INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: Department of Electronics and Communication Engineering

1. **Subject Code:** ECC-102 **Course Title:** Semiconductor Devices and Applications
2. **Contact Hours:** **L:** 3 **T:** 0 **P:** 2/2
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 15-30 **PRS:** 20 **MTE:** 15-25 **ETE:** 30-40 **PRE:** 0
5. **Credits:** 4 **6. Semester:** Spring **7. Subject Area:** PCC
8. **Pre-requisite:** NIL
9. **Objective:** To introduce to semiconductor device, device physics and applications.
10. **Details of Course:**

S.No.	Contents	Contact Hours
1.	**Semiconductor Materials:** Introduction to semiconductors, types of materials, crystal structure, miller Indices, directions in Crystals, energy bands and bond model, concept of holes and mobile electrons, effective mass, Density of states, Fermi-Dirac probability, Boltzmann distribution.	4
2.	**Electrostatics:** intrinsic and extrinsic semiconductors, carrier concentrations, Fermi levels, n.p product, semiconductor junctions: homo-junctions and hetero-junction, band-diagrams for semiconductor junctions, metal-semiconductor junctions: Schottky and Ohmic.	5
3.	**Transport:** Carrier drift, mobility, velocity saturation, diffusion, quasi-Fermi levels, continuity equation, total current density, induced electric field and Einstein relation, Hall effect.	4
4.	**p-n Junction:** basic structure, built-in potential, electric field and depletion width, reverse bias effect, junction capacitance, forward bias effect, ideal I-V relationship, boundary conditions and short diode, Schottky diodes, Tunnel diodes Half wave- full wave rectifiers, clippers and clampers, load-line analysis, Zener diode applications.	7
5.	**MOS Electrostatics:** Two terminal MOS structure, flat-band, work-function, surface potential, depletion layer thickness, regions of operation and related physics, Ideal C-V characteristics, threshold voltage, frequency effects, Application: MOSCAPs, Varactors, circuit examples, biasing.	7
6.	**MOSFET:** MOSFET structure, regions of operation, transports, I-V relationship and derivation including subthreshold conduction, C-V characteristics, small-signal equivalent circuit, Applications: Modern devices, Short channel effects (qualitative), Basic CMOS circuits and analysis.	6
7.	**Bipolar Junction Transistor:** BJT structure and principles of operation, I-V characteristics, equivalent circuit models, Transistor configurations: CB, CC, CE, Input, output and transfer characteristics of transistor, relation between α and β, amplifiers and figures of merit, DC & AC load line and Q point Transistor biasing.	4
8.	**Optical devices:** Optical absorption; Solar cells, conversion efficiency, photodetectors, Light emitting diodes, photo transistors, quantum efficiency (internal and external), Application: Solar cells, LEDs, Photodetectors, sensors and opto couplers.	5
Total		**42**

11. Suggested Books

S.No.	Name of Authors/Books/Publishers	Year of Publication/ Reprint
1.	Robert L. Boylestad, Louis Nashelsky "Electronic Devices and Circuit Theory" Pearson Prentice Hall.	2006
2.	Donald A. Neamen, "Semiconductor Physics and Devices: basic principles", McGraw Hill	2011
3.	Robert F. Pierret, "Advanced Semiconductor Fundamanetals", Prentice Hall	2002
4.	B. G. Strretman and S. K. Banerjee, "Solid State Electronic Devices", Pearson Education	2016
5.	S. M. Sze and K. K. Ng, "Physics of Semiconductor Devices", Wiley	2007
6.	Y. Tsividis and C. McAndrew, "Operation and Modeling of the MOS Transistor", Oxford Univ. Press	2010
7.	Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective" Pearson 2nd edition	2016

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPTT./CENTRE: Department of Electronics and Communication Engineering

1. **Subject Code:** ECC-104 **Course Title**: Digital Logic and Systems
2. **Contact Hours**: **L:** 3 **T:** 1 **P:** 0
3. **Examination Duration (Hrs.)**: **Theory:** 3 **Practical:** 0
4. **Relative Weightage: CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 4 **6. Semester:** Spring **7. Subject Area:** PCC
8. **Pre-requisite:** NIL
9. **Objective:** To acquaint with the fundamental principles of Digital Logic Circuits, FPGA, HDL, Micro-processor, Micro-controller and their applications to Digital System Design.
10. **Details of Course:**

