

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

EDITED. NO CHANGE IN SCOPE.

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

WAS "FIELD CONCEPTS". MINOR EDIT, NO CHANGE IN SCOPE.

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

MINOR EDITS FOR CLARITY. NO CHANGE IN SCOPE.

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, Farwaz, 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 **NEW (25-COMP-A4)**

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.
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INTRODUCTION

The Canadian Engineering Qualifications Board of Engineers Canada issues the Examination Syllabus that includes a continually increasing number of engineering disciplines.

Each discipline examination syllabus is divided into two examination categories: compulsory and elective. A full set of Electrical Engineering examinations consists of nine, three-hour examination papers. Candidates will be assigned examinations based on an assessment of their academic background. Examinations from discipline syllabi other than those specific to the candidates' discipline may be assigned at the discretion of the constituent association.

Before writing the discipline examinations, candidates must have passed, or have been exempted from, the Basic Studies Examinations.

Information on examination scheduling, textbooks, materials provided or required, and whether the examinations are open or closed book, will be supplied by the constituent association.

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.

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. **ADD**

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.

MINOR CHANGE

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.

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. **TTL/TTL-IS REMOVED**

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.

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.

GROUP B**ELECTIVE 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.

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.

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.

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.

CHANGE

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.

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.

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.

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.

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.

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.

NOTE: Please feel free to use the most recent edition of textbooks referenced in this list

NOTA : Utilisez l'édition la plus récente des manuels cités dans cette liste.

16-Elec-A1 Circuits

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

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

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

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

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

16-Elec-A6 Power Systems and Machines

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

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

16-Elec-B1 Digital Signal Processing

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

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

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

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

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

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

Glover, J. Duncan, and Mulukutla Sarma, Power System Analysis and Design, latest edition. Thomson Learning.

Grainger, John and William Stevenson Jr., Power System Analysis. McGraw Hill.

16-Elec-B8 Power Electronics and Drives

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

Ulaby, Farwaz, Fundamentals of Applied Electromagnetics, latest edition. Prentice Hall,

16-Elec-B10 Electro-Optical Engineering

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

INTRODUCTION

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Each discipline examination syllabus is divided into two examination categories: compulsory and elective. A full set of Electrical Engineering examinations consists of nine, three-hour examination papers. Candidates will be assigned examinations based on an assessment of their academic background. Examinations from discipline syllabi other than those specific to the candidates' discipline may be assigned at the discretion of the constituent member.

Before writing the discipline examinations, candidates must have passed, or been exempted from, the Basic Studies Examinations.

The constituent members will supply information on examination scheduling, textbooks, materials provided or required, and whether the examinations are open or closed book.

ELECTRICAL ENGINEERING EXAMINATIONS

GROUP A

COMPULSORY EXAMINATIONS (SEVEN REQUIRED)

07-Elec-A1 Circuits EXTENSIVE EDITING. 98-ELEC-A1 COMBINED W/ 98-ELEC-B1

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.

07-Elec-A2 Systems and Control MINOR EDITS. NO CHANGE IN SCOPE.

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.

07-Elec-A3 Signals and Communications REWRITTEN. NO CHANGE IN SCOPE.

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 frequency modulation and demodulation. Digital communication systems: pulse code modulation; bandpass modulation and demodulation techniques.

07-Elec-A4 Digital Systems and Computers NO CHANGE IN SCOPE.

Combinational, sequential, and synchronous logic circuits. Register level design of digital systems. Computer arithmetic, central processing unit, memory systems and peripherals. Assembly language programming, interrupts, and interfacing and communication. Computer architecture..

REWRITTEN

07-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: TTL, TTL-LS, and CMOS.

CLARIFIED/REWRITTEN.

07-Elec-A6 Power Systems and Machines RENAMED, REWRITTEN. NO SCOPE CHANGE.

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.

