INSTITUTE OF AERONAUTICAL ENGINEERING

Dundigal, Hyderabad - 500 043

ELECTRONICS AND COMMUNICATION ENGINEERING
COURSE DESCRIPTION

Course Title	**Pulse and Digital Circuits**			
Course Code	A40415			
Academic Year	2016 – 2017			
Regulation	R15-JNTUH			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	4	1	-	4
Course Coordinator	Mr. B.Naresh			
Team Instructors	P.Saritha			
Branch	II - B. Tech -ECE			

I. Course overview

This course starts by introducing some basic ideas of electronic linear networks, attenuator and ringing circuits. Subsequently the course covers important concepts like analysis of clippers, clampers, comparators. Steady State Switching Characteristics diode and transistor times, Silicon Controlled Switch Circuits and Sampling Gates. Next the brief introduction of oscillator circuits further, designs various multivibrators, various sweep and time base generators. In later units study of synchronization and frequency division of symmetrical signals and sweep circuits and also realization of logic gates using diodes and transistors.

II. Prerequisite(s)

Level	Credits	Periods / Week	Prerequisites
UG	4	5	Electronic Devices &Circuits, switching theory and logic design.

III. Marks Distribution

Sessional Marks (25 Marks)	University End Marks	Total Marks
Mid Semester Test There shall be 2 midterm examinations. Each midterm examination consists of subjective type and Objective type tests. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each semester shall contain 4 questions The student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks with duration of 20minutes. It consists of 10 Multiple choice and 10 objective type questions. The student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first 21/2 unit of syllabus and second midterm examination shall be conducted for the remaining portion. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course reason whatsoever, will get zero marks(s).the conduct of the second mid-examination. The total marks secured by the student in each mid-term examination are evaluated for 25 marks, and the average of the two mid-term examinations shall be taken as the final marks secured by each candidate.	75	100

IV. Evaluation Scheme

Sl.No	Component	Duration(Hrs)	Marks
1	I Mid Examination	1hr 20 min	20
2	I Assignment	--	5
3	II Mid Examination	1hr 20min	20
4	II Assignment	--	5
5	End Semester Examination	3hr	75

V. Course Educational Objectives

1. To explain the Complete Response of R-C and R-L-C transient circuits
2. To explain the concepts of wave shaping and switching characteristics of diodes and transistors to design various circuits for any application.
3. To construct the various Multivibrators Using Transistors, design of Sweep Circuits and Sampling Gates.
4. To demonstrate time base generators and the principles of synchronization and frequency division.
5. To discuss and realize the Logic Gates using Diodes and Transistors.

VI. Course Outcomes

1. **Understand** the linear wave shaping circuits like high pass circuits for various input signals.
2. **Understand** the linear wave shaping circuits like low pass RC circuits for various input signals.
3. **Analyze** the application of attenuators.
4. **Understand** the non-linear wave shaping circuits like clippers diodes and transistors.
5. **Understand** the non-linear wave shaping circuits like clampers using diodes.
6. **Analyze** the clamping circuit theorem.
7. **Analyze** the diode & transistor switching times.
8. **Remember** the operating principles of unidirectional and bidirectional sampling gates.
9. **Analyze** sampling gates applications like chopper stabilized amplifier, sampling scope and etc.
10. **Analyze** various non-sinusoidal signals using different multivibrators for various electronic applications.
11. **Apply** time base generator circuits which are used in applications like CRO and TV.
12. **Understand** the different methods of linearity improvements.
13. **Remember** the principles of synchronization and frequency division in systems operating at different frequencies.
14. **Understand** the sweep circuits.
15. **Create** various logic gates using different logic families and comparing their performances.

VII. How Course Outcomes are assessed

Program Outcomes		Level	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	H	Assignments, Exercises
PO 2	**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.	H	Hands on Practice Sessions
PO 3	**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.	N	-
PO 4	**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	Lab sessions
PO 5	**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	Design Exercises
P0 6	**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	--
PO 7	**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	Lab sessions
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice**.**	N	-
PO 9	**Individual and Team Work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	S	Design Exercises
PO 10	**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.	N	-
PO 11	**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	Development of Mini Projects
PO 12	**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.	S	Exercises

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

VIII. How Program Specific Outcomes are assessed:

PROGRAM SPECIFIC OUTCOMES		LEVEL	PROFICIENCY ASSESSED BY
PSO 1	**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 and Assignments
PSO 2	**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
PSO 3	**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

LINEARWAVESHAPING: High pass, low pass RC circuits, their Response for Sinusoidal, Step, Pulse, Square, and Ramp inputs. High pass RC Network as Differentiator and Low pass RC circuit as an integrator, Attenuators and its application as a CRO, RL and RLC circuits and their response for step input, Ringing circuit.

