University of Windsor
Program Development Committee

*5.26: **Electrical Engineering - Summary of Minor Course and Calendar Changes**

Item for: **Information**

Forwarded by: **Faculty of Engineering**

PART A

Please indicate with an "X" whether this change will be made to the undergraduate calendar or the graduate calendar, or both.	
_x__	The changes below, minor and largely editorial, will be made to the **Undergraduate Calendar**. These changes required no new resources.
__	The changes below, minor and largely editorial, will be made to the **Graduate Calendar**. These changes required no new resources.

When will these proposed change(s) be effective? [include semester and year]**:**	Fall 2014

PART B

Please list the course number and indicate with an "X" the changes that are being made. Add rows to the table as required. Full details on the proposed change(s) are to be provided in Part C.

Current course number	Deleting courses which are not part of any program's degree requirements*	Course calendar description changes	Pre/anti/co-requisite changes	Contact hour/ laboratory requirement changes	Course title changes	Renumbering courses	Cross-listing courses
88-214		x					
88-225		x					
88-226		x	x				
88-228		x			x		
88-324		X					
88-327		X					
88-330		x					
88-333	x						
88-419		x					
88-431		x					
88-432		x			x		
88-434		x					
88-435		x					
88-443		x					
88-444		x					
88-445		x					

PROGRAM DEVELOPMENT COMMITTEE
SUMMARY OF COURSE AND CALENDAR CHANGES
FORM "E"

88-447		x					
88-448		x					
88-449		x			x		
88-450		x					
88-460		x					

**If the deleted course was a required course in any program, the proposed deletion must be presented on a PDC Form C.*

PART C

Please provide the current and the proposed new course information by cutting and pasting from the current undergraduate or graduate web calendar (www.uwindsor.ca/calendars) and clearly marking deletions with strikethrough (~~strikethrough~~) and additions/new information with bolding and underlining.

For contact hour/laboratory requirement changes which do not always appear in the calendar, please type in the current information and clearly mark deletions with strikethrough (~~strikethrough~~) and additions/new information with bolding and underlining.

Example: **03-101. University Senates ~~– Role and Power~~** This course explores the history, role, and power of Senates in Canadian universities. ~~(Also offered as 04-101.)~~ (Prerequisite: 03-100.) ~~2 lecture hours and 1 tutorial hour per week~~ **3 lecture hours/week**

88-214. Circuit Analysis
Current, voltage, power and energy; simple resistive circuits; Kirchhoff's laws; Wye-delta transformations; techniques of circuit analysis, nodal and mesh analysis; network theorems, superposition, Thevenin's and Norton's theorems; source transformations; operational amplifiers and Op-amp circuit analysis, inductors and capacitors, natural response of first-order RL and RC circuits; natural response of RLC circuits; sinusoids and phasers; ac power analysis; balance three-phase circuits; ~~Laplace and Fourier transforms;~~ network simulations using SPICE and MATLAB.(Prerequisite: 64-141) (3 lecture, 2 laboratory/tutorial hours or equivalent a week.) (Credit cannot be obtained for both 85-234 and 85/88-124 or 85-234 and 85/88-214.) (Corequisites:62-215 and 62-216). Credit Weight 4.0.

88-225. Physical Electronics
Free electron theory of metals; Fermi level, work function; resistivity; band theory of solids, Fermi-Dirac distribution, density of states; semiconductors, donor and acceptor states; Hall effect; semiconductor devices, Field-Effect Transistors; dielectric materials and devices; ~~magnetic materials; energy storage; Lasers; superconductivity.~~ **semiconductor devices; P-N junction diodes, Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFET), and Bipolar Junction Transistors (BJT).** (Prerequisites: 62-215 and 62-216) (3 lecture, 1.5 laboratory/tutorial hours or equivalent a week.) Credit Weight 3.75.

