BEE401	Digital Electronics	3L:0T:0P	3 credits

Course Outcomes:

At the end of this course, students will demonstrate the ability to
- Understand the characteristics of transistors.
- Design and analyse various rectifier and amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Understand the functioning of OP-AMP and design OP-AMP based circuits.

Module 1: Diode circuits (4 Hours)

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Module 2: BJT circuits (8 Hours)

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

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Module 3: MOSFET circuits (8 Hours)

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, trans-conductance, high frequency equivalent circuit.

Module 4: Differential, multi-stage and operational amplifiers (8 Hours)

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)

Module 5: Linear applications of op-amp (8 Hours)

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.

Module 6: Nonlinear applications of op-amp (6 Hours)

Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

Text/References:

2. A. S. Sedra and K. C. Smith, " Microelectronic Circuits", New York, Oxford University Press, 1998.
3. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
4. J. Millman and A. Grabel, " Microelectronics", McGraw Hill Education, 1988.

5. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

BEE451: Analog Electronic Circuits Laboratory (0:0:2 – 1 credit)

Hands-on experiments related to the course contents of BEE401.

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