S.No.	Contents	Contact Hours
1.	**Logic family:** Brief overview of Transistor as a switch; Logic gate characteristics: propagation delay, speed, noise margin, fan-out, and power dissipation; Static CMOS implementation of Logic gates.	6
2.	**Gate-level minimization and Codes:** Simplification of logic minimization, K-map, POS and SOP simplifications, NAND and NOR implementation, BCD and ASCII.	6
3.	**Combinational logic design:** Analysis of combinational circuits, binary adder, and subtractor, carry lookahead adder, BCD adder, multiplier, decoders, encoders, multiplexer, demultiplexers.	6
4.	**Sequential logic design:** Latches: SR-latch, D-latch; Flip-Flops: D-Flip-Flop, JK-Flip-Flop, T-Flip-Flop; Timing in sequential circuits: setup time and hold time; Shift register; Counters: synchronous and asynchronous; Other counters: Ring counter, Johnson counter, and Decade counter; Finite state machines: Moore and Mealy.	8
5.	**Memory, FPGA, and HDL:** ROM, RAM, Memory decoding, Error detection and correction, Programmable logic: PLA and PAL; sequential programmable devices: SPLD, CPLD, and FPGA; Introduction to HDL: Verilog or VHDL based Designs.	8
6.	**Processor architectures:** Architectures of micro-processor, Micro-controller, and Digital signal processors; Memory map, Interrupts, Direct Memory Access (DMA), Serial and parallel port.	8
Total		**42**

11. Suggested Books:

S.No.	Name of Authors / Books / Publishers	Year of Publication/ Reprint
1.	Mano M.M., Ciletti M.D., "Digital Design", Pearson India, 6th Edition.	2018
2.	Wakerly J.F., "Digital Design: Principles and Practices," Pearson India, 4th Edition.	2008
3.	Muhammad Ali Mazidi, Janice Mazidi, and Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education India; 2nd edition	2007
4.	Samir Palnitkar, "Verilog HDL" Pearson 2nd edition	2003
5.	Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits: A Design Perspective" Pearson 2nd edition	2016
6.	Donald P Leach, Albert Paul Malvino and Goutam Saha "Digital Principles and Applications", Tata McGraw-Hill Publishing Company,	2010

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: Electronics and Communication Engineering

Subject Code: ECE-102 **Course Title:** Introduction to Communication Systems

L-T-P: 3-1-0 **Credits:** 4 **Subject Area:** PCC

Course Outline:

Continuous and discrete-time signals, Properties of LTI systems, Convolution, Impulse response, Fourier series, Fourier transform, Sampling theorem, Quantization, Generation and detection techniques for AM, FM, and PM, Super heterodyne receivers, Digital modulation and demodulation techniques.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: Electronics and Communication Engineering

Subject Code: ECC-106 **Course Title:** Signals and Systems

L-T-P: 3-1-0 **Credits:** 4 **Subject Area:** PCC

Course Outline:

Continuous and discrete-time signals and systems, LTI systems, Impulse response and step response, Convolution, Causal LTI systems described by LCCDE, Fourier Series (CTFS, DTFS), Fourier transform (CTFT, DTFT), Laplace (unilateral and bilateral) transform and z-transform, LTI system analysis in s-domain and z-domain, Circuit analysis in s-domain, Applications of above transforms: Sampling, Modulation, Ideal and non-ideal filters, Butterworth and Chebyshev filters.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: Electronics and Communication Engineering

Subject Code: ECC-201 **Course Title:** Fundamentals of Communication System

L-T-P: 3-1-0 **Credits:** 4 **Subject Area:** PCC

Course Outline:

Complex envelope and baseband equivalent representation of bandpass signals, Generation and detection techniques for AM, FM, and PM, Noise models, Noise figure, Correlation and power spectrum of random signals, PLL, Carrier acquisition and FM demodulation, Effect of noise on AM and FM systems, Super heterodyne and other receiver architecture.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: Electronics and Communication Engineering

Subject Code: ECC-202 **Course Title:** Digital Communications

L-T-P: 3-0-0 **Credits:** 3 **Subject Area:** PCC

Course Outline:

Sampling theorem, Pulse modulation, Multiplexing techniques, Uniform and non-uniform quantization, Adaptive quantization and prediction, Line codes and their PSD, Matched filter, ISI, Wave shaping techniques, Channel equalization, Detection of signals in noise, Signal space representation, Symbol detection and error analysis, Entropy and mutual information, Channel capacity, Shannon limit.

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPT./CENTRE: Electronics and Communication Engineering

Subject Code: ECC-301 **Course Title:** Digital Signal Processing

L-T-P: 3-0-0 **Credits:** 3 **Subject Area:** PCC

Course Outline:

Orthogonal transforms, Properties and applications of DFT, Implementing LTI systems using DFT, Circular and linear convolution using DFT, Fast Fourier transform: DIT, DIF, Goertzel algorithm, Design of digital FIR and IIR filters, Multi-rate signal processing, Filter banks, Polyphase structures, Wavelet transform, Adaptive filters and LMS algorithm.