COURSE NET1010: DIGITAL TECHNOLOGY 1

Level: Introductory

Prerequisite: None

Description: Students construct and demonstrate logic systems and their unique functions.

Parameters: Access to a five-volt power supply, a logic probe and related materials.

Outcomes: The student will:

1. **describe the binary numbering system and logic gates and construct and verify basic logic gates**
   1.1 research and describe the binary numbering system
   1.2 develop the circuits and tables for the following logic gates:
      1.2.1 AND
      1.2.2 OR
      1.2.3 NOT
      1.2.4 XOR
      1.2.5 NAND
      1.2.6 NOR
      1.2.7 XNOR
2. **construct a simple logic circuit and explain its functions**
   2.1 construct digital probes
   2.2 test digital probes
   2.3 breadboard a digital system, such as a combination lock and a keyboard
   2.4 use emulation software; e.g., electronics workbench
3. **identify the major integrated circuit (IC) families and describe their unique functions**
   3.1 distinguish between analog and digital systems
   3.2 identify major component sections of a logic system including:
      3.2.1 random-access memory (RAM)
      3.2.2 read-only memory (ROM)
      3.2.3 central processing unit (CPU)
      3.2.4 registers
      3.2.5 input/output (I/O) ports
   3.3 identify the application, pinouts and use of various IC chips from manufacturing codes
   3.4 identify characteristics of various IC chips from different manufacturers which do similar
        functions using ECG, NTE and other replacement guides
   3.5 identify the pinouts and function of any IC using the IC master reference texts
   3.6 identify the difference between various logic families
   3.7 identify and explain differences between various logic systems
   3.8 solve a digital problem and build a digital system for a solution; e.g., two or three inputs for a
        single output
4. **demonstrate established laboratory procedures and safe work practices**
   4.1 identify and follow laboratory safety procedures
   4.2 explain how to avoid electrostatic discharges around IC chips
   4.3 demonstrate an understanding of grounding, voltage and current rating of various IC families
   4.4 use a digital probe

5. demonstrate basic competencies
- 5.1 demonstrate fundamental skills to:
  - 5.1.1 communicate
  - 5.1.2 manage information
  - 5.1.3 use numbers
  - 5.1.4 think and solve problems
- 5.2 demonstrate personal management skills to:
  - 5.2.1 demonstrate positive attitudes and behaviours
  - 5.2.2 be responsible
  - 5.2.3 be adaptable
  - 5.2.4 learn continuously
  - 5.2.5 work safely
- 5.3 demonstrate teamwork skills to:
  - 5.3.1 work with others
  - 5.3.2 participate in projects and tasks

6. make personal connections to the cluster content and processes to inform possible pathway choices
- 6.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
- 6.2 create a connection between a personal inventory and occupational choices

COURSE NET1910: NET PROJECT A

Level: Introductory

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Introductory project courses must connect with a minimum of two CTS courses, one of which must be at the introductory level and be in the same occupational area as the project course. The other CTS course(s) can be either at the same level or at the intermediate level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. **identify the connection between this project course and two or more CTS courses**
    1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
    1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. **propose the project and/or performance**
    2.1 identify the project and/or performance by:
        2.1.1 preparing a plan
        2.1.2 clarifying the purposes
        2.1.3 defining the deliverables
        2.1.4 specifying time lines
        2.1.5 explaining terminology, tools and processes
        2.1.6 defining resources; e.g., materials, costs, staffing
    2.2 identify and comply with all related health and safety standards
    2.3 define assessment standards (indicators for success)
    2.4 present the proposal and obtain necessary approvals

The student will:

3. **meet goals as defined within the plan**
    3.1 complete the project and/or performance as outlined
    3.2 monitor the project and/or performance and make necessary adjustments
    3.3 present the project and/or performance, indicating the:
        3.3.1 outcomes attained
        3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies
4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. make personal connections to the cluster content and processes to inform possible pathway choices
5.1 complete/update a personal inventory; e.g., interests, values, beliefs, resources, prior learning and experiences
5.2 create a connection between a personal inventory and occupational choices

COURSE NET2010: DIGITAL TECHNOLOGY 2

Level: Intermediate

Prerequisite: NET1010: Digital Technology 1

Description: Students demonstrate knowledge of digital principles, by using small-scale transistor–transistor logic (TTL) and complementary metal-oxide semiconductor (CMOS) integrated technology.