07-Elec-A7 Electromagnetics

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

GROUP B

ELECTIVE EXAMINATIONS (TWO REQUIRED)

**07-Elec-B1 Digital Signal Processing WAS 98-ELEC-B2
REWRITTEN**

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.

07-Elec-B2 Advanced Control Systems WAS 98-ELEC-B3

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 delay. Systems with noise. Computer control, discrete systems. System identification; least squares.

**07-Elec-B3 Digital Communications Systems WAS 98-ELEC-B4
REWRITTEN - TV STANDARDS REMOVED**

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.

07-Elec-B4 Information Technology Networks NEW

Layered architecture, circuit-switching networks, peer-to-peer protocols and data link layer, medium access control protocols, local area networks, packet-switching networks, TCP/IP, ATM networks, cellular networks, paging and wireless networks, telephone networks.

07-Elec-B5 Advanced Electronics REWRITTEN

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.

07-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.

07-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.

07-Elec-B8 Power Electronics and Drives

COMBINES 98-ELEC-B8 & 98-ELEC-B9

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.

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

WAS 98-ELEC-B10

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.

07-Elec-B10 Electro-Optical Engineering

WAS 98-ELEC-B11

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

07-Elec-A1 – Circuits

Nilsson, James W. and Susan Riedel, Electric Circuits, 7th Edition. Prentice Hall, 2004.
Alexander, Charles and Mathew Sadiku, Fundamentals of Electric Circuits, 3rd Edition. McGraw Hill, 2007.
Schwarz and Oldham, Electrical Engineering: An Introduction, 2nd Edition. Oxford University Press, 1993.

07-Elec-A2 – Systems and Control

Dorf, Richard C. and Robert H. Bishop, Modern Control Systems, 10th Edition. Addison-Wesley, 2004.
Nise, Norman S., Control Systems Engineering, 4th Edition, Wiley, 2003.

07-Elec-A3 – Signals and Communications

Haykin, Communication Systems, 4th Edition, John Wiley & Sons Canada Ltd., 2000.
Or
Haykin, Simon & Michael Moher, Introduction to Analog and Digital Communication Systems, 2nd Edition, John Wiley & Sons, 2006.
Lathi, B.P., Signal Processing and Linear Systems. Oxford University Press, 2000. ISBN: 13-97801952191173
or
Haykin, Simon & Barry Van Veen, Signals and Systems, 2005 Interactive Solutions Edition, 2nd Edition, John Wiley & Sons Canada Ltd., 2005.
.

07-Elec-A4 - Digital Systems and Computers

Brey, Barry, The Motorola Microprocessor Family: 68000, 68008, 68010, 68020, 68030, and 68040: Programming and Interfacing with Applications. Saunders College Publishing, 1995.

07-Elec-A5 – Electronics

Sedra and Smith, Microelectronic Circuits, 5th Edition. Oxford University Press, 2003.

07-Elec-A6 – Power Systems and Machines

Chapman, Stephen, Electric Machinery and Power System Fundamentals, McGraw Hill, 2001.
Wildi, Theodore, Electrical Machines, Drives, and Power Systems, 6th Edition, Prentice Hall, 2005.

07-Elec-A7 – Electromagnetics

Hayt, William H. and John A. Buck, Engineering Electromagnetics. McGraw Hill, 2006. ISBN: 0073104639.

07-Elec-B1 - Digital Signal Processing

Ifeachor, Emmanuel, and Barrie Jervis, Digital Signal Processing, a Practical Approach, 2nd Edition. Prentice Hall, 2001.
Mitra, Sanjit, Digital Signal Processing, a Computer-Based Approach, 3rd Edition. McGraw Hill, 2006.

07-Elec-B2 - Advanced Control Systems

Dutton, Ken, Steve Thompson, and Bill Barraclough, The Art of Control Engineering. Prentice Hall, 1997.

Nise, Norman, Control Systems Engineering. John Wiley, 2005.

