Electrical engineering syllabus

Electrical engineering examinations

Group A - Compulsory examinations (seven required)

22-Elec-A1 Circuits

Electric circuit components: lumped parameter models. Nodal and mesh analysis of linear, passive circuits; equivalent networks. Circuits with operational amplifiers. 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. Prentice Hall.
- Alexander, Charles and Mathew Sadiku, Fundamentals of Electric Circuits. McGraw Hill.
- Schwarz and Oldham, Electrical Engineering: An Introduction. Oxford University Press.

22-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: Nyquist criterion, Bode diagram, stability margin. Frequency domain design. State variable representation. Simple PID control systems.

Textbooks (most recent edition is recommended):

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

22-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, Simon, Communication Systems. John Wiley & Sons Canada Ltd.
- Haykin, Simon & B. Van Veen, Signals and Systems, Interactive Solutions Edition. John Wiley & Sons Canada Ltd.

Or

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

22-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):

- Mano, Morrice and M. Ciletti, Digital Design. Pearson.
- Vahid, Frank and T. Givargis, Embedded Systems Design: A Unified Hardware/Software Approach. John Wiley & Sons.

22-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, Adel S. and K. C. Smith, Microelectronic Circuits. Oxford University Press.
- Malvino, Albert P. and D. J. Bates, Electronic Principles. McGraw Hill.

22-Elec-A6 Power Systems and Machines

Principles of electromagnetic force and torque in rotating machinery, three-phase 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 J., Electric Machinery and Power System Fundamentals. McGraw Hill.
- Wildi, Theodore, Electrical Machines, Drives, and Power Systems. Prentice Hall.

22-Elec-A7 Electromagnetics

Electric and magnetic fields. 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.
- Ulaby, F. E. Michelssen and U. Ravaioli, Fundamentals of Applied Electromagnetics. Pearson Education.

Group B - Optional examinations (two required)

22-Elec-B1 Digital Signal Processing

Discrete-time signals and systems: system input-output and convolution, Z-transform and transfer functions. Discrete-Time Fourier transform (DTFT). Discrete 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. Prentice Hall.
- J. G. Proakis and D. G. Manolakis, Digital Signal Processing. Prentice Hall.
- Mitra, Sanjit, Digital Signal Processing, a Computer-Based Approach. McGraw Hill.

22-Elec-B2 Advanced Control Systems

Modelling of engineering systems: state variables representations. Analytical and numerical solutions of

state variable equations. Observability, controllability, stability. State feedback and state observer design based on eigenvalue assignment (pole placement). Systems with noise. Discrete systems. Digital Control. System identification. Optimal Control.

Textbooks (most recent edition is recommended):

- Nise, Norman, Control Systems Engineering. John Wiley.
- Goodwin, Graham C., S. F. Graebe, M. E. Salgado, Control System Design. Prentice Hall.
- Chen, Chi-Tsong, Linear System Theory and Design. Oxford.

22-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. Prentice Hall.
- Lathi, B. P., Modern Digital and Analog Communication Systems. Oxford University Press.
- Sklar, Bernard, Digital Communications Fundamentals and Applications. Prentice Hall.

22-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. McGraw Hill.
- Freeman, Roger L., Telecommunication System Engineering. John Wiley & Sons Canada, Ltd.
- Rappaport, Theodore S., Wireless Communications: Principles and Practice. Prentice Hall.

22-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, Adel S. and K. C. Smith, Microelectronic Circuits. Oxford University Press.
- Horowitz, Paul, and Winfield Hill, The Art of Electronics. Cambridge University Press.

22-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. Prentice Hall.
- Muller Richard S., T. I. Kamins, Device Electronics for Integrated Circuits. Wiley.

22-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 M. Sarma, O. Thomas, Power System Analysis and Design. Thomson Learning.
- Grainger, John and William Stevenson Jr., Power System Analysis. McGraw Hill.

22-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. 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. Wiley.

22-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, et al., Fundamentals of Applied Electromagnetics. Prentice Hall.

22-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. Oxford University Press.
- Sennaroglu, Alphan, Photonics and Laser Engineering: Principles, Devices, and Applications. McGraw Hill.

22-Elec-B11 Program Design and Data Structures

Programming language syntax and semantics. Design of structured and modular programs in a high level language (C, C++). Basics of object-oriented programming: classes. Non-numerical processing. Design and construction of programs involving structured data: arrays, stacks, queues, lists, trees, and records.

Textbooks (most recent edition is recommended):

- Carrano and Henry, Data Abstraction and Problem Solving with C++. Pearson.
- Deitel & Deitel, C++: How to Program. Pearson.
- Weiss, Data Structures and Algorithm Analysis in C++. Pearson.
- Hanley, Essential C++ for Engineers and Scientists. Addison-Wesley.
- Wunder & Roberts, Developing Java Software. Wiley.

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.

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