Parameters: Access to a digital logic trainer, an oscilloscope, function generation and resource materials.

Supporting Course: ELT2010: Electro-assembly 2

Outcomes: The student will:

1. **identify and interface components with TTL and CMOS small-scale integrated circuit (IC) families**
   1.1 explain the difference between various gate applications, counters and registers
   1.2 distinguish the difference among various numbering systems and binary codes including:
      1.2.1 binary
      1.2.2 octal
      1.2.3 hexadecimal
      1.2.4 binary coded decimal (BCD)
      1.2.5 American standard code for information interchange (ASCII)
2. **identify components and construct a prototype of typical small-scale and complex logic networks using TTL and CMOS families of ICs**
   2.1 use emulation software on a design problem
   2.2 demonstrate the use of boolean algebra to analyze a logic circuit
   2.3 demonstrate how to prototype and troubleshoot the following fundamental logic gates in typical and complex logic networks:
      2.3.1 AND
      2.3.2 NAND
      2.3.3 NOR
      2.3.4 XNOR
      2.3.5 OR, Registers
      2.3.6 F/F counters
      2.3.7 simple comparators
   2.4 use a printed circuit (PC) board to fabricate a digital circuitry project; e.g., digital dice, sound generator decision maker, electronic scoreboard, IC tester
   2.5 use PC board software to lay out a digital circuit
   2.6 solve, construct and experiment with real-world problems using combination and sequential logic design for applications; e.g., traffic lights, aircraft landing gear, motor controls
   2.7 prototype the solution for a logic problem using a breadboard and develop a truth table
3. **demonstrate established laboratory procedures and safe work practices**
   3.1 explain and demonstrate how to avoid electrostatic discharges around IC chips, using static mats and grounding straps
   3.2 demonstrate an understanding of grounding, voltage and current rating of various IC families

4. demonstrate basic competencies
    4.1 demonstrate fundamental skills to:
        4.1.1 communicate
        4.1.2 manage information
        4.1.3 use numbers
        4.1.4 think and solve problems
    4.2 demonstrate personal management skills to:
        4.2.1 demonstrate positive attitudes and behaviours
        4.2.2 be responsible
        4.2.3 be adaptable
        4.2.4 learn continuously
        4.2.5 work safely
    4.3 demonstrate teamwork skills to:
        4.3.1 work with others
        4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster
    5.1 recognize and then analyze the opportunities and barriers in the immediate environment
    5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE NET2020: WORKSTATION TECHNOLOGY & OPERATIONS

Level: Intermediate

Prerequisite: None

Description: Students learn computer work station operations, including computer architecture, peripherals, configurations, operating system environments and platforms, utility software, diagnostic and protection software, hard drive file updating and maintenance, support resource application and troubleshooting activities.

Parameters: Access to an appropriate computer work station, a storage medium, utility software, the Internet and support materials.

Outcomes: The student will:

1. disassemble/assemble a working computer and perform basic troubleshooting procedures
    1.1   assemble a computer from given computer parts including:
          1.1.1   set the system configuration switches
          1.1.2   install computer operating system
          1.1.3   install monitor/keyboard
          1.1.4   test computer
    1.2   demonstrate basic computer troubleshooting techniques by:
          1.2.1   using a system board flowchart to locate a system board fault
          1.2.2   listing symptoms of hard drive failure
    1.3   explain the use of debug, error check and format/reformat of a hard drive
2. identify and explain computer system components
    2.1   research the history of computers, processors and various operating systems
    2.2   describe the environmental, social, economic and political contribution that computers have made to our social fabric
    2.3   define basic computer terms
    2.4   identify and describe parts of a computer
    2.5   explain the different sizes and types of expansion boards
    2.6   identify and compare ports
    2.7   identify adapter cards
    2.8   explain memory expansion methods
    2.9   explain the operation of various hard drive types; e.g., platter, solid state
    2.10 name the types of displays
    2.11 define and describe various purposes of software; e.g., system, application
3. identify the fundamentals of using operating systems
    3.1   identify differences between operating systems, e.g., Mac, Windows, Linux, and describe operating system revision levels including graphical user interface (GUI), system requirements, application and hardware compatibility
    3.2   identify names, purposes and characteristics of the primary operating system components including registry, virtual memory and file system
    3.3   describe features of operating system interfaces

