INSTITUTE OF AERONAUTICAL ENGINEERING

(AUTONOMUS)
Dundigal, Hyderabad - 500 043

ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**INTEGRATED CIRCUITS APPLICATIONS**			
Course Code	**A50423**			
Regulation	**R15 – JNTUH**			
Course Structure	Lectures	Tutorials	Practicals	Credits
	4	1	-	4
Course Coordinator	Mr. R Gangadhar Reddy, Assistant Professor, ECE			
Team of Instructors	Mr. R Gangadhar Reddy, Assistant Professor, ECE			

I. COURSE OVERVIEW:

Integrated Circuits design can be divided into the broad categories of digital and analog IC design. The physical world is inherently analog indicating that there is always need for analog circuitry. Today the growth of any industry is dependent upon electronics to a great extent. Integrated circuit is electronics and this course IC application acquaints the students with general analog principles and design methodologies using practical devices and applications. It focuses on process of learning about signal condition, signal generation, instrumentation, timing and control using various IC circuitries. With modern digitization advantages we need to work with digital data and hence digital ICs play a crucial role in connecting physical world to the more sophisticated digital world. This course focuses on analysis, design and applications of modern digital integrated circuits.

II. PREREQUISITE(S):

Level	Credits	Periods/ Week	Prerequisites
UG	4	5	Basics of Electronic Devices & Digital Electronics

III. MARKS DISTRIBUTION:

Sessional Marks	University End Exam Marks	Total Marks
Midterm Test There shall be two midterm examinations. Each midterm examination consists of essay paper, objective paper and assignment. The essay paper is for 10 marks of 60 minutes duration and shall contain 4 questions. The student has to answer 2 questions, each carrying 5 marks. The objective paper is for 10 marks of 20 minutes duration. It consists of 10 multiple choice and 10 fill-in-the blank questions, the student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first two and half units of syllabus and second midterm examination shall be conducted for the remaining portion.	75	100

Sessional Marks	University End Exam Marks	Total Marks
Five marks are earmarked for assignments. There shall be two assignments in every theory course. Assignments are usually issued at the time of commencement of the semester. These are of problem solving in nature with critical thinking. Marks shall be awarded considering the average of two midterm tests in each course.		

IV. EVALUATION SCHEME:

S. No	Component	Duration	Marks
1.	I Mid Examination	80 minutes	20
2.	I Assignment	-	5
3.	II Mid Examination	80 minutes	20
4.	II Assignment	-	5
5.	External Examination	3 hours	75

V. COURSE OBJECTIVES:

At the end of the course, the students will be able to:

I. To differentiate between CMOS and TTL logic families, realize various logic functions using CMOS logic and study various combinational and sequential circuits using TTL logic.
II. To understand the internal block diagram of operational amplifier and its characteristics both ideal and practical.
III. To illustrate some typical applications of operational amplifiers in linear and non linear modes of operation.
IV. To construct various active filter circuits using operational amplifier for various frequency response characteristics.
V. To study the block diagrams of 555 timer and 565 phase locked loops ICs and use them to construct various applications.
VI. To study the techniques of Analog to digital and digital to analog converters and its specifications

VI. COURSE OUTCOMES:

After completing this course the student must demonstrate the knowledge and ability to:

1. Define significance of Op-amps and their importance.
2. Infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
3. Build circuits using Analog IC's.
4. Elucidate and design the linear and non-linear applications of an opamp and special application ICs.
5. Ability to use Op-amp as summer, Subtractor, Multiplier, Comparator and Divider.
6. Able to use Op-amp to generate Sine waveform, Square wave form, Triangular wave forms.
7. Classify and construct various active filter configurations based on frequency response using Op-amp.
8. Design audio, radio frequency oscillators.
9. Explain and compare the working of multivibrators using special application IC 555 and general purpose Op-amp.
10. Able to use Op-amp to as analog to digital and digital to analog converter.
11. Classify and comprehend the working principle of data converters.
12. Design input/output interfacing with CMOS integrated circuits.
13. Analyze TTL and CMOS logic families

14. Illustrate the function of application specific ICs such as Voltage regulators, PLL and its application in communication.
15. In-depth knowledge of applying the concepts in real time applications.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency assessed by
PO1	**Engineering Knowledge** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems	H	Assignments, Tutorials
PO2	**Problem Analysis** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	S	Assignments
PO3	**Design/Development of Solutions** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	H	Mini Projects
PO4	**Conduct Investigations of Complex Problems** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions	H	Projects
PO5	**Modern Tool Usage** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations	S	Projects
PO6	**The Engineer and Society** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice	N	--
PO7	**Environment and Sustainability** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development	S	Assignments
PO8	**Ethics** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice	S	Oral Discussions
PO9	**Individual and Team Work** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings	N	--
PO10	**Communication** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	S	Presentations
PO11	**Project Management and Finance** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments	S	Seminars, Discussions
PO12	**Life-long Learning** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	H	Development of Prototype, Projects

