Techno India NJR Institute of Technology

Course File

Session 2020-21

Analog Electronics (3EE4-06)

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SYLLABUS

2nd Year - III Semester: B.Tech. (Electrical Engineering)

3EE4-06: Analog Electronics

Credit: 3 **Max. Marks: 150 (IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN		Hours
1.	**Diode circuits** P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.	4
2.	**BJT circuits** Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits.	8
3.	**MOSFET circuits** MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.	8
4.	**Differential, multi-stage and operational amplifiers** Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)	8
5.	**Linear applications of op-amp** Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.	8
6.	**Nonlinear applications of op-amp** Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators, Precision rectifier, peak detector. Monoshot	6
	TOTAL	42

Course Overview:

This course on Analog Circuits has been designed primarily as a core course for undergraduate students and, as a refresher course for master level students and circuit designers working in industry. It starts with basic circuit components and circuit concepts and then, gradually moves to practical building blocks of analog electronic systems. In this course, a serious attempt has been made to make a balance between theory and practice so that the discussed circuits can be constructed in an undergraduate level laboratory class and their measured performance can be easily compared with the analytically predicted performance. It helps to build confidence on theory. The other important feature of this course is, it covers both BJT based circuits and MOSFET based circuits parallel so that similarities and performance differences between these two classes of circuits are understandable. Moreover, the BJT based circuits discussed here can be easily constricted on bread board to verify their characteristic through measurement. On the other hand, analysis of the MOSFET based circuits provides the necessary foundation for Analog VLSI circuit/system design, a next level course in Microelectronics and VLSI Design.

Course Outcomes:

CO.NO.	Cognitive Level	Course Outcome
1	Synthesis	Able to design and analyze various oscillator.
2	Application	Know about different power amplifier circuits, their design and use in electronics and communication circuits
3	Application	Demonstrate the ability to design practical circuits using operational amplifier that perform the desired operations.

Prerequisites:

1. Knowledge of semiconductor Physics
2. Electrical technology and, Semiconductor Devices

Course Outcome Mapping with Program Outcome:

Course Outcome	Program Outcomes (PO's)											
CO. NO.	Domain Specific					Domain Independent						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	2	1	0	0	0	0	0	0	0
CO2	2	2	1	2	1	0	0	0	0	0	0	0
CO3	2	1	2	2	1	0	0	0	0	0	0	0
1: Slight (Low) , 2: Moderate (Medium), 3: Substantial (High)												

For Techno India NJR Institute of Technology
पंकज पोरवाल
Dr. Pankaj Kumar Porwal
(Principal)

Course Coverage Module Wise:

Lecture No.	Unit	Topic
1	**1**	**DIODE CIRCUITS:** Overview
2	1	P-N junction diode
3	1	I-V characteristics of a diode
4	1	Review of half wave rectifiers and full wave rectifiers
5	1	Zener diodes
6	1	Clamping and clipping circuits, Numerical
7	**2**	**BJT CIRCUITS STRUCTURE AND I-V CHARACTERISTICS OF A BJT:** Overview
8	2	(Contd.) I-V characteristics of a BJT
9	2	BJT as a switch, BJT as an amplifier
10	2	Small-signal model, biasing circuits
11	2	Current mirror
12	2	Common-emitter, common-base and common collector amplifier
13	2	Small signal equivalent circuits, high-frequency equivalent circuits.
14	2	Numerical
15	**3**	**MOSFET CIRCUITS:** Overview
16	3	MOSFET structure, MOSFET I-V characteristics
17	3	MOSFET as a switch, MOSFET as an amplifier
18	3	Small-signal model and biasing circuits
19	3	Common-source, common-gate and common-drain amplifiers
20	3	Small signal equivalent circuits - gain
21	3	Input and output impedances, transconductance
22	3	High frequency equivalent circuit, Numerical
23	**4**	**DIFFERENTIAL, MULTI-STAGE AND OPERATIONAL AMPLIFIERS** Overview
24	4	Differential amplifier, multi-stage amplifier
25	4	Operational amplifiers Differential amplifier
26	4	Power amplifier
27	4	Direct coupled multi-stage amplifier
28	4	Internal structure of an operational amplifier, ideal opamp
29	4	Non-idealities in an op-amp (Output offset voltage, input bias current), Numerical
30	**5**	**LINEAR APPLICATIONS OF OP-AMP:** Overview
31	5	Idealized analysis of op-amp circuits
32	5	Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier
33	5	Integrator, active filter, P, PI and PID controllers
34	5	Lead/lag compensator using an op-amp, voltage regulator
35	5	Oscillators (Wein bridge and phase shift).
36	5	Analog to Digital Conversion, Numerical
37	**6**	**NONLINEAR APPLICATIONS OF OP-AMP** Overview