88-226. Electronics I
~~Examples of electronic systems, Frequency spectrum of periodic and non-periodic signals. Network Theorems; Step-response and frequency characteristics of STC circuits. Operational amplifiers; Examples of Op Amp Circuits: Non-inverting and inverting configurations, Difference Amplifier, Negative impedance converter, Voltage-to-Current converter, General Impedance converter and other circuit applications of Op Amps. Non-ideal performance of Op Amps. Diodes, Varactors; Zener Diodes. Analysis of Diode Circuits, Rectifiers, Super-Diode Circuits, Precision Rectifiers, Limiters and Comparators. Schmidt trigger. Waveform Generators.~~ **Classification of signals; introduction to diodes; rectifier circuits, Zener diode, limiting and clamping circuits; Op amp amplifier configurations, Op amp distortion, non ideal op amp performance; active filters, Tow-Thomas Biquad; Introduction to data converters; oscillators; super-diodes; pulse generation.** ~~(Corerequisite: 88-224)~~ (Prerequisites: 62-215 and 62-216) (3 lectures, 1.5 Laboratory/tutorial hours or equivalent per week).Credit Weight 3.75.

88-228. ~~EM Waves and Radiating Systems I~~ Electromagnetic Fields
~~Electricity and magnetism; time varying fields and Maxwell's equations; introduction to electromagnetic waves;~~

~~analysis techniques for distributed parameter electrodynamic systems; traveling waves and reflections; transmission line modeling; matching network design and "Smith Chart" techniques; waveguides; propagation; radiating systems.~~ **Static electric fields; Coulomb's law, Gauss's law and its applications; electric potential; dielectrics; boundary conditions; capacitance; resistance; steady electric currents, current density, boundary condition for current density, equation of continuity and Kirchhoff's law; power dissipation; static magnetic fields; Biot-Savart's law, Ampere's law; vector magnetic potential; magnetic dipole; magnetic circuits; boundary conditions for magnetic fields; magnetic forces and torque; induction current.** (Prerequisites: 62-215 and 62-216) (3 lecture, 1.5 laboratory/tutorial hours or equivalent a week.) Weight 3.75.

Students must have completed all the 1st year courses and at least ten (10) of their 2nd year courses before being allowed to register into the 3rd year courses, including all pre-requisite courses required for registration into the 3rd year courses.

88-324. Control Systems I

~~Transfer function and state variable description of linear systems; linearization of nonlinear systems; controllability and observability; transient performance; stability analysis; tracking performance; root locus and frequency response; performance analysis in frequency domain; PID control design.~~ **Transfer function and state-space model for linear time-invariant systems; linearization of nonlinear systems; controllability and observability; transient performance; stability; tracking performance; Proportional-Integral-Derivative (PID) control design; frequency response and root locus** (Prerequisites: 62-215,62-216.88-313.) (3 lecture. 1.5 laboratory hours or equivalent a week.)Credit Weight 3.75.

88-327. Microprocessors

~~Microprocessor systems and architecture; pipelining; arithmetic units; memory structures; addressing modes; typical instruction sets; accumulator and memory reference instructions; stacks, subroutines, and other instructions; interrupts and timing; interfacing I/O devices; interfacing data converters; software development systems and assemblers; microcontrollers.~~ **Microprocessor systems (8 and 16 bit) and architecture; data representations, arithmetic units; memory structures; complex instruction set; accumulator, index, and memory reference instructions; addressing modes; stacks, subroutines, and other instructions; interrupts and timing; interfacing I/O devices and data converters; software development systems and assemblers; code implementation on microcontrollers**. (Prerequisites: 62-215, 62-216, 88-217, 88-316 and 88-330.) (3 lecture, 1.5 laboratory/tutorial hours or equivalent a week.) Credit Weight 3.75.

88-330. Digital Logic Design II

~~Combinational logic circuits; combinational logic design; sequential circuits and design; registers and counters; hardware description languages; memory and programmable logic devices; register transfers and datapaths; sequencing and control; central processing unit designs; memory systems; reconfigurable computing.~~ **Contemporary digital system design; programmable logic; device architectures; reconfigurable computing; design entry methods; VHDL (Hardware Description Language); Electronic Design Automation (EDA) tools; combinational and sequential logic design, implementation using programmable logic devices.** (Prerequisites: 62-215, 62-216 and 88-217.) (3 lecture, 1.5 laboratory/tutorial hours or equivalent a week.)Credit Weight 3.75.