N - None **S - Supportive** **H - Highly Related**

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	Proficiency assessed by
PSO1	**Professional Skills:** An ability to understand the basic concepts in Electronics & Communication Engineering and to apply them to various areas, like Electronics, Communications, Signal processing, VLSI, Embedded systems etc., in the design and implementation of complex systems.	H	Lectures, Assignments
PSO2	**Problem-solving skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	S	Tutorials
PSO3	**Successful career and Entrepreneurship:** An understanding of social-awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	S	Seminars and Projects

N - None **S - Supportive** **H - Highly Related**

IX. SYLLABUS:

UNIT – I

INTEGRATED CIRCUITS: Classification, chip size and circuit complexity, classification of integrated circuits, comparison of various logic families, standard TTL NAND Gate-Analysis & characteristics , TTL open collector Ops, Tristate TTL, MOS & CMOS open drain and tri-state outputs, CMOS Transmission gate, IC interfacing –TTL driving CMOS & CMOS driving TTL.

UNIT – II

OP-AMP and Applications: Basic information of Op-AMP, Ideal and practical OP – AMP , internal circuits, Op-Amp characteristics - DC and AC, IC741 Op-Amp and its features, Modes of operation inverting and non-inverting differential.

Basic Applications of OP-Amp, Instrumentation amplifier, AC amplifier, V to I and I to V converters, Sample and Hold circuit, multipliers and dividers, Integrators and differentiators, Comparators, Introduction to Voltage Regulators.

UNIT – III

ACTIVE FILTERS & OSCILLATORS: Introduction, 1st order low pass and high pass filters, band pass, band reject and all pass filters. Oscillator types and principle of operation – RC, Wien and quadrature type, waveform generators-triangular, saw tooth, square wave and VCO.

UNIT – IV

TIMER AND PHASE LOCKED LOOPS: Introduction to IC 555 timer, description of functional diagram, monostable and astable operations and applications, Schmitt trigger, PLL - introduction, block schematic, principles and description of individual blocks of 565.

UNIT – V

D to A AND A to D CONVERTERS: Introduction, basic DAC techniques - weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC different types of ADCs- parallel comparator type

ADC, counter type ADC, successive approximation ADC and dual slope ADC, DAC and ADC Specifications.

TEXT BOOKS:

1. Linear Integrated Circuits, D. Roy Choudhury, 4th edition, New Age International Pvt. Ltd. (T1)
2. Op-Amps & Linear ICs, Ramakanth A, Gayakwad , PHI. (T2)

REFERENCE BOOKS:

1. Digital Fundamentals- Floyd and Jain, Pearson Education. (R1)
2. Modern Digital Electronics by R P Jain. (R2)
3. Operational Amplifiers & linear integrated circuits, R.F. Coughlin & Fredrick F. Driscoll, PHI. (R3)
4. Operational Amplifiers & linear integrated circuits: Theory & Applications, Denton J. Daibey, TMH. (R4)
5. Design with Operational Amplifiers and Analog Integrated Circuits, Sergio Franco, McGraw Hill, New Delhi. (R5)

X. COURSE PLAN:

At the end of the course, the students are able to achieve the following course learning outcomes:

Lecture No.	CLO	Unit	Learning Objective	Topics to be covered	Reference
Course Content Delivery --- Lecture Wise Break-up of Topics I SPELL					
1	1.	I	**Identify** the sizes of ICs based on the no. of gates and transistors	Introduction, Chip size and circuit Complexity	T1:Pg 1 to 3
2	2		**Describe** the basics of logic gates using ICs	Comparison of logic families	R2:Pg 89
3-5	3		**Analyze** the TTL logic and its characteristics	Standard TTL NAND Gate-Analysis & characteristics	R2:Pg 105
6	4		**Identify** the TTL open collector and its tri state conditions	TTL open collector Ops, Tristate TTL	R2:Pg 108
7-8	5		**Describe** the CMOS logic levels and drain outputs	MOS & CMOS open drain and tri-state outputs	R2:Pg 119
9	6		**Analyze** the transmission gate	CMOS Transmission gate	R2:Pg 120
10-12	7		**Relate** the CMOS and TTL logics and its interfacing	IC interfacing –TTL driving CMOS & CMOS driving TTL	R2:Pg 123
13-14	8		**Understand** the basic circuit of Op-amp	Ideal and practical op-amp, its equivalent circuit	T1:Pg 37 to 82
15	9		**Study** the DC characteristics of Op-amp	Op-amp characteristics-DC characteristics	T1:Pg 104 to 110
16	10		**Study** the AC characteristics of Op-amp and its techniques	AC characteristics of Op amp and its compensation Techniques	T1:Pg 110 to 120
17-18	11		**Know** the features of IC 741	741 Op Amp and its features	T1:Pg 120 to 127
19-21	12		**Study** the modes of operations of IC 741	Modes of operation inverting , non inverting	T1:Pg 42 to 51

