Academic Course Description

BHARATH UNIVERSITY
Faculty of Engineering and Technology
Department of Electronics and Communication Engineering

BEC405 Linear Integrated Circuits

Fourth Semester 2016-2017 (Even Semester)

Course (catalog) description

This is a course on the design and applications of operational amplifiers and analog integrated circuits. This course introduces basic op-amp principles and show how the op-amp can be used to solve a variety of application problems. Much attention is given to basic op-amp configurations, linear and non-linear applications of op-amp and active filter synthesis, including switched capacitor configurations. It also deals with oscillators, waveform generators and data converters

Compulsory/Elective course: Compulsory for ECE students

Credit & contact hours **:** 3 & 45

Course Coordinator **:** Ms.M.Jasmin, Assoc. Professor, Department of ECE

Instructor(s)

Name of the instructor	Class handling	Office location	Office phone	Email (domain: @bharathuniv.ac.in)	Consultation
Ms.M.Jasmin	II year ECE	SA block		jasmine.ece@bharathuniv.ac.in	12.30-1.30 PM
Mr S.Rajesh	II year ECE	SA block		rajesh.ece@bharathuniv.ac.in	12.30-1.30 PM

Relationship to other courses

Pre – requisite : BEC 302-Principles of Digital Electronics

Assume Knowledge : Basic knowledge in circuit analysis and in phasor algebra or elementary calculus

Following courses : -

Syllabus Contents

UNIT I CIRCUIT CONFIGURATION FOR LINEAR ICS 9

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Operational Amplifier-DC Characteristics-Frequency response characteristics-Stability-Limitations- Frequency compensation-Slew rate.

UNIT II APPLICATION OF OPERATIONAL AMPLIFIERS 9

Integrator Voltage to Current convertor, Instrumentation amplifier, Sine wave Oscillators, Low pass and band pass filters, comparator, Multivibrator and Schmitt trigger, Triangle wave generator, Precision rectifier, Log and Antilog amplifiers, Non-linear Linear and Nonlinear Circuits using operational amplifiers and their analysis, Inverting and Non inverting Amplifiers, Differentiator function generator.

UNIT III ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications ,Voltage controlled Oscillator, Closed loop analysis of PLL, AM, PM and FSK modulators and demodulators. Frequency synthesizers, Compander ICs.

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTOR 9

Analog switches, High speed sample and hold circuits and sample and hold IC's, Types of D/A converter Current driven DAC, Switches for DAC, A/D converter, Flash, Single slope, Dual slope, Successive approximation, DM and ADM, Voltage to Time and Voltage to frequency converters.

UNIT V SPECIAL FUNCTION IC 9

Timers, Voltage regulators - linear and switched mode types, Switched capacitor filter, Frequency to Voltage converters, Tuned amplifiers, Power amplifiers and Isolation Amplifiers, Video amplifiers, Fiber optics ICs and Opto couplers, Sources fo Noises, Op Amp noise analysis and Low noise OP-Amps.

Text book(s) and/or required materials

TEXT BOOKS

T1. D.Roy Choudhry,Shail Jain,"LinearIntegratedCircuits", NewAgeInternational Pvt.Ltd.,2000.

T2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rdEdition, Tata Mc Graw-Hill, 2007.

REFERENCES

R1. Ramakant A.Gayakwad, "OP-AMP and LinearICs",4thEdition, Prentice Hall /PearsonEducation,2001.

R2. Robert F.Coughlin,FrederickF.Driscoll,"Operational Amplifiers and Linear Integrated Circuits", Sixth Edition,PHI,2001.

R3. B.S.Sonde, "System design using Integrated Circuits" ,2nd Edition, New Age Pub, 2001

R4. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits",Wiley International,2005.

R5.Michael Jacob,"Applications and Design with Analog Integrated Circuits",Prentice Hall of India,1996.

R6.William D.Stanley,"Operational Amplifiers with Linear Integrated Circuits",Pearson Education,2004.

R7.TMH,2008.

R8. www.chegg.com/tutors/

Computer usage: Spice is used to facilitate analysis and design of circuits.

Professional component

General	- 0%
Basic Sciences	- 0%
Engineering sciences & Technical arts	- 0%
Professional subject	- 100%

Broad area : Communication | Signal Processing | **Electronics** | VLSI | Embedded

Test Schedule

S. No.	Test	Tentative Date	Portions	Duration
1	Cycle Test-1	February 2nd Week	Session 1 to 14	2 Periods
2	Cycle Test-2	March 2nd Week	Session 15 to 28	2 Periods
3	Model Test	April 3rd Week	Session 1 to 45	3 Hrs
4	University Examination	TBA	All sessions / Units	3 Hrs.