UNIT-II

NON-LINEARWAVEHAPING: Diode clippers, Transistor clippers, clipping at two independent levels, Comparators, Applications of Voltage Comparators, clamping operation, Clamping Circuit taking Source and Diode Resistances into account, Clamping circuit theorem, practical clamping circuits, effect of diode characteristics on clamping voltage, Synchronized Clamping.

UNIT - III

STEADYSTATESWITCHINGCHARACTERISTICSOFDEVICES: Diode as a switch, Piece Wise Linear Diode Characteristics, Diode Switching Times, Transistor Acts as a Switch, Breakdown Voltages, transistor in saturation, temperature variation of saturation parameters, transistor-switching times, Silicon Controlled Switch Circuits. Sampling Gates: Basic Operating Principles of Sampling Gates, Unidirectional and Bi directional Sampling Gates, Four Diode Sampling Gates, Reduction of Pedestal in Gate Circuits.

UNIT - IV

BISTABLEMULTIVIBRATORS: Design and Analysis of Bistable, Monostable and Astable Multivibrators, and Schmitt Trigger using Transistors.

TIMEBASEGENERATORS: General features of a time base signal, methods of generating time base waveform, Miller and Bootstrap time base generators – basic principles, Transistor miller time base generator, Transistor Bootstrap time base generator, Current time base generators, and methods of linearity improvement.

UNIT – V

SYNCHRONIZATIONANDFREQUENCYDIVISION: Pulse Synchronization in Relaxation devices, Frequency division in sweep circuit, Stability of Relaxation Devices, Astable relaxation circuits,

Monostable relaxation circuits, Synchronization of a sweep circuit with symmetrical signals, Sine wave frequency division with a sweep circuit, A Sinusoidal divider using Regeneration and Modulation.

LOGICFAMILIES: Realization of Logic Gates (OR, AND, NOT) Using Diodes & Transistors, DCTL, RTL, DTL, TTL, ECL, CML, CMOS logic family and comparison of logic families.

Text Books:

1. Jacob Millman, Herbert Taub and Mothiki S. Prakash Rao, *Millman's Pulse, Digital and Switching Waveforms*, Tata McGraw-Hill,3rd Edition, 2008.
2. Solid State Pulse Circuits – David A. Bell , 4 Ed,2002 PHI

Reference Books:

1. Anand Kumar, *Pulse and Digital Circuits*, 2005, PHI.
2. *Pulse and Digital Circuits* by Yoganarsimha.
3. Fundamentals of *Pulse and Digital Circuits, Ronald .J.Tocci, 3Ed,2008*
4. Motheki S. Prakash Rao, *Pulse and Digital Circuits*, TMH, 2006.

X. Course Plan

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

Lecture No.	Unit NO	Topics to be covered	Course Learning Outcomes	Reference
1-2	I	Introduction to Pulse and Digital Circuits, introduction to signals	**Explain** the generation and processing of different signals like sinusoidal, step, pulse, ramp etc	T1:2, R1:1
3		High pass RC circuit	**Discuss** the response to sinusoidal input	T1: 2.5, R1:1.1.1
4-8	I	Response for sinusoidal, step, pulse, square and ramp inputs	**Define** linear wave shaping concept and Analyze the response to different non sinusoidal inputs	T1:2.5&2.6,R1 :1.1.2-1.1.4
9		Low pass RC circuit, Response for sinusoidal.	**Discuss** the response to sinusoidal input	T1:2.1,R1:1.3, 1.3.1
10-12		Response for step, pulse, square and ramp inputs	**Define** the linear wave shaping concept and **Evaluate** the response to different non sinusoidal inputs	T1:2.2&2.4R1: 1.3.2-1.3.5
13		High pass RC network and Low pass RC network as Differentiator and integrator	**Identify** how the High pass RC circuit and Low pass RC circuit acts as Differentiator and integrator	T1:2.3&2.7 R1:1.2&1.4
14-16		RL and RLC circuits and their response for step input	**Discuss** The response Low pass and High pass RL circuits and Different RLC circuits	T1:2.9&2.10 R1:1.7-1.9
17-18		Attenuators & its application as a CRO probe and Ringing Circuit	**Explain** the amplitude of the input signal is reduced and its application in CRO probe. And Ringing Circuit	T1:2.8&2.11 R1:1.6,1.6.1
19-21	II	Introduction to Non-Linear Wave Shaping, Diode clippers and two independent clippers.	**Explain** how to clip the portion of a input wave form using nonlinear elements	T1:7.2&7.7 R:2.1.2-2.1.6
22-23		Transistor clippers, Comparators, applications of voltage comparators.	**Distinguish** the comparison of two input waveforms and **Evaluate** the relation between them.	T1:7.11 R:2.1.7-2.1.9
24-26		Clamping operation, Clamping circuits taking source and diode resistances into account, Clamping circuit theorem.	**Explain** how to insert a D.C in the signal using Clamping circuits	T1:8.1,8.2& 8.3, R1:2.2.5-2.2.6
27-28		Practical clamping circuits, effect of diode characteristics on clamping voltage. synchronization	**Describe** the practical clamping circuits and its characteristics	T1:8.4,8.5& 8.7, R1:2.2.7-2.2.9

