ADVANCE PHYSICS 3(ELECTRONICS)

PRE-REQUISITE: Undergraduate level Physics and Mathematics

INTRODUCTION: CREDITE HOURS: 3

This course provides physics students with the fundamental electronic principles needed for advanced study in physics laboratories and graduate school. An introduction to digital electronics, the physics of semiconductors, p-n junctions, transistors and integrated circuits.

COURSE OBJECTIVE:

Upon successful completion of the course material, students will be able to: Qualitatively and quantitatively describe the operation of operational amplifiers in a variety of signal processing applications. Demonstrate the ability to use and to analyze circuits containing digital to analog (DAC) and analog to digital converters (ADC). Learn the proper use of modern test equipment and be able to write simple computer programs which will interface the computer (transfer data to and from) to ADC's, DAC's and registers. Build and analyze the basic digital circuits which become the building blocks for more complex circuits which are used in computers and digital instruments. Demonstrate basic knowledge of the physics of semiconductors, diodes and transistors.

COURSE OUTLINE:

The Semiconductor Diode:
The junction diode, the diode voltage-current equation, Zener diode, light-emitting diodes, capacitance effects in the pn diode.
The Diode as Rectifier and Switch:
The ideal diode model, the half-wave rectifier circuit, the full-wave rectifier circuit, the bridge rectifier circuit, measurement of the ripple in the rectifier circuit, the capacitor filter, the filter; -r filter, regulated power supply.
Models for Circuit:
The black box concept; active one-port models: the voltage-source circuit; active one-port models, the current-source circuit: the two-port network, the h-parameter equivalent circuit, power in decibels.
Junction Transistor as Amplifier:
The junction transistor, the volt-ampere curves of a transistor, the current amplification factors, relations between the amplification factors, the load line and Q point, the basic transistor amplifiers, simplification of the equivalent C-E circuit, the transconductance, g, the common-emitter amplifier, conversion of the h parameters, the common-collector amplifier, performance of the C-C amplifier, comparison of amplifier performance.

DC Bias for the Transistor:
Choice of the quiescent point, variation of the Q point: fixed transistor bias, the four-resistor bias circuit, design of a fixed-bias circuit, design of the bias-stabilized C-E amplifier, voltage feedback bias, design of voltage-feedback bias circuit, bias for the emitter follower, design of the emitter follower circuit.
The Field Effect Transistor:
The junction field-effect transistor; the MOS field-effect transistor, the load line for the FET, obtaining bias for the FET, the FET as an amplifier.
Frequency Response of RC Amplifiers:
Cascaded amplifier, the amplifier passband, the frequency plot, low-frequency response, the low-frequency limit, the unbypassed emitter resistor, high-frequency equivalent circuits and the Miller effect, high-frequency response, the frequency limit of the transistor, the common-base connection at high frequencies, bandwidth of cascaded amplifiers.
Negative Feedback in Amplifiers:
The black box with feedback, stabilization of gain by negative feedback, bandwidth improvement with negative feedback, reduction of nonlinear distortion, control of amplifier output and input resistances, a current series-feedback circuit, voltage shut-feedback circuit, voltage feedback with the FET.
Integrated Amplifiers:
The integrated amplifier, the differential amplifier, the Darlington compound transistor, introduction to operation amplifier.
Power Amplifiers:
Classification of power amplifier, power relations in the class a amplifier, voltage limitations, determination of output distortion, the push-pull circuit and glass B operation, performance of a class B push-pull amplifier, output circuits without transformers, phase inverters for push-pull input.
Oscillators:
Oscillator feedback principles, the Hartley and Colpitts oscillators, practical transistor oscillators, crystal control of frequency, resistance-capacitance feedback oscillator.
Waves Shaping and Switching Circuits:
Diode clipper, diode clamper, differentiator, integrator. Multivibrators, the bistable multivibrator, the one-shot or monostable multivibrator and astable multivibrator.
Digital Circuits:
Binary numbers, Binary codes, Logic switches and gates, Logic Circuits.

Evaluation Criteria

Examination	Type	Marks
Internal Examination	Sessional Work	15%
	Mid-Semester	25%
External Examination	Final Semester	60%

REFERENCE BOOKS:

1. Electronic Circuits and Systems by J.D. Ryder/Charles M. Thomson, (1976).
2. Electronics devices and Circuits by Millman and Halkies (1978).
3. Electronics Devices by Thomos L. Floyd, Prentice-Hall Inc., Englewood Cliffs, (1996).
4. Electronic Principles by Albert P. Malvino, Glencoe McGraw-Hill Book Co. (1993).
5. Digital Fundamentals by Thomas L. Floyd, Prentice-Hall International Inc. Englewood Cliffs, (1994).
6. Electronic Devices and Circuit Theory by Boylestad and Nashhelsky, 7th Edition A. Published by Prentice-Hall, (1997).
7. Electronic Devices and Circuits, by Theodre F. Bogart, Jr. 4th Edition, Prentice-Hall, Upper Saddle River, NJ (USA) 1997.

Advance Physics Lab II (Electronics):

Note: The candidate must perform at least EIGHT experiments from the list given below.
50% weightage must be given to viva-voce about apparatus, theory of experiments and estimation of errors.

1. To construct a power supply and study the rectified wave form (measurement of peak value), ripple factor and regulation (without regulator).
2. To construct a voltage-regulated power supply with Zener diode.
3. To construct a single stage CE transistor voltage amplifier and study gain, input impedance, output impedance, half power points by sine/square wave testing and effect of bias on the output and measurement of distortion.
4. To construct a source follower FET voltage amplifier and study gain, input impedance, output impedance, half power points by sine/square wave testing.
5. To construct an R-C oscillator and compare it with a standard frequency.
6. To construct a Hartley or Colpitts oscillator and measure its frequency.
7. To construct and study the wave forms at the base and collector of the transistors of a free running a multivibrator.
8. To construct and study of the height, duration and time period of the output pulses in a monostable and bistable multivibrators with reference to the input Trigger.
9. To construct from discrete components OR, AND, NOT, NAND, NOR exclusive OR Circuits and verify their truth tables.
10. Study of wave shaping circuits of diode, integrators and differentiators.
11. To construct the operational amplifier (741) by using discrete components and study its frequency response.

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