Course Code	21ECC202T	Course Name	ANALOG AND LINEAR ELECTRONIC CIRCUITS	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*ECE*	Data Book / Codes / Standards		*Nil*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*understand the operation and design of transistor amplifier circuits for a given specification*
CLR-2:	*discuss the elementary concepts and characteristics of an operational amplifier*
CLR-3:	*introduce the concepts of negative feedback on amplifier circuits, and investigate different feedback topologies to understand their properties, such as transfer gain, input resistances, and output resistances*
CLR-4:	*analyze and design RC and LC oscillator circuits*
CLR-5:	*analyze and design linear and non-linear applications of op-amp*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*apply the small signal equivalent circuit in the analysis of single and multistage transistor amplifier circuits*	2	2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO-2:	*infer the DC and AC characteristics of operational amplifier*	2	2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO-3:	*classify and identify the suitable feedback topologies and oscillators as per application*	2	2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO-4:	*elucidate and design linear and non-linear applications of op-amp*	2	2	3	-	-	-	-	-	-	-	-	-	-	-	3
CO-5:	*illustrate the function of application specific ICs*	2	2	3	-	-	-	-	-	-	-	-	-	-	-	3

Unit-1 - Single and Multistage Amplifiers	***9 Hour***
Bipolar Linear amplifier: Load line analysis, small-signal models, analysis of common-emitter, common-base, common-collector amplifiers and multistage amplifiers (cascade, cascode and Darlington) using Hybrid-π model, low- and high-frequency response of BJT amplifiers. MOSFET Linear Amplifier: Load line analysis, small-signal model, analysis of common-source, common-gate and common-drain amplifiers using hybrid-π model, low and high Frequency response analysis of MOSFET amplifier.	
Unit-2 - Introduction to Linear IC's	***9 Hour***
BJT and MOSFET differential amplifier with passive and active loads, Internal Structure of Op-amp, output stages and power amplifiers (Class-A and Class-AB push-pull Complementary amplifier configuration), Ideal operational amplifier, IC 741 packages, characteristics of op-amp, open-loop configurations, non-ideal effects in op-amp, Frequency response of an op-amp.	
Unit-3 - Feedback Amplifiers and Oscillators	***9 Hour***
Negative feedback amplifier: Introduction to feedback and types, advantages and disadvantages of negative feedback, basic feedback concepts, ideal feedback topologies, voltage (shunt- series) amplifier, current (shunt-series) amplifier, trans conductance (series-series) amplifiers, transresistance (shunt-shunt) amplifiers, stability analysis of the feedback Circuit (BJT/MOSFET/Op-amp). Oscillators: Principles of oscillation, classification of oscillators, RC, LC and Crystal oscillators (BJT/MOSFET/Op-amp)	
Unit-4 - Applications of Linear ICs - I	***9 Hour***
Summing amplifier, subtractor, integrator, differentiator, difference amplifier, instrumentation amplifier, voltage-to-current converter, current-to-voltage converter, comparators, Schmitt triggers and Non sinusoidal oscillators, active filters, first order and second order low and high pass filters, band-pass filters, band-stop filters, waveform generators.	

Unit-5 - Applications of Linear ICs - II	***9 Hour***
Converters: Weighted -Resistor D/A and R-2R ladder D/A, Analog-to-Digital Converter: Successive approximation A/D Converters, precision rectifiers, clippers, and clampers. Specialized ICs: 555 Timer, functional block, 566 VCO and 565 PLL, Applications of PLL and 555 Timer, voltage regulators-LM78xx, LM79xx, LM723, LM380 power amplifiers.	

Learning Resources	1. *David A. Bell, "Electronic Devices and Circuits", 5th ed., Oxford University Press, 2015* 2. *Donald Neaman, "Electronic Circuits: Analysis and Design", 3rd ed., Mc-Graw-Hill Education, 2011* 3. *Muhammad Rashid, "Microelectronic Circuits: Analysis and Design", 2nd ed., Cengage Learning, 2010* 4. *Robert L. Boylestad Louis Nashelsky, "Electronic Devices and Circuit Theory", 11th ed., Pearson Education, 2013*	5. *D. Roy Choudhry, Shail Jain, "Linear Integrated Circuits", 5th ed., New Age International Pvt. Ltd., 2015* 6. *Ramakant A. Gayakwad, "Op-amp and Linear ICs", 4th ed., Printice Hall/Pearson, Education,2015* 7. *Sergio Franco, "Design with Operational amplifiers and Analog Integrated circuits", 4th ed., Tata McGraw-Hill, 2016*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*15%*	*-*	*15%*	*-*	*15%*	*-*
Level 2	*Understand*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 3	*Apply*	*25%*	*-*	*25%*	*-*	*25%*	*-*
Level 4	*Analyze*	*25%*	*-*	*25%*	*-*	*25%*	*-*
Level 5	*Evaluate*	*10%*	*-*	*10%*	*-*	*10%*	*-*
Level 6	*Create*	*5%*	*-*	*5%*	*-*	*5%*	*-*
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
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