07-Elec-B3 – Digital Communications Systems

Couch, Leon W., Digital and Analog Communication Systems, 7th Edition. Prentice Hall, 2007. ISBN: 013-142420.

Lathi, B. P., Modern Digital and Analog Communication Systems, 3rd Edition. Oxford University Press, 1998, ISBN13: 978-0-19-511009-8.

Sklar, Bernard, Digital Communications Fundamentals and Applications, 2nd Edition, Prentice Hall, 2001.

07-Elec-B4 – Information Technology Networks

Leon-Garcia, Alberto, and Indra Widjaja, Communication Networks, 2nd Edition. McGraw-Hill, 2003.

Freeman, Roger L., Telecommunication System Engineering, 4th Edition. John Wiley & Sons Canada, Ltd. 2004.

Rappaport, Theodore S., Wireless Communications: Principles and Practice, 2nd Edition. Prentice Hall, 2001.

07-Elec-B5 - Advanced Electronics

Sedra and Smith, Microelectronic Circuits, 5th Edition. Oxford University Press, 2003.

Horowitz, Paul, and Winfield Hill, The Art of Electronics, 2nd Edition. Cambridge University Press, 1989.

07-Elec-B6 - Integrated Circuit Engineering

Rabaey, Jan A., Anantha Charndrakasan and Borivoje Nikolic, Digital Integrated Circuits, 2nd Edition. University of California, Berkeley, Prentice-Hall, 2003. ISBN# 01-0130909963.

07-Elec-B7 - Power Systems Engineering

Glover, J. Duncan, and Mulukutla Sarma, Power System Analysis and Design, 3rd Edition. Thomson Learning, 2002.

Grainger, John and William Stevenson Jr., Power System Analysis. McGraw Hill, 1994.

07-Elec-B8 - Power Electronics and Drives

Rashid, Muhammad H., Power Electronics: Circuits, Devices and Applications, 3rd Edition. Prentice-Hall, 2003.

Mohan, N, Undeland, T, Robbins, W, Power Electronics – Converters, Applications, and Design. John Wiley, 2003, ISBN 0-471-22693-9.

Sen, P C., Principles of Electric Machines and Power Electronics, 2nd Edition. Wiley, 1996.

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

Ulaby, Farwaz, Fundamentals of Applied Electromagnetics, 5th Edition. Prentice Hall, 2007. ISBN: 013-2413264.

07-Elec-B10 - Electro-Optical Engineering

Yariv, Amnon, and Pochi Yeh, Photonics: Optical Electronics in Modern Communication, 6th Edition. Oxford University Press, 2006.

ELECTRICAL ENGINEERING EXAMINATIONS SYLLABUS

GROUP A

COMPULSORY EXAMINATIONS (7 REQUIRED)

98-Elec-A1 **Circuits** **REDUCED SCOPE**

Nodal and mesh analysis of linear, finite, passive circuits; equivalent networks. Steady state AC response of lumped constant, time-invariant networks. Time and frequency response of linear systems: impulse response and transfer functions, Laplace transform analysis, frequency response, including steady-state sinusoidal circuits.

98-Elec-A2 **Control**

Models, transfer functions, and system response. Root locus analysis and design. Feedback and stability: Bodes diagrams. Nyquist criterion, frequency domain design. State variable representation. Simple PID control systems.

ADD

98-Elec-A3 **Communications**

Amplitude and frequency modulation systems: signals, spectra, implementation. Sampling of continuous signals and the Nyquist sampling theorem. Fourier series and transforms, spectral concepts. Discrete signals and systems: the sampling theorem, time and frequency response, the Z-transform. PCM and simple baseband pulse code modulation systems.

98-Elec-A4 **Digital Systems and Computers**

Combinatorial and sequential switching circuits. Register level design of digital systems. Computer memories. Computer architecture, assembly language programming, interrupts, and interfacing.