~~**88-333. Practicum in Electrical Engineering**~~

~~This is a hands-on introductory course on programmable logic controller (PLC's) systems which covers fundamentals of PLC's and their application to various processes and machines; software development and interpretation of simple ladder logic. Also covered are the basic processes needed to layout printed circuit board (PCB) design using PCB software. Etching a positive coated copper clad board is done during the lab. (Prerequisite: Successful completion of WHMIS [Workplace Hazardous Materials Information System]) Training is available online at: http://www.whmis.net/ (1 lecture, 2 laboratory hours a week.)Credit Weight 2.0.~~

Students cannot register in any of the 4th year courses until all Electrical Engineering courses from 1st, 2nd and 3rd year have been completed.

88-419. Digital Communications

Digital communication systems; discrete Fourier transform; sampling theory; A/D converters; digital modulation;

time-division multiplexing; packet transmission; ~~spread spectrum systems;~~ random processes and spectral analysis for digital systems; error probabilities; noise; ~~wire and wireless digital communication systems~~; **introduction to information theory.** (Prerequisites: completion of all Electrical Engineering courses from 1st year, 2nd year and 3rd year.) (3 lecture, 1.5 laboratory/tutorial hours or equivalent a week.) Credit Weight 3.75.

88-431. Control Systems II

~~Elementary control design in frequency domain; introduction to optimal and robust control design; elementary observer and control design in state-space; Z-transform and Z-plane analysis; digital control design; implementation of digital control systems using microcontroller/DSP systems.~~ **Stability and performance analysis in frequency domain; lead-lag control design in frequency domain; elementary observer and control design in state space; z- transformation and z-plane analysis; direct and indirect discrete-time control design; implementation of digital control.** (Prerequisites: completion of all Electrical Engineering courses from 1st year, 2nd year and 3rd year.) (3 lecture, 1.5 laboratory/tutorial hours or equivalent a week.)Weight 3.75.

88-432. ~~EM Waves and Radiating Systems II~~ EM Waves and Radiating Systems

~~Fundamentals of electromagnetic radiation, antenna impedance dipoles, arrays, and long wire antennas; aperture antennas, receiving system considerations.~~ **Maxwell equations; time varying potentials; time harmonic fields; electromagnetic wave propagation; wave polarization; power and Poynting vector; transmission lines; Smith chart; rectangular waveguides; waveguide current and mode excitation; dipole antenna; small loop antennas; antenna characteristics; antenna arrays.** (Prerequisites: completion of all Electrical Engineering courses from 1st year, 2nd year and 3rd year.) (3 lecture, 1.5 tutorial hours a week.) Credit Weight 3.75.

88-434. Automotive Electronics

~~Electrical energy generation and distribution; ignition systems; motor drive controllers; sensors; signal conditioners; power-train management; electromagnetic interference; automatic control; embedded real-time controllers; diagnostics; automotive DSP; telematics; automotive computing.~~ **Proportional-Integral-Derivative (PID) controllers and limit cycle controllers; fundamentals of digital control of Spark-Ignition (SI) engine; MPC555 Motorola Power PC based SI engine control system; Motronic engine management system; automotive sensors and actuators; vehicle motion control including Antilock Braking System (ABS); Controller Area Network (CAN); Time-Triggered CAN (TTCAN); FlexRay.** (Prerequisites: completion of all Electrical Engineering courses from 1st year, 2nd year and 3rd year.) (3 lecture, 1.5 laboratory/tutorial hours or equivalent a week.)Credit Weight 3.75.

