CURRICULUM AND SYLLABI

for

Minor Programme

(Applicable to 2022 admission onwards)

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राष्ट्रीय प्रौद्योगिकी संस्थान गोवा
NATIONAL INSTITUTE OF TECHNOLOGY GOA
कोट्टामल प्लाटू, कुंकोलिम, सालसेट, दक्षिण गोवा, गोवा - ४०३७०३, इंडिया
Kottamoll Plateau, Cuncolim, Salcete, South Goa, Goa- 403703, India

Minor Specialization

in

Electronics and Communication Engineering

Offered by the

Department of Electronics and Communication Engineering

Scheme and Curriculum up to V Semester

Semester Offered	**Course Code**	**Course Name**	**Type**	**L-T-P**	**Credits**
IV	EC250M	Analog Electronics	MR	3-0-2	4
V	EC300M	Digital Electronics ***(for MCE and CVE Students)***	MR	3-0-2	4
V	EC301M	Semiconductor Devices ***(for CSE and EEE Students)***	MR	3-1-0	4
VI	EC350M	Communication Engineering	MR	3-0-0	3
VII	EC400M	Sensors Technology	MR	3-0-0	3
VIII	EC450M	Microcontroller ***(Project Based)***	MR	3-0-2	4
Total Credits					**18**

Detailed Syllabi of courses

Course Code	Course Name	L	T	P	Credits
EC250M	Analog Electronics	3	0	2	4

Course Objective

1. Exploring the behaviour of the diodes and BJTs in analogue and digital environment.
2. Analysis of the various circuits using MOSFETs and study of the amplifiers.
3. Understand the high frequency model of the bipolar junction transistors (BJTs) for the different configurations.
4. Understanding and analysis of the different types of the feedback amplifiers.

Course Outcomes

CO1. Applying the device characteristics in different circuits and studying the related impact.
CO2. Acquire the basic understanding of the Field effect transistor (FET) and its small signal model, analyses the low frequency configurations of the amplifier using FET.
CO3. Understand the high frequency model of the BJTs & MOSFETs for the different configurations.
CO4. Exploration of the feedback concepts in different BJT and MOSFET amplifiers.

Relationship of Course Outcomes to Program Outcomes
H = High correlation; M = Medium correlation; L = Low correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	L	M	L	H	M	H	H
CO2	H	H	H	H	M	L	L	L	H	M	H	H
CO3	H	H	H	H	M	L	L	L	H	M	H	H
CO4	H	H	H	H	M	L	L	L	M	M	H	H

Syllabus

Module 1: Diode & Bipolar Transistors (12 hours)

Diode circuits: clipping, clamping and rectifiers.

Small and Large Signal Model, DC & Small Signal Analysis, Operating Point Analysis and Design: Simple Biasing and Resistive Divider Biasing, Ebers-Moll and Gummel-Poon Model, Common Emitter and Common Base Bipolar Amplifiers with Active Load, BJT Differential Pair

Module 2: MOSFETs (10 hours)

Small & Large Signal Model, Current Source, Current Mirror Circuits, MOS Differential Amplifiers, Differential and Common Mode Gain, CMRR, MOS Differential Amplifiers with Active Load-Qualitative & Quantitative Analysis.

Module 3: Frequency Response (12 hours)

Miller's Theorem, High Frequency Models of Transistors, Use of Miller's Theorem, Frequency Response of Followers, Cascode Stage and Differential Pairs. Voltage Amplifiers, Current Amplifiers.

Module 4: Feedback Amplifiers (10 hours)

Series-Shunt Feedback Amplifiers, Series-Series Feedback Amplifiers, Shunt-Shunt Feedback Amplifiers, Shunt Series Feedback Amplifiers, Loop Gain Stability.

List of Experiments (Any Five)

Experiment No. 1: Set-up and extract the input and output characteristics of the P-N junction diode.
Experiment No. 2: Realization of the different clipping and clamping circuits and observe the waveforms.
Experiment No. 3: To study input and output characteristics of a NPN Bipolar Junction Transistor (BJT) in Common-emitter configuration.
Experiment No. 4: To study transfer and output characteristics of an n-channel MOSFET in common-source configuration.
Experiment No. 5: Determine the Q-point stability of base bias.
Experiment No. 6: Construct the dc load line and plot the Q-point of voltage divider bias circuit.
Experiment No. 7: Study and simulate the frequency response of the common emitter amplifier.

Textbooks:

1. Behzad Razavi, "Fundamentals of Microelectronics", John Wiley & Sons .2008.
2. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
3. B.G. Streetman and S. K. Banerjee, Solid State Electronic Devices, Prentice Hall of India, New Delhi, 1995.
4. T. C. Carusone, D. Johns, and K. Martin, Analog Integrated Circuit Design, 2nd edition. Wiley-India, 2013.
5. P. R. Gray, P. J. Hurst, S. H. Lewis, and R. G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th edition. Wiley-India, 2009.

Reference Books:

6. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 11th edition. Pearson, 2013.
7. D. A. Neamen, Electronic Circuits: Analysis and Design, 3rd edition. Tata McGraw-Hill, 2008.

Course Code	Course Name	L	T	P	Credits
EC300M	Digital Electronics (*for MCE and CVE Students*)	3	0	1	4

Course Prerequisites: Basic Electrical Science.

Course Objectives: To understand the working of digital systems. Various hardware components of the Digital logics/computer shall be studied in greater depth.

Course Outcome (CO):

CO1: Apply Boolean algebra and Karnaugh maps to simplify digital logic circuits.

CO2: Design and implement fundamental combinational circuits like adders, subtractors, comparators, decoders, encoders, multiplexers, and de-multiplexers.