38	6	Hysteretic Comparator, Zero Crossing Detector
39	6	Square-wave and triangular-wave generators
40	6	Precision rectifier, peak detector, Mono shot & Numerical

TEXT/REFERENCE BOOKS

1. Microelectronic Circuits – Theory and Applications, Adel S Sedra, Kenneth C Smith and Arun N Chandorkar, Oxford University Press
2. Op-amps and linear integrated circuit technology, Ramakant A. Gayakwad,PHI
3. Electronic Devices and Circuits, J.B. Gupta, S.K. Kataria& Sons.

Teaching and Learning resources:

MOOC (NPTEL): - https://nptel.ac.in/courses/108/102/108102112/

Assessment Methodology:

1. Viva and circuit design in practical lab.
2. Numerical Assignment
3. Two Midterm exams where student have to showcase subjective learning.
4. Final Exam (subjective paper) at the end of the semester.

4E1219

Roll No. .

Total No of Pages: 3

4E1219

B. Tech. IV - Sem. (Main) Exam., May - 2019
PCC Electronics & Comm. Engg.
4EC4-04 Analog Circuits
EC. EI

Time: 3 Hours **Maximum Marks: 120**

Instructions to Candidates:

Attempt all ten questions from Part A, five questions out of seven questions from Part B and four questions out of five from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

PART – A

(Answer should be given up to 25 words only) **[10×2=20]**

All questions are compulsory

Q.1 Explain why is base made thin?

Q.2 Why 'transistor' is called so?

Q.3 Explain how BJT amplifier, bias stability is achieved?

Q.4 Explain Gain Margin?

Q.5 Explain common mode gain for an oscillator.

Q.6 Explain low pass active filters.

Q.7 Describe single slope of ADC.

Q.8 Design a low pass filter at a cut off frequency of 1 kHz with a pass band gain of 2.

Q.9 An operational amplifier has a slew rate of 2V/μs. If the peck output is 12V, what is the power bandwidth?

Q.10 Explain concept of stability?

PART – B

(Analytical/Problem solving questions) **[5×8=40]**

Attempt any five questions

Q.1 Explain low frequency analysis of multistage amplifiers.

Q.2 For a p-channel silicon FET with $a = 2 \times 10^{-4}$ cm and channel resistivity $\rho = 10\Omega$-cm

(i) Find the pinch off voltage

(ii) Repeat (i) for a p-channel germanium FET with $\rho = 2\Omega$ - cm

Q.3 Calculate the operating frequency of a transistor Hartley oscillator if L_1=100 μH, L_2 = 1mH, mutual inductance between the coils, M = 10μH and C =10pF.

Q.4 With a neat diagram, explain the action of Hartley and Colpitts oscillators.

Q.5 Explain Schmitt trigger and its applications.

Q.6 Explain Switched Capacitor Circuits?

Q.7 Describe concept of stability and gain margin?

PART C

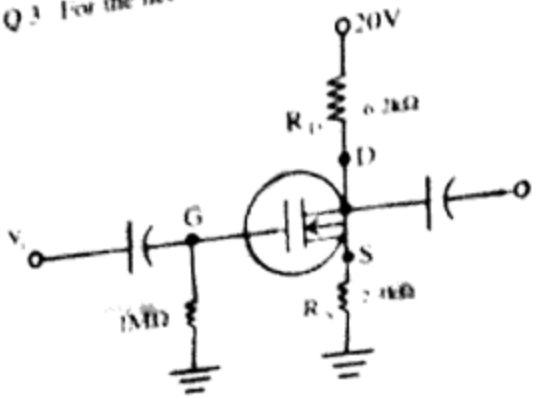
(Descriptive/Analytical/Problem Solving/Design Questions) [4×15=60]

Attempt any four questions

Q.1 Design and explain Digital to Analog Converters.

Q.2 Explain active filters with low pass, high pass, band pass and band stop

Q.3 For the network of figure below given I_{DSS} = 8 mA and V_P = −8 volt



Q.4 Explain differential amplifier, its basic structure and principle of operation.

Q.5 Explain current mirror, its basic topology and its variants.