88-435. Microelectromechanical Systems

~~Microelectromechanical structures; materials; microactuators and microsensors including micro-motors; grippers, accelerometers and pressure sensors; microlithography, micromachining, microfabrication processes; mechanical and electrical design issues; input/output structures; integration of MEMS and microelectronics; design project; CAD tools.~~ **MicroElectroMechanical System (MEMS) technology overview and design process; microfabrication and process integration; lumped element modeling; 3-D finite element modeling; energy conserving transducers (electrostatics); linear and nonlinear system dynamics; elasticity, stress, strain, material properties; structure analysis, beams, plates; MEMS sensing and actuation; material case studies; MEMS design methodology; device modeling.** (Prerequisites: completion of all Electrical Engineering courses from 1st year, 2nd year and 3rd year.) (3 lecture, 1.5 laboratory/tutorial hours or equivalent a week.) Credit Weight 3.75.

88-443. Embedded System Design

~~Hardware and software for embedded computing systems. Introduction to embedded systems. Custom single-purpose processors: Hardware Design (includes review of FSMs, registers/counters and register files). General-purpose processors: Software; design flow environment and tools; testing and debugging. Standard single-purpose processors: Peripherals. Memory system design. Interfacing issues: serial and parallel communication, bus standards, protocols and arbitration. Putting it all together -- a digital camera example. Course labs will involve use of FPGA embedded processors (Altera NIOS or Xilinx Microblaze), programmable logic (Altera or Xilinx FPGAs) and associated CAD tools for design mapping (modeling, simulation, synthesis and debugging).~~ **Embedded hardware and software systems; introduction to embedded systems; custom single-purpose processors, hardware design; general-purpose processors, software, design flow environment and**

tools, testing and debugging; standard single-purpose processors, peripherals, memory system design; interfacing issues, serial and parallel communication, bus standards, protocols and arbitration; exercises on real world applications; Laboratory implementation on modern Field Programmable Gate Arrays (FPGAs) and microcontrollers using associated Electronic Design Automation (EDA) tools. (Prerequisites: completion of all Electrical Engineering courses from 1st year, 2nd year and 3rd year.) (3 lecture, 1.5 laboratory hours a week.) Credit Weight 3.75.

88-444. Analog Integrated Circuit Design

~~Bipolar and CMOS technology; CMOS analog circuit modelling; CMOS device characterization; current sinks and sources; current mirrors, current amplifiers; amplifiers; differential amplifiers; comparators; operational amplifiers; A/D converters; multipliers; wave-shaping; low voltage and power; CAD tools.~~ **Bipolar and Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFET) technology; device characterization; analog circuit modelling; current sinks, sources, and mirrors; differential pairs; current and voltage amplifiers; differential amplifiers; comparators; operational amplifiers; A/D and D/A converters; Integrated Circuit (IC) implementation with Electronic Design Automation (EDA) tools.** (Prerequisites: completion of all Electrical Engineering courses from 1st year, 2nd year and 3rd year.) (3 lecture, 1.5 laboratory/tutorial hours or equivalent a week.) Credit Weight 3.75.

88-445. Power Electronics

Power diodes; thyristors; power **Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFET)** ~~MOSFETs;~~ **Insulated-Gate Bipolar Transistors (IGBT)**; controlled rectifiers; DC-DC converters; inverters; AC-AC converters; ~~DC/DC conversion;~~ gate drive circuits; motor drives; ~~r~~ computer simulation of power electronics and motor ~~Drives~~ drives. (Prerequisites: completion of all Electrical Engineering courses from 1st year, 2nd year and 3rd year.) (3 lecture, 1.5 laboratory/tutorial hours or equivalent a week.) Credit Weight 3.75.

88-447. Computer Networks ~~and~~ Security

~~Introduction to computer networking and security; packet switching; networking protocols; local area networks, fiber channel protocols; transport protocol and security, encryption; application on running on various transport protocols, inter-working protocols and security; frame relaying and asynchronous transfer modes; digital switching; emerging computer networking and security technology.~~ **Introduction to computer networks security; cryptography; public-key and secret key encryption; encryption algorithms; network security mechanisms and techniques; security protocols; authentication and network security services; traditional and emerging Information Technology (IT) security; cyber-security.** (Prerequisites: completion of all Electrical Engineering courses from 1st year, 2nd year and 3rd year.) (3 lecture, 1.5 laboratory/tutorial hours or equivalent a week.) Credit Weight 3.75.

