Category B: Attributes for all-roundedness 7. An ability to communicate effectively 8. An ability to think critically and creatively 9. An ability to assimilate new technological development in related field
Subject Synopsis/ Indicative Syllabus	**Syllabus:** 1. Integrated Analog Circuits 1.1 *Analog filters*: Filter type and specifications, transfer function, Butterworth and Chebyshev filters, first-order and second-order filter functions, passive second-order LCR filters, active second-order filters based on inductor replacement / two-integrator-loop / single-amplifier biquad, switched-capacitor filters 1.2 *Waveform generators*: Basic principles of sinusoidal oscillators, oscillator feedback loop and oscillation criteria, op-amp-RC oscillator circuits (Wien-Bridge oscillator, phase-shift oscillator, quadrature oscillator), LC and crystal oscillators, bistable multivibrators, monostable multivibrators, 555 integrator circuit timer 1.3 *Output stage design*: Classification of output stages, Class A / B / AB output stages, biasing circuit design, transfer characteristic, signal waveform, power dissipation and conversion efficiency, harmonic distortion 2. Integrated Digital Circuits 2.1 *CMOS logic*: Basic logic inverter, voltage transfer characteristic, noise margins, propagation delay, inverter sizing, power dissipation, pull-up and pull-down networks, synthesis method for CMOS logic-gate circuits, transistor sizing, fan-in and fan-out 2.2 *Advanced logic circuit families – an overview*: Pseudo-NMOS logic, pass-transistor logic, dynamic MOS logic, emitter-coupled logic (ECL), bipolar CMOS (BiCMOS) logic 2.3 *Memory circuits*: Flip-flop (basic principles and applications), memory-chip organization, random-access memory (RAM) – static

<table>
<tr><td></td><td>and dynamic RAM, sense amplifiers, address decoders, read-only memory (ROM) – programmable ROM (PROM), erasable PROM (EPROM), electrically EPROM (EEPROM)

Laboratory Experiments:

1. Design of Butterworth / Chebyshev filter.
2. Sinusoidal, square-wave, and triangular waveform generators.
3. Characterization of basic CMOS logic inverter.</td></tr>
<tr><td>Teaching/ Learning Methodology</td><td>
<table>
<tr><th>Teaching and Learning Method</th><th>Intended Subject Learning Outcome</th><th>Remarks</th></tr>
<tr><td>Lectures</td><td>1, 2, 3, 4, 5, 6</td><td>Fundamental principles and key concepts of the subject are delivered to students</td></tr>
<tr><td>Tutorials</td><td>1, 2, 3, 4, 5, 6</td><td>Students will be able to clarify concepts and to have a deeper understanding of the lecture material;
Problems and application examples are given and discussed</td></tr>
<tr><td>Laboratory sessions</td><td>1, 2, 3, 4, 7, 8, 9</td><td>Students in groups of 2-3 will conduct practical measurement and evaluate the performance of electronic circuits</td></tr>
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Assessment Methods in Alignment with Intended Subject Learning Outcomes

Specific Assessment Methods/Tasks	% Weighting	Intended Subject Learning Outcomes to be Assessed (Please tick as appropriate)								
		1	2	3	4	5	6	7	8	9
1. Continuous Assessment (40%)										
• Assignment	13%	✓	✓	✓	✓	✓	✓			
• Tests	13%	✓	✓	✓	✓	✓	✓			
• Laboratory sessions	14%	✓	✓	✓	✓			✓	✓	✓
2. Examination	60%	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total	100%									

The continuous assessment consists of assignments, quizzes and two tests.

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

Specific Assessment Methods/Tasks	Remark
Short quizzes	Mainly objective tests (e.g., multiple-choice questions, true-false, and matching items) conducted to measure the students' ability to remember facts and figures as well as their comprehension of subject materials
Tests and examination	End-of chapter type problems used to evaluate students' ability in applying concepts and skills learnt in the classroom; Students need to think critically and creatively in order to come with an alternate solution for an existing problem
Laboratory sessions	Each group of students are required to produce a written report; Accuracy and the presentation of the report will be assessed

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; 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	**Textbooks:** 1. Adel S. Sedra and Kenneth C. Smith, *Microelectronic Circuits*, 6th ed., Oxford University Press, 2011. 2. Jacob Millman and Arvin Grabel, *Microelectronics*, 2nd ed., McGraw-Hill,1987. **Reference Books:** 1. Thomas L. Floyd, *Digital Fundamentals*, 10th ed., Pearson, 2009. 2. Rolf Schaumann and Mac E. Van Valkenburg, *Design of Analog Filters*, Oxford University Press, 2001. 3. John P. Hayes, *Introduction to Digital Logic Design*, Addison-Wesley, 1993. 4. Paul Horowitz and Winfield Hill, *The Art of Electronics*, 2nd ed, Cambridge University Press, 1989.
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