98-Elec-A5 **Electronics**

Semiconductor devices; diodes and thyristors. Bipolar and field effect transistors as linear devices and switches. Small signal amplifiers. Operational amplifiers and comparators. Digital circuits and logic families. Small signal amplifiers. Digital circuits and logic families.

98-Elec-A6 Electromagnetic Energy Conversion

Magnetic circuits. Three - phase circuits. Transformer equivalent circuit at both low frequency and high frequency. Electromagnetic and electrostatic force calculations. AC machines and stepper motors. Permanent magnet DC machines.

98-Elec-A7 Electromagnetics

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

GROUP B

ELECTIVE EXAMINATIONS (2 REQUIRED)

98-Elec-B1 Advanced Circuits Analysis and Design

Network equilibrium equations. Two port analysis. Classical passive filter design. Non linear operational amplifier applications and active filters. Principles of computer aided design tools: frequency and time domain analysis; transmission line effects; sensitivity analysis. Scattering matrix description of microwave devices.

98-Elec-B2 Digital Signal Processing

Discrete system theory: convolution, Z-transforms, transfer functions. Design and implementation of digital filters. Spectral analysis, DFT and FFT implementations. Implementation; DSP chips architecture and programming.

98-Elec-B3 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 delay. Systems with noise. Computer control, discrete systems. System identification; least squares.

ADD

98-Elec-B4 Communications Systems

Sampling, A/D conversion, source coding; signal sets, line codes, modulation, optimal reception, demodulation, performance in noisy channels, error detecting and correcting codes. Public Switch Telephone Networks, television standards. Radio communications; link analysis and performance, terrestrial and satellite communications; personal communication networks; cellular telephone networks.

98-Elec-B5 Advanced Electronics

WAS 92-ELEC-B6

Device models and implementation in computer aided analysis packages. Multi-stage amplifiers, oscillators, non-linear circuits. Power amplifiers and linear regulators. Communication circuits; phase locked loops, filters, modulator/demodulators. Electronic instrumentation and measurement. Microwave circuits; properties of microwave tubes and semi-conductor devices.

98-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.

98-Elec-B7 Power Systems Engineering

Power system representation and analysis. Components: transmission lines, transformers, synchronous machines. Distribution: loads, power flow, operations, and control. Fault analysis: short circuits, balanced and unbalanced operation. System stability.

98-Elec-B8 Switched Mode Power Supply Design

Control of electrical power with semiconductor devices -- Specifications and requirements. Design of high frequency magnetic devices. Power supply models and control methods. Harmonic analysis. Filter design and EMC issues. Heatsink calculations.

98-Elec-B9 Power Electronics and Drives

Construction and modelling of electric machines; induction, synchronous, permanent magnet DC, stepper motors. Electronic power converters; choppers, DC link inverters, cycloconverters, current source inverters. Torque and speed controllers. Vector oriented control techniques.

98-Elec-B10 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. Other types of antennas.

98-Elec-B11 Electro-Optical Engineering

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

Professional Electrical Text List

**** NOTE TO CANDIDATES, THE LISTED TEXTBOOKS BELOW ARE ONLY SUGGESTED. THE LIST DOES NOT DEFINE OR LIMIT THE SYLLABUS.**

98-Elec-A1 - Circuits

Johnson, Electric Circuit Analysis, 3rd edition. John Wiley.

J.D. Irwin, Basic Engineering Circuit Analysis, MacMillan.

Haykin and Van Veen, Signals and Systems, Wiley, 1999.

Sinha, Linear Systems, Wiley.

98-Elec-A2 - Control

Dorf, Modern Control Systems, 8th edition. Addison-Wesley.

98-Elec-A3 - Communications

Haykin, Simon, Communication Systems, latest edition, John Wiley & Sons, 1983.

Oppenheimer, Signals and Systems, 2nd edition. Prentice-Hall.

98-Elec-A4 - Digital Systems and Computers

Tocci & Widmar, Digital Systems, 7th edition. Prentice Hall, 1998.

