Electrical engineering syllabi

Electrical engineering examinations

Group A - Compulsory examinations (seven required)

16-Elec-A1 Circuits

Electric circuit components: lumped parameter models. Nodal and mesh analysis of linear, passive circuits; equivalent networks. Steady state analysis of lumped parameter, time- invariant circuits: differential equation formulation, sinusoidal inputs, frequency response, impulse response, and transfer functions. Laplace transform analysis and circuit transient response. Two-port circuit models and analysis.

Textbooks (most recent edition is recommended):

- Nilsson, James W. and Susan Riedel, Electric Circuits, latest edition. Prentice Hall.
- Alexander, Charles and Mathew Sadiku, Fundamentals of Electric Circuits, latest edition. McGraw Hill.
- Schwarz and Oldham, Electrical Engineering: An Introduction, latest edition. Oxford University Press.

16-Elec-A2 Systems and Control

System models, impulse response functions, and transfer functions. System input-output and convolution. Root locus analysis and design. Feedback and stability: Bode diagrams.

Nyquist criterion, frequency domain design. State variable representation. Simple PID control systems. Systems with delay.

Textbooks (most recent edition is recommended):

- Dorf, Richard C. and Robert H. Bishop, Modern Control Systems, latest edition. Addison-Wesley.
- Nise, Norman S., Control Systems Engineering, latest edition, Wiley.

16-Elec-A3 Signals and Communications

Analysis of continuous-time signals: Fourier series and Fourier transform; magnitude, phase, and power spectra. Analysis of discrete-time signals: Nyquist sampling theorem; the Z- transform. Analog communication systems: amplitude and angle modulation and demodulation. Digital communication systems: digital modulation; and demodulation techniques.

Textbooks (most recent edition is recommended):

- Haykin, Communication Systems, latest edition, John Wiley & Sons Canada Ltd.

Or

- Haykin, Simon & Michael Moher, Introduction to Analog and Digital Communication Systems, latest edition, John Wiley & Sons.
- Lathi, B.P., Signal Processing and Linear Systems. Oxford University Press.

Or

- Haykin, Simon & Barry Van Veen, Signals and Systems, Interactive Solutions Edition, latest edition, John Wiley & Sons Canada Ltd.

16-Elec-A4 Digital Systems and Computers

Combinational, sequential, and synchronous logic circuits. Register level design of digital systems. Computer arithmetic, central processing unit, memory systems and peripherals. Embedded and higher-level (e.g. C) programming, interrupts, and

interfacing and communication. Computer architecture.

Textbooks (most recent edition is recommended):

- Brey, Barry, The Motorola Microprocessor Family: 68000, 68008, 68010, 68020, 68030, and 68040: Programming and Interfacing with Applications. Saunders College Publishing.

16-Elec-A5 Electronics

Semiconductor devices; diodes and thyristors. Bipolar and field effect transistors as linear devices and switches. Bias circuits, basic amplifiers, small-signal equivalent circuits, transfer functions, and frequency response. Operational amplifiers and comparators. Digital integrated circuits and logic families: CMOS.

Textbooks (most recent edition is recommended):

- Sedra and Smith, Microelectronic Circuits, latest edition. Oxford University Press.

16-Elec-A6 Power Systems and Machines

Magnetic circuits and transformers. Wye and delta connected three-phase systems. Generation, transmission, and distribution of electric power. Three-phase transformers. AC and DC machines. Three-phase synchronous machines and three phase induction motors.

Textbooks (most recent edition is recommended):

- Chapman, Stephen, Electric Machinery and Power System Fundamentals, McGraw Hill.
- Wildi, Theodore, Electrical Machines, Drives, and Power Systems, latest edition, Prentice Hall.

16-Elec-A7 Electromagnetics

Field concepts. Maxwell's equations, integral and differential forms. Free space and guided wave propagation, transmission lines. Radiation from current elements.

Textbooks (most recent edition is recommended):

- Hayt, William H. and John A. Buck, Engineering Electromagnetics. McGraw Hill.

Group B - Optional examinations (two required)

16-Elec-B1 Digital Signal Processing

Discrete-time signals and systems: system input-output and convolution, Z-transform and transfer functions. Discrete-time Fourier transform (DFT) and Fast Fourier transform (FFT). Design of finite impulse response (FIR) and infinite impulse response (IIR) filters. DSP implementation considerations.

Textbooks (most recent edition is recommended):

- Ifeachor, Emmanuel, and Barrie Jervis, Digital Signal Processing, a Practical Approach, latest edition. Prentice Hall.
- Mitra, Sanjit, Digital Signal Processing, a Computer-Based Approach, latest edition. McGraw Hill.

