Course Outline (EE-215 Electronic Devices and Circuits)

a. **Credit Hours**: 3+1

Operational amplifiers basics and non-idealities, Physical operation and terminal characteristics of diodes, modelling of forward and reverse characteristics of diodes, zener diodes, rectifier, limiting and clamping circuits, Physical Structure and principle of operation of BJTs, MOSFETs, Analysis of dc circuits and biasing of transistors, small/large signal models of BJT and MOSFETs. Small signal model, design and analysis of various amplifier configurations, high frequency model and introduction to low and high frequency response of various amplifiers.

b. **Text Books:** Sedra/Smith, Microelectronic Circuits, 5th Ed., Oxford Univ. Press, 2004

c. **Reference Books:** 1. Microelectronics, 2nd Edition, by Millman & Grabel, McGraw Hill

2. Electronic Devices & Circuit Theory, 5th Ed.

By R. Boylestad and L. Nashelsky, 1992.

d. **Course Objectives:** The objective of this course is to build a strong foundation of UG students in microelectronic circuit design by teaching the physical structure and principle of operation of fundamental devices such as diodes, MOSFETs, BJTs , their models and design and analysis of various circuits based on these devices. Specific objectives are to help student learn:

1) Behaviour and characteristics of ideal and non-ideal op amps.
2) Circuit analysis techniques for ideal and non-ideal op amps.
3) Design and analysis of inverting, non-inverting, summing and difference amplifiers, voltage follower and integrator.
4) Regions of operation of the diode (forward, reverse bias, and reverse breakdown) (a,e,k)
5) Apply various diode models including the mathematical model, the ideal diode model, and the constant voltage drop model in circuit analysis and design.

6) MOSFET characteristics in regions of operation of cut-off, triode and saturation.
7) Analyze and design circuits that bias MOS transistors into different operating regions.
8) Design and Analysis of MOS amplifiers (Common-gate, common-source, and common-drain)
9) Physical structure and principle of operation of BJTs.
10) Design and analyze circuits that bias BJT transistors into different operating regions.
11) Design and analyze BJT amplifiers (Common-emitter, common-collector, and common-base.

e. **Course Outcomes:** ***After completion of this course students should be able to:***

1) Be able to design and analyze operational amplifier circuits.
2) Gain a thorough understanding of physical model and principle of operation of Diodes
3) Be capable of design and analysis of diode based circuits
4) Gain a thorough understanding of physical model and principle of operation of Metal oxide semiconductor field effect transistor (BJT)
5) Be capable of designing and analyzing MOSFET circuits
6) Gain a thorough understanding of physical model and principle of operation of Bipolar Junction transistors (BJT)
7) Be capable of designing and analyzing BJT circuits
8) Be able to design and construct variable DC power supply.
9) Be able to design and construct basic audio amplifier.

f. **Topics:**

1. Operational amplifiers and its different configurations
2. Difference and Instrumentation Amplifier
3. DC Imperfections and OP-Amp applications
4. Terminal characteristics of Diode, diode Models, and its currents voltage characteristics.

5. Diode applications
6. Physical operation of diodes
7. MOSFET Device structure, physical Operation and current voltage characteristics

8. MOSFET circuits at DC and Biasing in MOS amplifier circuits
9. Small Signal Operations, Models and single stage MOS amplifiers
10. Frequency Response of MOS Amplifiers
11. BJT Device structure, physical Operation and current voltage characteristics
12. BJT circuits at DC and Biasing in MOS amplifier circuits
13. Small Signal Operations, Models and single stage BJT amplifiers
14. Frequency Response of BJT Amplifiers

LAB: Three hours Lab work per week would be done in context with theory part of the course.