Course: Core Paper X–HPHCR4102T & HPHCR4102P

Semester	IV
Paper Number	HPHCR4102T & HPHCR4102P
Paper Title	ANALOG SYSTEMS AND APPLICATIONS
No. of Credits	06 (Theory – 4, Lab – 2)
Theory/ Composite	Composite
No. of periods assigned	Th:4 periods/week Pr:3 periods/week
Name of Faculty member(s)	
Course description/ objective	1) The course introduces the physics of semiconductors including that of a junction of extrinsic semiconductors which forms the basis of several devices such as the diode and transistors. 2) The characteristics of a semiconductor diode, its operation under different bias conditions as well as a few of its applications will be covered. 3) Bipolar junction transistors, their characteristics, different ways of DC biasing and an equivalent AC model for its analysis will be dealt with in some detail. 4) With the above knowledge, the students will able to design and analyse circuits using BJT in the case of amplifiers and oscillators. 5) The characteristics of an operational amplifier along with its application in achieving numerous mathematical operations will enable students to understand the potential of an integrated circuit. 6) The students will also have the knowledge of effects of feedback in a circuit and its advantage in the design of amplifiers and oscillators, when chosen appropriately.
Syllabus	As enclosed
Texts	As enclosed
Reading/ Reference Lists	As enclosed
Evaluation	Total – 100 (Theory – 60, Practical – 40) Theory – CIA – 10 Semester Examination – 50 Group A (25 marks) Group B (25 marks) One 10 marks qs out of two qs One 10 mark qs out of two qs Three 5 mark qs out of five qs Three 5 mark qs out of five qs

Syllabus:

HPHCR4102T - ANALOG SYSTEMS AND APPLICATIONS(Credits: Theory-04, Practicals-02)

Module A [26 lectures]

Semiconductor Diodes: P and N type semiconductors. Energy Level Diagram.Conductivity and Mobility, Concept of Drift velocity.PN Junction Fabrication (Simple Idea).Barrier Formation in PN Junction Diode.Static and Dynamic Resistance.Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Current Flow Mechanism in Forward and Reverse Biased Diode. **[7 Lectures]**

Two-terminal Devices and their Applications: (1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter (2) Zener Diode and Voltage Regulation.Principle and structure of (1) LEDs, (2) Photodiode and (3) Solar Cell.**[6 Lectures]**

Operational Amplifiers (Black Box approach): Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain.Frequency Response.CMRR. Slew Rate and concept of Virtual ground. [5 Lectures] Applications of Op-Amps: (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Wein bridge oscillator**. [5 Lectures]**

Conversion: Resistive network (Weighted and R-2R Ladder). A/D Conversion (successive approximation) **[3 Lectures]**

Module B[26 lectures]

Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between $\alpha$and β. Load Line analysis of Transistors.DC Load line and Q-point.Physical Mechanism of Current Flow.Active, Cutoff and Saturation Regions.**[5 Lectures]**

Amplifiers: Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias.Transistor as 2-port Network.h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage & Power Gains. Classification of Class A, B & C Amplifiers **[10 Lectures]**

Coupled Amplifier: Amplifier Coupling methods, Two stage RC-coupled amplifier and its frequency response. [3 Lectures] Feedback in Amplifiers: Effects of Positive and Negative Feedback on Input Impedance, Output Impedance, Gain, Stability, Distortion and Noise. **[4 Lectures]**

Sinusoidal Oscillators: Barkhausen's Criterion for self-sustained oscillations. LC and RC Phase shift oscillator, determination of Frequency. Hartley &Colpitts oscillators.**[4 Lectures]**

Reference Books

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2.Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. Solid State Electronic Devices, B.G.Streetman&S.K.Banerjee, 6th Edn.,2009, PHI Learning.
4. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.

5. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer.
6. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India.
7. Electronic fundamentals & applications, Chattopadhyay&Rakshit, New Central Book Agency.
8. Electronic devices and circuit theory, Boylestad&Nashelsky, Pearson.

HPHCR4102P - Analog Systems and Applications Lab ; Credits 02 (39 periods)

1. To study V-I characteristics and rectification of PN junction diode, and Light emitting diode.
2. To study the V-I characteristics of a Zener diode and its use as voltage regulator.
3. Study of V-I & power curves of solar cells, and find maximum power point & efficiency.
4. To study the characteristics of a Bipolar Junction Transistor in CE configuration.
5. To study the various biasing configurations of BJT for normal class A operation.
6. To design a CE transistor amplifier of a given gain (mid-gain) using voltage divider bias.
7. To design a Wien bridge oscillator for given frequency using an op-amp.
8a) To design an inverting amplifier using Op-amp (741,351) for dc voltage of given gain
b) To design inverting amplifier using Op-amp (741,351) and study its frequency response
c) To design non-inverting amplifier using Op-amp (741,351) & study its frequency response
d) To study the zero-crossing detector and comparator
e) To add two dc voltages using Op-amp in inverting and non-inverting mode
f) To design a precision Differential amplifier of given I/O specification using Op-amp.
g) To investigate the use of an op-amp as an Integrator.
h) To investigate the use of an op-amp as a Differentiator.

Reference Books:

1. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994,Mc-Graw Hill.
2. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
3. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
4. Electronic Devices & circuit Theory, R.L. Boylestad& L.D. Nashelsky, 2009, Pearson

Paper Structure

(a) **Marks for experiment : 30 marks**
(i) Class performance on any one expt. – 8
(ii) Lab. Viva on the same experiment as (i) - 7
(iii) LNB for each of the three experiments - 5 x 3 = 15

(b) Grand Viva – 8 marks
(c) Attendance – 2 marks