16-Elec-B2 Advanced Control Systems

Modelling of engineering systems; state variables and transfer function representations. Analytical and numerical solutions of state variable equations. Observability, controllability, stability; classical design, stabilization by pole assignment. Systems with noise. Computer control, discrete systems. System identification; least squares.

Textbooks (most recent edition is recommended):

- Dutton, Ken, Steve Thompson, and Bill Barraclough, The Art of Control Engineering. Prentice Hall.

- Nise, Norman, Control Systems Engineering. John Wiley.

16-Elec-B3 Digital Communications Systems

A/D conversion, source coding; signal sets, line codes, modulation, optimal reception, demodulation, performance in noisy channels, error detecting and correcting codes. Radio communications; link analysis and performance, terrestrial and satellite communications.

Textbooks (most recent edition is recommended):

- Couch, Leon W., Digital and Analog Communication Systems, latest edition. Prentice Hall.
- Lathi, B. P., Modern Digital and Analog Communication Systems, latest edition. Oxford University Press.
- Sklar, Bernard, Digital Communications Fundamentals and Applications, latest edition, Prentice Hall.

16-Elec-B4 Information Technology Networks

Layered architecture, circuit-switching networks, peer-to-peer protocols and data link layer, medium access control protocols, local area networks, packet-switching networks, cellular networks, and wireless networks.

Textbooks (most recent edition is recommended):

- Leon-Garcia, Alberto, and Indra Widjaja, Communication Networks, latest edition. McGraw-Hill.
- Freeman, Roger L., Telecommunication System Engineering, latest edition. John Wiley & Sons Canada, Ltd.
- Rappaport, Theodore S., Wireless Communications: Principles and Practice, latest edition. Prentice Hall.

16-Elec-B5 Advanced Electronics

Device models: circuit behaviour, high frequency, and feedback. Multi-stage amplifiers, oscillators, current mode op-amps, non-linear circuits. Power amplifiers and linear regulators. Instrumentation: differential amps, optical isolators, and analog-digital and digital-analog converters.

Textbooks (most recent edition is recommended):

- Sedra and Smith, Microelectronic Circuits, latest edition. Oxford University Press.
- Horowitz, Paul, and Winfield Hill, The Art of Electronics, latest edition. Cambridge University Press.

16-Elec-B6 Integrated Circuit Engineering

Integrated Circuit Design: MOS circuit design methods; specification; use of CAD design tools. Non-ideal effects. Mask level layout. Integrated Circuit Fabrication: basic knowledge of IC processing techniques. Digital and analog IC's: basic building blocks. Design considerations for submicron CMOS and bipolar devices.

Textbooks (most recent edition is recommended):

- Rabaey, Jan A., Anantha Charndrakasan and Borivoje Nikolic, Digital Integrated Circuits, latest edition. University of California, Berkeley, Prentice-Hall.

16-Elec-B7 Power Systems Engineering

Power system representation and analysis. Components: power transmission lines, transformers, synchronous machines. Distribution: power flow, operations, and control. Fault analysis and power system protection. System stability.

Textbooks (most recent edition is recommended):

- Glover, J. Duncan, and Mulukutla Sarma, Power System Analysis and Design, latest edition. Thomson Lerning.
- Grainger, John and William Stevenson Jr., Power System Analysis. McGraw Hill.

16-Elec-B8 Power Electronics and Drives

Principles and modelling of electric machines: dc machines, induction machines, and synchronous machines. Power electronic devices and converters: choppers, inverters, cycloconverters, and switched power supplies. Electric drives: torque and speed control, and field and vector-oriented control techniques.

Textbooks (most recent edition is recommended):

- Rashid, Muhammad H., Power Electronics: Circuits, Devices and Applications, latest edition. Prentice-Hall.
- Mohan, N, Undeland, T, Robbins, W, Power Electronics – Converters, Applications, and Design. John Wiley.
- Sen, P C., Principles of Electric Machines and Power Electronics, latest edition. Wiley.

16-Elec-B9 Electromagnetic Field, Transmission Lines, Antennas, and Radiation

Field radiation equations. Distributed circuits: steady-state transmission line equations; impedance transformation, Smith charts, matching. Transients. Coaxial lines, waveguides. Antennas: infinitesimal elements, linear antennas, radiation resistance, antenna patterns, gain.

Textbooks (most recent edition is recommended):

- Ulaby, Farwwaz, Fundamentals of Applied Electromagnetics, latest edition. Prentice Hall.

16-Elec-B10 Electro-Optical Engineering

Optical transmission: waveguide modes, fibre optic propagation characteristics. Optoelectronics: lasers, sources and detectors, couplers, modulators, guided wave devices. Applications.

Textbooks (most recent edition is recommended):

- Yariv, Amnon, and Pochi Yeh, Photonics: Optical Electronics in Modern Communication, latest edition. Oxford University Press.