Kalasalingam Academy of Research and Education
(Deemed to be University)
Under Sec. 3 of UGC Act 1956
Anand Nagar, Krishnankoil (Via)
Virudhunagar (Dt), Tamil Nadu, India – 626 126

ECE101 Sample Course

ECE101 Sample Course	L	T	P	X	C
	3	0	2	0	4
Pre-requisite: Course Code of Sample Pre-requisite Course Code of Sample Pre-requisite	**Course Category / Type:** PM/TC				

Course Description

This course introduces fundamental circuit analysis methods for linear networks.

Course Objectives

- Develop the ability to model simple electrical networks using ideal elements.
- Apply systematic methods to solve DC and AC linear circuits.
- Interpret circuit behaviour using standard engineering metrics.
- Develop the ability to model simple electrical networks using ideal elements.
- Apply systematic methods to solve DC and AC linear circuits.
- Interpret circuit behaviour using standard engineering metrics.

Course Outcomes

CO1: Analyse linear circuits using nodal and mesh methods.
CO2: Determine steady-state AC responses using phasor techniques.
CO3: Evaluate power in AC circuits using appropriate quantities.

Articulation Matrix CO to PO, PSO

CO	PO											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	1	-	-	-	-	-	-	-	2	1	1
CO2	2	3	2	1	-	-	-	2	1	1	-	-	-	-
CO3	1	2	3	2	1	-	-	-	-	-	2	1	1	-

Articulation Matrix CO to SO, PSO

CO	SO							PSO		
	1	2	3	4	5	6	7	1	2	3
CO1	3	2	1	1	-	-	-	2	1	1
CO2	2	3	2	1	-	2	1	1	-	-
CO3	1	2	3	2	1	-	-	1	1	-

Course Topics

Unit	Contents	Hrs.	COs
1	**Semiconductor Physics**		CO1
	Theory: • Energy band formation – E-k diagrams, Energy band formation: conductors, semiconductors, insulators • Intrinsic and extrinsic semiconductors – Intrinsic and extrinsic semiconductors, their energy bands • Doping, impurity ionization, Fermi level – Doping, impurity ionization, Fermi level • Carrier transport; carrier generation and recombination – Carrier transport: drift, mobility, diffusion – Carrier generation and recombination • Resistivity; sheet resistance; Poisson and continuity equations – Resistivity of doped semiconductors; sheet resistance fundamentals – Poisson and continuity equations	9	
	Practical: • Simulation of Energy Band Models and Material Resistivity Trends – Define realistic semiconductor materials, doping concentrations, and temperature ranges using standard material parameters. – Compute and plot resistivity variation with doping concentration and temperature, ensuring physically meaningful results. – Illustrate qualitative energy band diagrams and analyse Fermi level shift with doping type and level. • Carrier Concentration vs Temperature Visualization – Compute carrier concentration variation with temperature for intrinsic and doped semiconductors. – Select doping concentrations to satisfy a target resistivity condition at room temperature. – Plot and analyse carrier concentration trends over a practical temperature range.	6	
2	**PN Junction and Diode Characteristics**		CO2

	Theory: • PN junction and biasing – PN junction formation, equilibrium, depletion region – Forward and reverse bias characteristics • Diode characteristics and models – Diode I–V equation – Temperature effects on diode behaviour – Junction capacitances – Spice modelling of diodes, diode small signal model • Breakdown mechanisms and special diodes – Breakdown mechanisms: Zener, avalanche – Zener and Schottky diode basics • Optoelectronic diodes – Photodiode operation, responsivity, dark current – LED operation – Solar cell: photocurrent, open-circuit voltage • Diode datasheets – Interpretation of diode datasheets	9	
	Practical: • PN Junction and Zener Diode I–V Characteristics – Design a safe experimental setup to measure forward and reverse I–V characteristics within datasheet limits. – Record and plot I–V characteristics to identify key operating regions. – Compare experimentally obtained parameters with datasheet specifications. • LED and Photodiode I–V Characteristics under Illumination – Measure I–V characteristics of LEDs and photodiodes under controlled illumination. – Select appropriate sensing resistance and analyse wavelength-dependent response. – Interpret results using responsivity and wavelength data from datasheets.	6	
3	**Diode Circuits and Applications**		CO3