3.4 identify the names, locations, purposes and characteristics of operating system files
3.5 identify concepts and procedures for creating, viewing and managing disks, directories and files in operating systems

4. install, configure, optimize and upgrade operating systems
4.1 determine what permission level is required for performing the task
4.2 analyze system requirements for upgrading operating systems
4.3 install and/or add a device driver for appropriate peripheral (signed or unsigned) including:
    4.3.1 verify installation of the driver; e.g., device manager, functionality
4.4 identify procedures and utilities used to optimize operating systems; e.g., virtual memory, hard drives, temporary files, service, startup, applications

5. identify tools, diagnostic procedures and troubleshooting techniques for operating systems
5.1 identify basic boot sequences, methods and utilities for recovering operating systems
5.2 identify and apply diagnostic procedures and troubleshooting techniques including:
    5.2.1 identify the problem
    5.2.2 analyze the problem; e.g., potential causes and initial determination of software and/or hardware problem
    5.2.3 test related components including connections, hardware/software configurations, device manager, and consult vendor documentation
    5.2.4 evaluate results and take additional steps, if needed; e.g., consultation, alternate resources, manuals
    5.2.5 document activities and outcomes
5.3 recognize and resolve common operational issues; e.g., bluescreen (PC), force quit (Mac), system lockup
5.4 recognize common error messages, codes and their function
5.5 identify the names, locations, purposes and characteristics of operating system utilities

6. perform preventive maintenance on operating systems using common utilities; e.g., software updates, service packs, scheduled backups, restore and restore points

7. apply consistent and appropriate work station routines
7.1 describe grounding methods when working on computers and use personal grounding systems; e.g., ankle and wrist straps
7.2 describe the aspects and importance of safety and environmental issues
7.3 identify potential safety hazards and take preventive action
7.4 use material safety data sheets (MSDS) or equivalent documentation and appropriate equipment documentation
7.5 use appropriate repair tools
7.6 describe methods to handle environmental and human accidents including incident reporting; e.g. electrical, chemical, physical
7.7 identify potential hazards and implement proper safety procedures including electrostatic sensitive device (ESD) precautions and procedures, a safe work environment and equipment handling
7.8 identify proper disposal procedures for batteries, display devices and chemical solvents and containers

8. demonstrate basic competencies
8.1 demonstrate fundamental skills to:
    8.1.1 communicate
    8.1.2 manage information
    8.1.3 use numbers
    8.1.4 think and solve problems

8.2 demonstrate personal management skills to:
    8.2.1 demonstrate positive attitudes and behaviours
    8.2.2 be responsible
    8.2.3 be adaptable
    8.2.4 learn continuously
    8.2.5 work safely
8.3 demonstrate teamwork skills to:
    8.3.1 work with others
    8.3.2 participate in projects and tasks

9. identify possible life roles related to the skills and content of this cluster
9.1 recognize and then analyze the opportunities and barriers in the immediate environment
9.2 identify potential resources to minimize barriers and maximize opportunities

COURSE NET2030:   **NETWORK STRUCTURES**

Level: Intermediate

Prerequisite: None

Description: Students acquire an understanding of network infrastructure and assess the advantages and disadvantages of different types of networks. They also develop knowledge of data transmission principles in a computer network and compare features of different network topologies and transmission methods.

Parameters: Designed to be delivered in conjunction with other intermediate level courses in the computer networking systems. Schools have the option of delivering courses in conjunction with one or more project courses if they wish to extend learning and/or address other specific technologies.

                         Access to an appropriate computer work station, the Internet, networking hardware, software and tools, and consumable supplies.

                         Access to instruction from an individual with specialized knowledge and skills in computer networking.