CO3: Analyze the behavior of various flip-flops (SR, D, JK, and T) and design sequential circuits like counters, shift registers, and sequence detectors.

CO4: Model digital systems using state machines represented by state diagrams and tables, and perform state minimization for efficient design.

CO5: Understand the principles of logic families (e.g., ECL, CMOS) and use hardware description languages (Verilog/VHDL) for digital system modeling.

Relationship of Course Outcomes to Program Outcomes

H = High correlation; M = Medium correlation; L = Low correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	-	L	-	-	-	-	-	-	L
CO2	H	H	M	-	L	-	-	-	-	-	-	L
CO3	H	H	H	-	L	-	-	-	-	-	-	L
CO4	M	L	H	-	L	-	-	-	-	M	-	L
CO5	M	L	M	-	M	-	-	-	-	M	L	M

Syllabus

Module 1 Minimization of Boolean function (6 hours)

Number systems and binary codes, error detecting & correcting codes, Boolean algebra and Logic Gates, simplification of logic functions using Karnaugh map, Quine McCaskey method.

Module 2 Combinational Logic Design (8 hours)

Implementation of combinational logic functions, binary adder- subtractor, parallel adder, BCD adder, binary multiplier, magnitude comparator, decoders, BCD to 7-segment decoder driver, encoders, priority encoders, code converters, parity generator/checker, multiplexers & de-multiplexers, implementation of logical functions using multiplexers.

Module 3 Sequential Logic Design (12 hours)

Sequential circuits, latches and flip-flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop, timing hazards and races, edge-triggered flip-flops, register, shift register, universal shift register; application of shift register: ring counter, Johnson counter, sequence generator and detector, up- and down counter, asynchronous ripple counter, synchronous counters, counter design using flip flops, counter design with asynchronous reset or preset, applications of counters.

Module 4 State Machine (08 hours)

Canonical model of a state machine, types of state machines, state diagram, state table, state assignment, Moore and Mealy model, state minimization.

Module 5 Logic families (8 hours)

ECL, CMOS. Memories: read only and read/write memories, Hardware modeling using Verilog/VHDL; Laboratory exercises and assignments to supplement the course.

Reference and Text Books:

1. M. Morris Mano, Michael D. Ciletti, Digital Design: With an Introduction to Verilog HDL, 5-th edition, Pearson Education India, 2013.
2. Stephen Brown, ZvonkoVranesic, Fundamentals of Digital Logic with VHDL Design, Third edition, McGraw Hill Education, 2017.
3. Ronald J. Tocci, Digital Systems, 10-th edition, Pearson, 2009.
4. Vahid, Digital Design, with RTL Design, VHDL, and Verilog, 2nd Edition, John Wiley and Sons Publishers, 2010.
5. S. Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Second Edition, Pearson Education, 2004

List of Experiments

1. Implementing and realization of boolean expressions using logic gates and universal gates.
2. Study of the 7483 chip and implementing half/full adder & half/full subtractors using logic gates.
3. Realization and verification of the truth table of the JK flip-flop, D flip-flop and T flip-flop.
4. Implementation of the 3-bit sequential counter.
5. Write and implement the VHDL code of half adder using behavioral, dataflow and structural modelling.

Course Code	Course Name	L	T	P	Credits
EC301M	Semiconductor Devices *(for CSE and EEE Students)*	3	1	0	4

Course Objective

1. Understand the importance, types, and behaviors of different semiconductor materials.
2. Explore the properties and functions of p-n junction devices.
3. Develop a thorough understanding and comprehensive knowledge of transistors and their applications.

Course Outcomes

The student will be able to

CO1. Analyze the fundamental properties and behavior of semiconductor materials.

CO2. Understand the working of p-n junction devices and evaluate their usage in real world applications.

CO3. Analyze and design transistor circuits for a given application.

Relationship of Course Outcomes to Program Outcomes

H = High correlation; M = Medium correlation; L = Low correlation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	H	M	L	M	L		M		H
CO2	H	H	H	H	H	L	L	L		M	L	H
CO3	H	H	H	H	H	M	L	L	L	M	L	H

Syllabus

Module 1: Introduction to Semiconductor Devices (10 hours)

Importance of semiconductor materials in electronics, basic semiconductor material types, intrinsic and extrinsic semiconductors, concept of charged carriers and its temperature dependence, Bond model, band model, charge carrier generation & recombination, minority current continuity equation.

Module 2: Introduction to p-n junction (10 hours)

Ideal band equation, diodes, forward & reverse biasing, built-in voltage, real & ideal VI characteristics & breakdown mechanism

Case study on p-n junction devices – Zener diodes, photovoltaic cells, LEDs, photodiodes, high frequency IMPATT diodes, Gunn diodes.

Module 3: Concept of Transistors (12 hours)

Unipolar & Bipolar transistors, construction, and operation of Bipolar Junction Transistors (BJT), concept of amplification, base transport factor, injection efficiency, VI characteristics, Ebers-Moll Model.

Concept of Unipolar Junction Transistors (UJT), Field Effect Transistors (FET), Junction Field Effect Transistors (JFET), Insulated Gate Field Effect Transistors (IGFET), Construction and operation of Metal Oxide Silicon Field Effect Transistors (MOSFET), MOS Capacitance, modes of operation, MOSFET based amplifiers and uses.

Textbooks:

1. T. L. Floyd, "Electronic Devices,"Prentice Hall, 9th Edition, 2012.
2. S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", Tata Mc-Graw Hill, 3rd Edition
3. Bell, David A. Electronic devices and circuits. Prentice-Hall of India, 1999.

Reference Books:

4. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 11th edition.Pearson, 2013.
5. D. A. Neamen, Electronic Circuits: Analysis and Design, 3rd edition. Tata McGraw-Hill,2008.