	Theory: • Rectifiers and ripple – Half-wave, full-wave, and bridge rectifiers – Ripple factor • Filter circuits – Filter circuits (capacitor filter, RC basics) • Wave shaping circuits – Clippers and clampers – Voltage multiplier • Zener diode applications – Zener diode as voltage limiter/regulator • Load-line and component considerations – Load-line analysis of Diodes – Component tolerances and derating fundamentals **Practical:** • Rectifier with Filter Design to Achieve Given Ripple Specification – Design a rectifier and filter circuit to meet a specified ripple requirement. – Select component ratings based on voltage and current constraints. – Measure output waveform and ripple and validate against design targets. • Design of a Zener Voltage Regulator – Design a Zener regulator to maintain approximately constant output voltage. – Select series resistance based on load and Zener current requirements. – Evaluate regulation performance under varying load conditions. • Clipper and Clamper Circuit Realisation and Analysis – Design clipper and clamper circuits to achieve specified voltage limits. – Analyse circuit behaviour considering diode forward voltage. – Validate output waveforms using practical component parameters.	9 6	
4	**Bipolar Junction Transistors (BJTs)** **Theory:** • BJT structure and operation – BJT structure: NPN and PNP – Carrier flow and transistor action • Operating regions and characteristics – Operating regions: cutoff, active, saturation – Large-signal output characteristics – Early effect • BJT parameters – Emitter efficiency, base transport factor • Switching behaviour – BJT switching characteristics: rise time, fall time, storage time	9	CO4

	Practical: • BJT CE Characteristics and Parameter Extraction – Design an experimental setup to measure CE characteristics safely. – Extract transistor parameters across different operating regions. – Verify measured values against datasheet limits. • BJT as a Switch Using Pulse Input – Design a BJT switch circuit for a specified load and supply. – Select base and collector resistances to ensure saturation. – Analyse switching behaviour using pulse input and output waveforms.	6	
5	**MOS Transistors and IC Fabrication** **Theory:** • MOS capacitor and MOSFET operation – MOS capacitor: accumulation, depletion, inversion – Threshold voltage concept – MOSFET I–V: cutoff, linear, saturation – MOSFET as a switch • IC fabrication technology – IC definition and classification – IC design flow – IC Fabrication: Purpose, Various stages – IC Packaging and Bonding **Practical:** • MOSFET Transfer and Output Characteristics – Measure MOSFET transfer and output characteristics to estimate threshold voltage. – Design a test circuit to observe MOSFET switching behaviour. – Interpret measured parameters using datasheet specifications. • IC Fabrication Flow and Device Cross-Section Sketching – Develop a logical IC fabrication process flow. – Draw device cross-sections after key fabrication steps. – Use standard IC fabrication terminology and layer conventions.	9 6	CO4, CO5

Textbooks

1. Sedra, A. S., and Smith, K. C., *Microelectronic Circuits*, 7th ed., Oxford University Press, 2016.
2. Boylestad, R. L., and Nashelsky, L., *Electronic Devices and Circuit Theory*, 11th ed., Pearson, 2013.

References

1. Millman, J., and Halkias, C., *Integrated Electronics*, McGraw-Hill, 1972.
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ECE102 Course Code of Sample New Courses

ECE102 Course Code of Sample New Courses	L	T	P	X	C
	3	0	2	0	4
Pre-requisite: Course Code of Sample Pre-requisite	**Course Category / Type:** PE/TC				

Course Description

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Course Outcomes

CO1: Analyse linear circuits using nodal and mesh methods.
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CO2	2	3	2	1	-	-	-	-	2	1	1	-	-	-
CO3	1	2	3	2	1	2	1	1	-	-	-	-	-	-

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	Theory:
	• PN junction and biasing
	  – PN junction formation, equilibrium, depletion region
	  – Forward and reverse bias characteristics
	• Diode characteristics and models
	  – Diode I–V equation
	  – Temperature effects on diode behaviour
	  – Junction capacitances
	  – Spice modelling of diodes, diode small signal model
	• Breakdown mechanisms and special diodes
	  – Breakdown mechanisms: Zener, avalanche
	  – Zener and Schottky diode basics
	• Optoelectronic diodes
	  – Photodiode operation, responsivity, dark current
	  – LED operation
	  – Solar cell: photocurrent, open-circuit voltage
	• Diode datasheets
	  – Interpretation of diode datasheets
		9	

	Practical:
	• PN Junction and Zener Diode I–V Characteristics
	  – Design a safe experimental setup to measure forward and reverse I–V characteristics within datasheet limits.
	  – Record and plot I–V characteristics to identify key operating regions.
	  – Compare experimentally obtained parameters with datasheet specifications.
	• LED and Photodiode I–V Characteristics under Illumination
	  – Measure I–V characteristics of LEDs and photodiodes under controlled illumination.
	  – Select appropriate sensing resistance and analyse wavelength-dependent response.
	  – Interpret results using responsivity and wavelength data from datasheets.
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3	**Diode Circuits and Applications**		CO3

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