				and differential amplifiers	
22	13		**Explain** the applications of Op-amps	Basic applications of op-amp, instrumentation amplifier	T1:Pg 135 to 144
23-24	14	**II**	**Understand** the amplifiers, and converters	AC amplifier, V to I and I to V converters	T1:Pg 144 to 147
25	15		**Describe** the sample and hold circuits	Sample & hold circuits, LF398	T1:Pg 153 to 154
26	16		**Describe** the concepts of multipliers and dividers	Multipliers and Dividers	T1:Pg 164 to 175
27	17		**Explain** the applications of Op-amps	Practical Differentiator and Integrators	T1:Pg 164 to 175
28-29	18		**Explain** the applications of Op-amps	Comparator, Schmitt trigger and Multi vibrators	T1:Pg 164 to 175
30	19		**Understand** the concept of voltage regulators	Introduction to voltage regulators features of 723 regulator	T1:Pg 240 to 258
31-33	20	**III**	**Analyze** the first and second order filters LPF, HPF	Introduction to filters, High Pass, Low Pass- First order and Second order	T1:Pg 262 to 277
34-36	21		**Analyze** BPF, BRF and all pass filters	Active Band Pass, Band Reject and All Pass Filter	T1:Pg 277 to 282
37	22		**Describe** concepts of RC oscillator	Oscillators- Principle and its types, RC Oscillator	T2:Pg 318 to 320
Course Content Delivery --- Lecture Wise Break-up of Topics II SPELL					
38-39	23	**III**	**Discriminate** various feedback amplifiers	Oscillators- Wien Bridge and Quadrature type Oscillators	T2:Pg 320 to 326
40-42	24		**Examine** the characteristics of negative feedback amplifiers	Waveform generators- Triangular, saw tooth and square wave, VCO	T2:Pg 326 to 334
43	25	**IV**	**Analyze** the IC555 timer	Introduction to 555 Timer, its specifications	T1:Pg 311 to 312
44-46	26		**Explain** the IC555 functional diagram and its operation	Functional Diagram of 555 Timer and its operation in detail	T1:Pg 311 to 312
47	28		**Analyze** the applications of IC 555 timer (monostable)	Monostable operation using 555 Timer	T2:Pg 418 to 424
48-50	29		**Analyze** the applications of IC 555 timer (astable)	Astable operation using 555 timer and its applications	T2:Pg 424 to 430
51	30		**Analyze** the Schmitt trigger operation	Schmitt Trigger and its applications	T1:Pg 324
52-54	31		**Understand** the PLL and each block of IC 565	PLL Introduction and its Block schematic, principle and description of IC-565	T2:Pg 327 to 345
55	32		**Understand** the concept of D/A and A/D converters	Introduction to Converters and their applications	R1:Pg 714
56-58	33		**Analyze** the various D/A converters (weighted type, R-2R ladder type)	Types of DAC's - Weighted type DAC, R-2R Ladder type DAC	R1:Pg 715 to 722
59	34		**Understand** the concept of inverted R-2R DAC	Inverted R-2R Ladder type DAC	R1:Pg 722 to 727

60-61	35	**V**	**Understand** the concept of flash type ADC	Types of ADC's - Flash type ADC	R1:Pg 734 to 738
62-63	36		**Understand** the concept of counter and SAR type ADC	Counter type ADC, Single Slope ADC, SAR type ADC	R1:Pg 734 to 738
64-65	37		**Distinguish** the DAC and ADC specifications	DAC and ADC specifications	R1:Pg 734 to 738
66	38		**Understand** the concept of dual slope ADC	Dual slope ADC and its specifications	R1:Pg 734 to 738

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	H							S				H		S	S
II		S					S			S			H	S	
III				H				S			S		H	S	
IV			H		S							H	H	S	S
V	H			H			S							S	
VI				H				S			S		H	S	

S – Supportive **H - Highly Related**

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	H		H					S			S	H		S	S
2	H				S		S				S		H	S	
3		S			S			S				H	H	S	
4	H			H			S	S		S	S			S	
5	H	S	H		S								H	S	
6	H		H	H			S			S			H	S	
7	H			H				S		S	S			S	
8	H	S	H		S		S						H	S	
9		S			S			S				H	H	S	
10	H			H			S	S		S	S			S	
11	H	S	H		S								H	S	
12	H		H	H			S			S			H	S	

13	H			H				S		S	S			S	
14	H	S	H		S		S						H	S	
15	H			H			S	S		S	S			S	

S – Supportive **H - Highly Related**

Prepared by **:** Mr. R Gangadhar Reddy, Assistant Professor, ECE
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HOD, EEE