Mapping of Instructional Objectives with Program Outcome

Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve engineering problems:	Correlates to program outcome		
	H	M	L
1.To Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve engineering problems	B	f	-
2. To develop skills to design simple circuits using OP-AMP	D	a,e,i	-
3.To Gain knowledge about various multiplier circuits, modulators and demodulators	-	a,b,c,e	-
4.Gain knowledge about PLL	-	a,g	-
5.Learn about various techniques to develop A/D and D/A convertors		d,g,i,j	b,e
6. Develop skills to develop simple filter circuits and various amplifiers and can solve problems related to it.	F	a,c	-

H: high correlation, M: medium correlation, L: low correlation

Draft Lecture Schedule

Session	Topics	Problem Solving (Yes/No)	Text / Chapter
UNITI Unit-1: CIRCUIT CONFIGURATION FOR LINEAR ICS			
1	Current mirror and current sources	**Yes**	T1-Chapter 2
2	Current sources as active loads,	No	
3	Voltage sources, Voltage References	Yes	
4	BJT Differential amplifier with active loads	Yes	
5	Block Diagram and Internal Schematic of Operational Amplifier	No	
6	DC Characteristics of Operational Amplifier	Yes	T1-Chapter 3
7	Frequency Response Characteristics	Yes	
8	Frequency Compensation	No	
9	Slew rate	Yes	
UNIT II APPLICATION OF OPERATIONAL AMPLIFIERS			
10	Inverting and Non Inverting Amplifier	Yes	T1-Chapter 3
11	Integrator ,Differentiator,Voltage to Current Converter.	Yes	T1-Chapter 4
12	Instrumentation Amplifier	No	
13	Sine Wave Oscillators	Yes	T1-Chapter 5
14	Low pass and Band pass Filters	Yes	
15	Comparator, Schmitt Trigger	Yes	
16	Triangular Wave Generator.	Yes	
17	Precission Rectifier, Log Amplifier	Yes	T1-Chapter 4
18	Antilog Amplifier and Function Generator	Yes	
UNIT III- ANALOG MULTIPLIER AND PLL			
19	Analog Multiplier using Emitter Coupled Transistor Pair	No	R4-Chapter 10
20	Gilbert Multiplier Cell.	No	
21	Variable transconductance technique	No	
22	Analog multiplier ICs and their applications	No	
23	Voltage controlled Oscillator	No	T1-Chapter 9
24	Block Diagram of PLL and its operation	Yes	
25	Closed Loop Analysis of PLL	No	
26	AM, PM and FSK modulators and demodulators	No	
27	Frequency synthesizers, Compander ICs.	Yes	
UNITIV- ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTOR			
28	Analog switches, High speed sample and hold circuits and sample and hold IC's	No	T1- Chapter 10
29	Types of D/A converter	No	T1- Chapter 10

30	Current driven DAC, Switches for DAC	No	
31	Flash and Single slope A/D converter	No	
32	Dual Slope and Successive approximation type ADC.	No	
33	DM	No	
34	ADM	No	
35	Voltage to time Converter	No	T2- Chapter 7
36	Voltage to Frequency Converter	No	
UNIT-V- SPECIAL FUNCTION IC			
37	Timers	No	T1-Chapter 8
38	Linear Voltage Regulators	No	T1-Chapter 6
39	Switched mode Voltage Regulators	No	
40	Switched capacitor filter, Frequency to Voltage converters	No	T1-Chapter 7
41	Tuned amplifiers	No	R1
42	Power amplifiers and Isolation Amplifiers	No	
43	Video amplifiers	No	
44	Fiber optics ICs and Opto couplers	No	
45	Op-amp Noise Analysis	Yes	R4-Chapter 11

Teaching Strategies

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures
- Laboratory sessions, which support the formal lecture material and also provide the student with practical construction, measurement and debugging skills.
- Small periodic quizzes, to enable you to assess your understanding of the concepts.

Evaluation Strategies

Cycle Test – I	-	5%
Cycle Test – II	-	5%
Model Test	-	10%
Assignments/Seminar/online test/quiz	-	5%
Attendance	-	5%
Final exam	-	70%

Prepared by: Mr.S.Rajesh, Asst. Professor ,Department of ECE **Dated :**

Addendum

ABET Outcomes expected of graduates of B.Tech / ECE / program by the time that they graduate:

a) An ability to apply knowledge of mathematics, science, and engineering
b) An ability to design and conduct experiments, as well as to analyze and interpret data
c) An ability to design a hardware and software system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d) An ability to function on multidisciplinary teams
e) An ability to identify, formulate, and solve engineering problems
f) An understanding of professional and ethical responsibility
g) An ability to communicate effectively
h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i) A recognition of the need for, and an ability to engage in life-long learning
j) A knowledge of contemporary issues
k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Program Educational Objectives

PEO1: PREPARATION
Electronics Engineering graduates are provided with a strong foundation to passionately apply the fundamental principles of mathematics, science, and engineering knowledge to solve technical problems and also to combine fundamental knowledge of engineering principles with modern techniques to solve realistic, unstructured problems that arise in the field of Engineering and non-engineering efficiently and cost effectively.

PEO2: CORE COMPETENCE
Electronics engineering graduates have proficiency to enhance the skills and experience to apply their engineering knowledge, critical thinking and problem solving abilities in professional engineering practice for a wide variety of technical applications, including the design and usage of modern tools for improvement in the field of Electronics and Communication Engineering.

PEO3: PROFESSIONALISM Electronics Engineering Graduates will be expected to pursue life-long learning by successfully participating in post graduate or any other professional program for continuous improvement which is a requisite for a successful engineer to become a leader in the work force or educational sector.

PEO4: SKILL
Electronics Engineering Graduates will become skilled in soft skills such as proficiency in many languages, technical communication, verbal, logical, analytical, comprehension, team building, interpersonal relationship, group discussion and leadership ability to become a better professional.

PEO5: ETHICS
Electronics Engineering Graduates are morally boosted to make decisions that are ethical, safe and environmentally-responsible and also to innovate continuously for societal improvement.

Course Teacher	Signature
Ms M.Jasmin	
Mr.S.Rajesh	

Course Coordinator **HOD/ECE**