COURSE TITLE	**ELECTRONIC DEVICES AND CIRCUITS**
COURSE CODE	**01EC0110**
COURSE CREDITS	**4**

Objective:

1 The objective of this course is to provide a foundational and broad understanding of semiconductor materials, electronic components like diodes, BJTs, FETs, MOSFETs, and CMOS, as well as to build a mathematical and numerical background for the design and analysis of electronic components and circuits.

Course Outcomes: After completion of this course, student will be able to:

1 Apply circuit theory concepts, frequency response, and feedback principles to design and analyze practical electronic systems. (Bloom's Level - Apply)

2 Analyze the characteristics and working principles of semiconductor devices and behaviour of Electronics circuits comprising Semiconductor devices using Modern tools and techniques. (Bloom's Level - Analyze)

3 Evaluate various electronic devices and circuits to ensure they meet specified performance requirements. (Bloom's Level - Evaluate)

4 Design, analyse and implement electronic circuits to solve the problem observed in the industry and the society. (Bloom's Level - Create)

Pre-requisite of course: To understand the basic knowledge of Physics (especially semiconductor physics). Fundamental understanding of electric circuits (Ohm's Law, KCL, KVL).

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Semiconductor Diodes** Symbol and Construction, Operating Characteristics in Forward and Reverse Bias, Applications of Diode as Switch, Applications of Diode as Clipper, Applications of Diode as Clamper, Applications of Diode as Rectifier, Special Purpose Diodes: Zener Diode, Optical Diodes like LED, Photo Diode, Laser Diode, Seven Segment Display, Special Purpose Diodes: Varactor Diode, Schottky Diode, PIN Diode, Tunnel Diode, Step Recovery Diode, High Speed Diodes and Applications	7

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Contents : Unit	Topics	Contact Hours
2	**Bipolar Junction Transistor (BJT)** Invention of the BJT—historical development and significance, Types of BJT—NPN vs PNP, material systems, and comparative features, BJT Symbol—standard schematic representations and terminal conventions, BJT Construction—physical structure, layer doping profiles, and fabrication overview, Basic Operation of BJT—charge flow, current-components in NPN/PNP devices, Common Base Configuration—circuit diagram, mode of operation, input/output characteristics, Common Emitter Configuration—circuit diagram, mode of operation, input/output characteristics, Common Collector Configuration—circuit diagram, mode of operation, input/output characteristics	8
3	**BJT Biasing & DC Analysis** Operating Point and Load Line, Fixed (Base) Biasing, Emitter Biasing, Voltage Divider Bias – Introduction, Voltage Divider Bias – Analysis, Emitter Feedback Bias, Collector Feedback Bias, Collector and Emitter Feedback Bias, Bias Stabilization – Concept and Factors, Bias Stabilization – Techniques and Summary	10
4	**Field Effect Transistors (FETs)** Types, Symbol, and Construction of JFET, Operation of JFET, Input/Output Characteristics of JFET, Biasing Methods for JFET, Applications of JFET, Types, Symbol, and Construction of MOSFET, Operation of MOSFET, Input/Output Characteristics of MOSFET, Biasing Methods for MOSFET, Applications of MOSFET	10
5	**CMOS Fundamental** Evolution and Significance of CMOS, Construction of nMOS and pMOS Transistors, Voltage-Current (VI) Characteristics of nMOS, Voltage-Current (VI) Characteristics of pMOS, CMOS Inverter – Construction, CMOS Inverter – VI Characteristics, Types of CMOS and Introduction to FinFET Transistors	7
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiment-1** To study and perform the V-I characteristic of the Silicon Diode and Zener Diode.	2
2	**Experiment-2** To use the Zener Diode as voltage regulator.	2
3	**Experiment-3** To use a silicon Diode as a Clipper and Clamper.	2
4	**Experiment-4** To analyse the Half Wave, Full Wave and Bridge Rectifiers.	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
5	**Experiment-5** To study and perform the Input and Output characteristics of BJT.	2
6	**Experiment-6** To use a Transistor as a Switch.	2
7	**Experiment-7** To analyse CE, CB and CC Amplifier Circuit.	2
8	**Experiment-8** To measure the variation of current gain with variation in temperature for different biasing of a transistor.	2
9	**Experiment-9** To study and perform the Input and Output characteristics of FET.	2
10	**Experiment-10** To study and perform the Input and Output characteristics of MOSFET.	2
11	**Experiment-11** Design a full wave bridge rectifier for input 50 Hz 10Vp-p AC signal and expected output of 5 V DC signal.	2
12	**Experiment-12** Design a regulated power supply using a Zener diode for input variation of 10 to 20 Vp-p.	2
13	**Experiment-13** A silicon diode has a reverse current of 5 µA at 25°C and 100 µA at 100°C. What are the values of the saturation current and the surface-leakage current at 25°C? – Do the required analysis using simulator.	2
14	**Experiment-14** Demonstrate Automatic street light control system using LED.	2
15	**Experiment-15** Design a +5 to +25 V variable power supply.	2
16	**Experiment-16** nMOS, pMOS, and CMOS circuit simulation and V-I Characteristics analysis	2
17	**Experiment-17** Layout design of nMOS, pMOS, and CMOS.	2
Total Hours		**34**

Textbook :

1 Electronic Devices and Circuit Theory, Boylestad & Nashelsky, Pearson Education, 2009

References:

1 Microelectronic Circuits, Microelectronic Circuits, Sedra & Smith, Oxford University Press, 2016

2 Electronic Devices and Circuits, Electronic Devices and Circuits, Millman & Halkias, McGraw Hill, 2008

References:

3 Electronic Devices and Circuits, Electronic Devices and Circuits, David A. Bell, Oxford University Press, 2008

4 Electronic Devices, Electronic Devices, Thomas L. Floyd, Pearson Education, 2008

5 CMOS Digital Integrated Circuits, CMOS Digital Integrated Circuits, Sung-Mo-Kang, Yusuf Leblebici, McGraw Hill, 2003

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
5.00	10.00	30.00	20.00	20.00	15.00

Instructional Method:

1 The internal evaluation will be done based on the continuous evaluation of students in the laboratory and class-room.

2 A practical examination will be conducted at the end of the semester for evaluation of practical performance.

3 Students may use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory, etc.

4 The course delivery method will depend upon the requirements of content and need of the students. The teacher in addition to conventional teaching methods (Chalk and Talk) may use any of the tools/techniques such as demonstration, role play, Quiz, brainstorming, Flipped class, Project based learning, Collaborative learning, MOOCs etc. for effective teaching.

Supplementary Resources:

1 http://textofvideo.nptel.iitm.ac.in/video.php?courseId=117103063

2 https://www.coursera.org/course/eefunlab

3 https://www.coursera.org/course/introtoelectronics

4 https://www.edx.org/course/circuits-electronics-1-basic-circuit-mitx-6-002-1x

5 http://www.learnabout-electronics.org

6 http://www.electronics-tutorials.ws

7 http://101science.com/Radio.htm

8 http://www.electronicsandyou.com

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