88-448. Digital Computer Architecture

~~Computer Organization and architecture; number, character and instruction representations; addressing methods and machine program sequencing; central processing unit; input-output organization; memory; arithmetic; pipelining, computer peripherals; advanced computer systems; assembly language programming.~~ **Computer Organization and architecture (32 bit); computer abstraction; reduced instruction set; high level to assembler level language translation; pipelinable instruction set architectures; speculation and branch prediction; instruction level parallelism; memory hierarchies, and virtual memory; secondary storage and I/O; multithreading, multicore, multiple CPU, and clustering; Graphics Processing Unit (GPU).** (Prerequisites: completion of all Electrical Engineering courses from 1st year, 2nd year and 3rd year.) (3 lecture, 1.5 laboratory/tutorial hours a week.) Credit Weight 3.75.

88-449. ~~Automotive Sensors~~ Sensor and Vision Systems

~~Evolution of automotive sensors, sensor design and applications in vehicles, sensor electronics and design, automotive pressure sensors, temperature sensors, combustion sensors, torque sensors, displacement and position sensors, accelerometer physics, gas composition sensors, liquid level sensors, design of sensor electronics systems, design of sensor system software, smart sensors and design, sensors for intelligent vehicles on the road, future development of sensor systems.~~ **Basics of sensors and transducers; sensor characteristics and applications; fundamentals of pressure, temperature, displacement and position sensors; accelerometer physics, strain gauges, and torque sensors; machine vision; image processing, image enhancement, edge and corner detectors; image segmentation techniques; image feature extraction and matching; colour models and processing; object recognition and classification;**

discussion on camera parameters and calibration; stereo vision, 3D range imaging techniques. (Prerequisites: completion of all Electrical Engineering courses from 1st year, 2nd year and 3rd year.) (3 lecture, 1.5 laboratory/tutorial hours a week.) Credit Weight 3.75.

88-450. Power Systems I

~~This course is intended to provide students with an understanding of the principles of operation, modeling and analysis of electric power systems. Covered topics are: complex power, phasors and per-unit system; three-phase circuits; power transformer and generator modeling; transmission line parameters; steady-state operation of transmission lines; network matrices and power flow analysis; symmetrical faults; symmetrical components; introduction to alternative energy sources.~~ **Principles of operation, modeling and analysis of electric power systems; complex power, phasors and per-unit system; three-phase circuits; power transformer and generator modeling; transmission line parameters; steady-state operation of transmission lines; network matrices and power flow analysis; introduction to alternative energy sources.** (Prerequisites: completion of all Electrical Engineering courses from 1^{st} year, 2^{nd} year and 3^{rd} year) (3 lecture, 1.5 laboratory/tutorial hours or equivalent a week.) Credit Weight 3.75.

88-460. Power Systems II

~~This course is intended to introduce advanced analytical tools for power systems such as analysis of abnormal operation, numerical methods, stability and control. Covered topics are: transient stability and voltage stability; control and monitoring of power systems; dynamics and control of multi-machine systems; unsymmetrical faults; power system protection and relaying; economic dispatch; optimal power flow; numerical simulation tools in power systems.~~

Advanced analytical tools; analysis of abnormal operation, numerical methods, stability and control; transient stability and voltage stability; control and monitoring of power systems; dynamics and control of multi-machine systems; symmetrical faults; symmetrical components; unsymmetrical faults; power system protection and relaying; economic dispatch; optimal power flow; numerical simulation tools in power systems. (Prerequisites: 88-450 and completion of all Electrical Engineering courses from 1st year, 2nd year and 3rd year.) (3 lecture, 1.5 laboratory/tutorial hours or equivalent a week.) Credit Weight 3.75.

Part D

Please indicate with an "X".	
Will the proposed changes result in changes to the learning outcomes of the course(s)?	
___	Yes. **If so, please complete the learning outcomes form and append new learning outcomes, as appropriate, to this Form E submission. (See attached for learning outcomes form))**
_x__	No.