B. Tech. ECE, 3rd Semester (Batch 2018) **Session Jul-Nov/Dec 2019**

ELECTRONIC DEVICES & CIRCUITS

Subject Code: BECE-301 **L T P C** **Duration: 60 Hrs**

3 1 0 4

Course Objectives:

This course is meant to provide fundamental knowledge to students for understanding of the various electronic devices, their circuits & behavior under various conditions.

1. To make aware the students about the various electronic devices and their circuits.
2. To impart knowledge of BJTs and FETs.
3. To provide the students detailed concepts of MOSFETs and CMOSFETs.
4. To analyze low and high frequency transistor models.

Course Outcomes:

At the end of this course student will be able to:

1. Understand the principles of semiconductor physics
2. Understand the concepts of junction diodes and their applications.
3. Understandandutilizethemathematicalmodelsofsemiconductorjunctionsand MOS transistors for circuits and systems
4. Analyze BJT characteristics and determine their behavior under low and high frequencies.
5. Analyze various concepts of FETs and their characteristics.
6. Design low and high frequency models and observe and their various characteristics.

UNIT-I (15 Hrs)

Semiconductors: Introduction to Semiconductors and their classification, Energy bands in intrinsic and extrinsic semiconductors, Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, Generation and recombination of carriers.

Semiconductors Diodes: P-N junction diode, diode resistance and capacitance, I-V characteristics, small signal switching models, Avalanche/Zener breakdown, Applications of PN diode: rectifier, clipper and clamper, Zener diode, Schottky diode, LED, photodiode and solar cell

UNIT-II (15 Hrs)

Bipolar Junction Transistor: BJT and its operation, Ebers-Moll Model, Various BJT configurations and their I-V characteristics, Biasing techniques and bias stability, BJT as a switch and as an amplifier.

Field Effect Transistor: JFET and its operation, various configurations and I-V characteristics, Biasing techniques, FET as a switch and as an amplifier, MOS capacitor, C-V characteristics, MOSFETs; their operation and characteristics, biasing and small signal models of MOS transistor, CMOS devices and CMOS inverter.

UNIT-III (15 Hrs)

Low & High Frequency Transistor Models: Small signal low frequency BJT hybrid Model, Analysis of transistor amplifier in CB, CE and CC configuration using h-parameters, small signal low frequency analysis of FET/MOSFET, Need of high frequency BJT model, high frequency T model, hybrid-pi model, hybrid-pi conductances in terms of low frequency h

parameters.

UNIT-IV (15 Hrs)

Integrated Circuit Fabrication Process: Fundamentals of IC fabrication, photolithography, etching, oxidation, diffusion, ion implantation, chemical vapor deposition, sputtering, twin-tub CMOS process. Monolithic IC-Fabrication: Resistor, PN junction Diode and BJTs.

Text/Reference Books:

1. G.Streetman,and S.K.Banerjee,"SolidStateElectronicDevices,"7thedition,Pearson,2014.
2. D.Neamen,D.Biswas"SemiconductorPhysicsandDevices,"McGraw-HillEducation
3. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley & Sons, 2006.
4. C.T.Sah,"Fundamentalsofsolidstateelectronics,"WorldScientificPublishingCo.Inc,1991.
5. Y.TsividisandM.Colin,"OperationandModelingoftheMOSTransistor,"Oxford Univ. Press, 2011.
6. J. Luo, "Integrated Modelling of Chemical Mechanical Planarization for sub-micron IC Fabrication", Springer.

Tentative Teaching Plan

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ELECTRONIC DEVICES & CIRCUITS

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3-1-0-4

Subject In-charge: Dr. Neeraj Gill

Lecture Plan	Topics to be Covered
L-1	**Brief Introduction to the subject** **Semiconductors**: Introduction to Semiconductors and their classification
L-2	Energy bands in intrinsic and extrinsic semiconductors, Carrier transport: diffusion current, drift current
L-3	Mobility and resistivity; sheet resistance, Generation and recombination of carriers
L-4	**Semiconductors Diodes**: P-N junction diode, diode resistance and capacitance
L-5	I-V characteristics, small signal switching models
L-6	Avalanche/Zener breakdown
L-7	Applications of PN diode: rectifier
L-8,9,10	clipper and clamper
L-11	Zener diode Schottky diode, LED
L-12	photodiode and solar cell
L-13,14	**Bipolar Junction Transistor:** BJT and its operation
L-15	Ebers-Moll Model
L-16,17	Various BJT configurations and their I-V characteristics
L-18,19	Biasing techniques and bias stability
L-20	BJT as a switch and as an amplifier
L-21	**Field Effect Transistor**: JFET and its operation
L-22	Various configurations and I-V characteristics
L-23	Biasing techniques
L-24	FET as a switch and as an amplifier
L-25	MOS capacitor, C-V characteristics
L-26	MOSFETs; their operation and characteristics
L-27	Biasing and small signal models of MOS transistor, CMOS devices and CMOS inverter
L-28	**Low & High Frequency Transistor Models**: Small signal low frequency BJT hybrid Model
L-29,30,31,32	Analysis of transistor amplifier in CB, CE and CC configuration using h-parameters
L-33,34,35	Small signal low frequency analysis of FET/MOSFET
L-36	Need of high frequency BJT model, high frequency T model
L-37	Hybrid-pi model
L-38	Hybrid-pi conductances in terms of low frequency h parameters
L-39,40	**Integrated Circuit Fabrication Process**: Fundamentals of IC fabrication
L-41	Photolithography, etching, oxidation
L-42	diffusion, ion implantation, chemical vapor deposition, sputtering
L-43	twin-tub CMOS process
L-44,45	Monolithic IC fabrication: Resistor, PN junctionDiode and BJTs
Rest of the 15 contact hours are assigned to Tutorials and two MSTs	