Kleitz, Digital Electronics, 4th edition. Prentice Hall, 1996.

98-Elec-A5 - Electronics

Sedra and Smith, Microelectronic Circuits, 4th edition. Oxford University Press.

Boylestad and Nashelsky et. al., Electronic Devices and Circuit Theory, Prentice Hall, latest edition. ISBN 0-130-86830-2

98-Elec-A6 - Electromagnetic Energy Conversion

Sen, P.C., Principles of Electrical Machines and Power Electronics, John Wiley and Sons Inc. ISBN 0-471-85084-5

98-Elec-A7 - Electromagnetics

Demarest, Engineering Electromagnetics. Prentice-Hall.

Staelin, D.H., Morgenthaler, A.W. and Kong, J.A., Electromagnetic Waves. Prentice Hall, 1994.

98-Elec-B1 - Advanced Circuits Analysis and Design

Nilsson, J. and Reidel S., Electric Circuits, Prentice-Hall, ISBN 0-130-32120-6

Decralo, Raymond A., and Lin, Pen-Min, Linear Circuit Analysis, Prentice-Hall, 1995 ISBN 0-134-73869-1

Liao, Samuel Y., Microwave Devices Uncircuits, Prentice-Hall, 1990 ISBN 0-135-83204-7

98-Elec-B2 - Digital Signal Processing

Jackson, Kluwer, Digital Filters and Signal Processing.

98-Elec-B3 - Advanced Control Systems

The Art of Control Engineering, Dutton, Addison-Wesley.

98-Elec-B4 - Communications Systems

Tanenbaum, Computer Networks, 3rd edition. Prentice-Hall.

98-Elec-B5 - Advanced Electronics

Boylestad and Nashelsky et. al., Electronic Devices and Circuit Theory, Prentice Hall, latest edition. ISBN 0-130-86830-2

98-Elec-B6 - Integrated Circuit Engineering

Jan A Rabaey, Digital Integrated Circuits, Prentice-Hall.

98-Elec-B7 - Power Systems Engineering

Charles A. Gross, Power Systems Analysis, John Wiley & Sons, latest edition, ISBN #0-471-862-06-1

B.M. Weedy, Electric Power Systems, latest edition, John Wiley and Sons Inc., 1987.

M.E. El-Hawary Electrical Power Systems: Design and Analysis IEEE Press, 1996
ISBN# 0-7803-1140-X

98-Elec-B8 - Switched Mode Power Supply Design

Billings, Switched Mode Power Supply Handbook. McGraw-Hill.

98-Elec-B9 - Power Electronics and Drives

M.H. Rashid, Power Electronics: Circuits, Devices and Applications, Prentice Hall, latest edition, 1988. ISBN 0-136-87667-6.

98-Elec-B10 - Electromagnetic Field, Transmission Lines, Antennas, and Radiation

Demarest, Engineering Electromagnetics. Prentice-Hall.

98-Elec-B11 - Electro-Optical Engineering

Yariv, Optical Electronics. Saunders College Publishing.

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92-Elec-A1 Circuits, Signal and Systems

Nodal and mesh analysis of linear, lumped, finite, passive circuits; equivalent networks. Steady state AC response of lumped constant, time-invariant networks. Time and frequency response of linear systems: impulse response and transfer functions, Laplace transform analysis, frequency response, including steady-state sinusoidal circuits. Feedback and stability. Fourier signals and systems: the sampling theorem, time and frequency response, the z-transform. Digital filters. The Discrete Fourier Transform, properties and computation - the FFT.

Recommended Text(s)

1. J.D. Irwin, **Basic Engineering Circuit Analysis**, 4th edition, MacMillan, 1989
2. Johnson, Johnson, and Hillburn, **Electric Circuit Analysis**, Prentice-Hall, 1990
3. Kamen, **Introduction to Signals and Systems**, MacMillan, latest edition
4. Sinha, **Linear Systems**, Wiley and Sons Inc., 1991

92-Elec-A2**Control**

Models, transfer functions, and system response. Root locus analysis and design. Stability and compensation: Nyquist criterion, frequency domain design. State variable representation.