		Clamp		
29-30	**III**	Diode as a switch, Switching Times, and temperature parameters	**Explain** how the P-N junction diode acts as a switch and its characteristics	T1:6.1& T1:20.1,R1:3.1
31-33		Piece wise linear diode characteristics, transistor as a switch, switching times, breakdown voltages, Transistor in saturation ,temperature variation in saturation parameters and SCR	**Explain** how the transistor acts as a switch and its characteristics	R1:3.2& 3.4 - 3.9, T1:20.11
34-35		Sampling Gates: Basic operating principles of sampling gates, Unidirectional diode gate	**State** the basic principles of sampling gates	T1:17.1&17.2, R1:7.1-7.3
36-37		Bi-directional sampling gates using transistors, Reduction of pedestal in gate circuit.	**Explain** the bidirectional sampling gates using transistors and to know how to reduce pedestal in gate circuit	T1:17.4&17.5 R1:7.4-7.6
38-39		Four diode sampling gate, Chopper Amplifier, Sampling Scope.	**Describe** the four diode and six diode sampling gate and its equivalent form	T1:17.10,17.12 &17.13 R1:7.7-711
40-41	**IV**	Bistable Multivibrators, The stable state of a Bistable Multivibrator.	**Discuss** the different multivibrators in real time applications	T1:10.1
42-44		Design and Analysis of Fixed bias, self biased and triggering bistable Multivibrator	**Explain** the design and analysis of fixed, self biased and emitter coupled bistable multivibrators	T1:10.3- 10, R1: 4.2-4.9
45-46	**IV**	Direct binary, and Schmitt trigger circuit using transistors.	**Explain** the Schmitt trigger circuit and converting sinusoidal into square wave	T1:10.11, R1: 4.10
47-49		Monostable and Astable Multivibrators	**Differentiate** the mono stable and astable Multivibrators	T1:11.1,11.4,11.5,11.12&11.14,R1:4.11-4.17
50-52		Introduction to Sweep Circuits, General features of a time base signal, Methods of generating a time base waveform, Transistor miller & Bootstrap time base generator	**Explain** the Sweep circuits and **Discuss** the Miller and Bootstrap transistor based time base generator	T1:14.1,14.2,14.9,14.11&14.14,R1: 5.1-5.10
53-55		Current time base generators: Method of linearity improvements	**Classify** the different current time base generators **Describe** the Method of Linearity Improvement	T1:15.1&15.3 T1:15.2
56-57	**V**	Synchronization and Frequency Division, Pulse synchronization of relaxation devices	**Explain** the synchronization and frequency division in pulse and digital circuits	T1:19.1&19.2 R1:6.1
58-59		Frequency division in sweep circuit, Astable and mono stable relaxation circuits	**Differentiate** the frequency division is in sweep ,monostable and astable relaxation circuits	T1:19.3,19.4& 19.5, R1:6.2-6.4
60-61		Phase delay and jitter, Sine wave frequency division with a sweep circuit	**Explain** the frequency division of a sine wave in a sweep circuit	T1:19.5-19.6,R1:6.5-6.6
62-65		Logic Families: Realization of Logic Gates (OR, AND, NOT) Using Diodes, Transistors	**Describe** the construction of the basic logic gates & universal gates using diodes and transistors	T1:9.3,9.4& 9.5,R1:8.1-8.1.3

66-68		DCTL, RTL, DTL, TTL, ECL,CML, CMOS logic family and Comparison of logic families.	**Classify** the different logic families and **Distinguish** the digital logic families	R1:8.2-8.4 R1:9.2- 9.7

XI: Mapping Course Objectives leading to the achievement of Program Outcomes and Program Specific Outcomes:

Course Objectives	Program Out Comes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
I	H			S			H		S				H	S	
II	H	S		S			H		S				H	S	
III	S								S				H	S	
IV	H	H		S			S				S	S	H	S	S
V	H				S		S		S		S	S	H	S	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		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	H	S					S						H	S	
2	H	S					S		S				S	S	
3	S	S							S				S		
4	S								S				S		
5	S	S											S	H	
6	H	H		S	S		S		S		S		S	S	
7	S	S					S		S				S	S	
8	S												S	S	
9		S											S		
10	S	H		S			S		S		S		S	H	
11	S								S				S	S	
12	S	S		S			S		S				S		
13	S	S		S			S						S	S	
14	S	S											S	S	
15	S	S							S		S		S		

S = Supportive H = Highly Related

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