MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)

Ph.D ADMISSION TEST (MR-PAT)

Ph.D. in Electronics & Communications Engineering

Module 1: Electronic Devices
1.1 Semiconductor Physics
Energy Bands, Carrier Transport
1.2 Diodes: PN Junction, Zener
1.3 Bipolar Junction Transistor (BJT)
1.4 Field Effect Transistors (MOSFET, JFET)
1.5 Device Characteristics and Biasing
1.6 Optoelectronic Devices: LED, Photodiode, Solar Cell

Module 2: Analog Circuits
2.1 Small Signal and Large Signal Analysis
2.2 Amplifiers: Common Emitter, Common Source
2.3 Operational Amplifiers: Characteristics and Applications
2.4 Filters, Oscillators, Wave Shaping Circuits
2.5 Feedback and Stability
2.5 Voltage Regulators

Module 3: Digital Circuits
3.1 Number Systems and Boolean Algebra
3.2 Combinational Logic: Adders, Multiplexers, Encoders, Decoders
3.3 Sequential Circuits: Flip-Flops, Counters, Shift Registers
3.4 Logic Families: TTL, CMOS
3.5 Memory: ROM, RAM, PLAs
3.6 A/D and D/A Converters
3.7 Basics of VHDL/Verilog (optional advanced topic)

Module 4: Signals and Systems
4.1 Classification of Signals and Systems
4.2 Linear Time Invariant (LTI) Systems
4.3 Convolution, Fourier Series and Fourier Transform
4.4 Laplace Transform
4.5 Z-Transform and Discrete-Time Signal Analysis
4.6 Sampling Theorem
4.7 Basics of Multirate Signal Processing

Module 5: Control Systems
5.1 Basic Control System Components
5.2 Transfer Function, Block Diagram Reduction
5.3 Time and Frequency Domain Analysis
5.4 Stability (Routh-Hurwitz, Nyquist, Bode Plots)
5.5 Root Locus, PID Controllers
5.6 State Space Analysis and State Feedback Control
5.7 Frequency Response, Nyquist and Bode Plots

Module 6: Microprocessors and Microcontrollers

6.1 Microprocessor Architecture (Intel 8085, 8086)
6.2 Instruction Set and Assembly Language Programming
6.3 Memory and I/O Interfacing
6.4 Interrupts, DMA
6.5 Microcontroller Architecture (e.g., 8051, ARM)
6.6 Timers, Counters, and Serial Communication
6.7 Embedded System Design and Applications

Module 7: Electromagnetics

7.1 Vector Fields and Coordinate Systems
7.2 Electrostatics and Magnetostatics
7.3 Maxwell's Equations
7.4 Plane Wave Propagation
7.5 Transmission Lines
7.6 Antennas Basics

Module 8: Communications and Advanced Topics

8.1 Analog Communication: AM, FM, SSB
8.2 Digital Communication: ASK, PSK, FSK, QAM
8.3 Information Theory and Coding
8.4 Error Detection and Correction
8.5 Sampling, Quantization, PCM
8.6 Multiplexing: TDM, FDM, CDMA
8.7 Basics of Wireless Communication and Optical Communication
8.8 Modern Topics :

- 5G Systems
- IoT and Embedded Systems
- Machine Learning in Communication Systems

Suggested Readings

Books

1. Electronic Devices and Circuit Theory – Boylestad & Nashelsky
2. Digital Logic and Computer Design – M. Morris Mano
3. Signals and Systems – Oppenheim & Willsky
4. Control Systems Engineering – K. Ogata
5. Communication Systems – Simon Haykin
6. Principles of Electromagnetics – Matthew N.O. Sadiku
7. Microprocessor Architecture, Programming and Applications with the 8085 – Ramesh Gaonkar

Web Resources

1. NPTEL ECE Courses
2. MIT OpenCourseWare – Electrical Engineering
3. All About Circuits
4. Electronics Tutorials