Recommended Texts:

1. C. L. Phillips and R. D. Harbor, ***Feedback Control Systems***, 3rd Edition, Prentice-Hall, 1996.
2. B. C. Kuo, ***Automatic Control Systems***, 7th Edition, Prentice-Hall, 1995

92-Elec-A4 Digital Systems and Computers

Combinatorial and sequential switching circuits. Register level design of digital systems. Computer architecture, assembly language programming, and interfacing.

Reference text(s)

1. M. Morris Mano, **Computer Engineering: Hardware Design**, Prentice-Hall, 1988. ISBN 0-13-162926-3

92-Elec-B1 Advanced Circuits Analysis and Design

Network equilibrium equations. Two-port analysis. Classical passive filter design. Operational amplifier designs; active filters. Principles of computer aided design tools: frequency and time domain analysis; noise and distortion analysis; transmission line effects; sensitivity analysis. Scattering matrix description of microwave devices.

Texts:

1. 2-Port Analysis: J. David Irwin, **Basic Engineering Circuit Analysis**, 5th Ed. Prentice-Hall, 1996, ISBN 0-13-397274-7, Chapter 14.
2. Classical Passive Filter Design: M. Kaufman & A.H. Seidam, **Handbook of Electronics Calculations**, 2nd Edition, McGraw-Hill, 1988, ISBN # 0-07-033528-1, Chapter 19.
3. Operational Amplifier Design: M.E. van Valkenberg, **Analog Filter Design**, Holt, Reinhart, & Winston, 1982, ISBN 0-03-059246-1, Chapters 1-12.
4. CAD Tools - Frequency & Time Domain Analysis: D.O. Pedersen & K. Mayaram, **Analog Integrated Circuits for Communication: Principles, Simulation and Design**, Kulwer Academic Publishers, Boston, 1991, ISBN # 0-7923-9089-X, Chapters 1-8.
5. Transmission Line and Microwave Devices: T. Koryu Ishii, **Microwave Engineering**, 2nd Ed., Harcourt Brace Jovanovich, ISBN # 0-15-558658-0, Chapters 2 and 6.

Modelling of engineering systems: state variables and transfer function representations. Analytical and numerical solutions of state variable equations. Observability, controllability, stability: Nyquist criterion, classical design, stabilization by pole assignment. Systems with delay. Systems with noise. Computer control: discrete systems.

Recommended Texts:

1. Sinha, **Control Systems**, 2nd Edition, John Wiley and Sons, ISBN # 0-470-23516-0
2. Phillips and Harbor, **Feedback Control Systems**, Prentice-Hall, 1988
3. Van De Vegte, **Feedback Control Systems**, Prentice-Hall, 1988

Device models: MOS, bipolar devices. Multi-stage amplifiers, oscillators, non-linear circuits, power amplifiers, regulators. Communication circuits: phase locked loops, filters, modulator/demodulators, transmitters, receivers. Electronic instrumentation and measurement. Microwave circuits: properties of microwave tubes and semi-conductor devices.

Recommended Texts:

- A.** Adel S. Sedra & Kenneth C. Smith, **Microelectronic Circuits**, Saunders College Publishing, 3rd edition, 1990, Holt, Rinehart & Winston. ISBN # 0-03-051648-X
- B.** Robert B. Northrop, **Introduction to Instruments and Measurements**, CRC Press – <http://www.crcpress.com> ISBN # 0-8493-7898-2
- C.** Gary M. Miller, **Modern Electronic Communication**, 4th Edition, Regents/Prentice-Hall, ISBN # 0-13-589201-5

Suggested chapters from the above texts for the material in the syllabus is available. Send email request to: ***mail@cybered.ab.ca***