                         Particular emphasis is given to network infrastructure, concepts and terminology relevant to network topology and architecture. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Supporting Courses: ELT1010: Electro-assembly 1
                         NET1010: Digital Technology 1
                         NET2020: Workstation Technology & Operations
                         NET2110: Telecommunications 1

Outcomes: The student will:

1. **describe and explain the evolution of computer/Internet networks and the general structure and function of peer-to-peer and server-based networks, local area networks and wide area networks**
   1.1 summarize the history of networking, from the telegraph to modern computer technology
   1.2 describe the evolution of standards for data transmission, from Morse code to the American standard code for information interchange (ASCII)
   1.3 create a time line of specific milestones in the history of computer networking
   1.4 identify emerging networking technologies and their impact on global communications
   1.5 describe a computer network and solutions provided by computer networking including:
        1.5.1 file sharing
        1.5.2 hardware sharing
        1.5.3 program sharing

      1.5.4   user communication

      1.5.5   new methodologies

1.6 give examples of resources commonly shared within a network environment

1.7 describe the structure, purpose and function of peer-to-peer and server-based networks

1.8 compare and contrast peer-to-peer and server-based networks with respect to:

      1.8.1   number of work stations

      1.8.2   relative cost

      1.8.3   security

      1.8.4   administration

      1.8.5   data backup

1.9 describe and compare the structure, purpose and function of local area networks (LANs), metropolitan area networks (MANs) and wide area networks (WANs)

1.10 create schematic diagrams for the physical layout of LANs, MANs and WANs

1.11 describe and give examples of how networks may be categorized; e.g., topology, protocol, architecture, media

2. describe and demonstrate basic principles of data transmission in a computer network

2.1 describe characteristics of digital and analog signalling

2.2 explain concepts and technical terms associated with data signalling and transmission including:

      2.2.1   propagation, modulation and encoding

      2.2.2   baseband and broadband signalling

      2.2.3   transmission speed and bandwidth

      2.2.4   attenuation, reflection and noise

      2.2.5   dispersion, jitter and latency

      2.2.6   data collision

2.3 describe and illustrate the structure of data packets and frames

2.4 explain applications of packet-sniffing software to capture and analyze data packets and frames

2.5 convert binary and hexadecimal numbers to decimal numbers

2.6 identify problems and solutions related to data collision in a shared media environment

3. describe and compare the features of bus, star, ring, mesh, wireless and hybrid topologies, Ethernet, token ring, fibre distributed data interface (FDDI) and wireless transmission methods

3.1 describe and compare the unique characteristics, advantages and disadvantages of common physical network topologies; e.g., bus, star, ring, mesh, wireless, hybrid and new topologies

3.2 explain the function of network segments and backbones

3.3 create schematic diagrams for the physical layout of bus, star, ring, mesh, wireless, hybrid and new topologies

3.4 describe the architecture of an Ethernet network with respect to:

      3.4.1   physical topology

      3.4.2   access strategy

      3.4.3   carrier sense multiple access with collision detection (CSMA/CD)

      3.4.4   media and hardware devices

      3.4.5   Institute of Electrical and Electronics Engineers (IEEE) standards

3.5 describe and compare the main features of token ring, FDDI, LocalTalk and wireless networks with respect to:

      3.5.1   topology

      3.5.2   methodology and access strategy

      3.5.3   media type

      3.5.4   speed

3.6 select an appropriate topology and network architecture, and design a network to address user needs, given a particular set of network requirements

4. demonstrate basic competencies
    4.1 demonstrate fundamental skills to:
        4.1.1 communicate
        4.1.2 manage information
        4.1.3 use numbers
        4.1.4 think and solve problems
    4.2 demonstrate personal management skills to:
        4.2.1 demonstrate positive attitudes and behaviours
        4.2.2 be responsible
        4.2.3 be adaptable
        4.2.4 learn continuously
        4.2.5 work safely
    4.3 demonstrate teamwork skills to:
        4.3.1 work with others
        4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster
    5.1 recognize and then analyze the opportunities and barriers in the immediate environment
    5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE NET2040: NETWORK MEDIA & DEVICES

Level: Intermediate

Prerequisite: None

Description: Students develop an understanding of different connectivity strategies for linking computers and other devices in a local area network (LAN). They acquire knowledge of industry standards for network cables and gain practical experience through installing cabling, connectors and other hardware components.

Parameters: Designed to be delivered in conjunction with other intermediate level courses in computer networking systems. Schools have the option of delivering courses in conjunction with one or more project courses if they wish to extend learning and/or address other specific technologies.

Access to an appropriate computer work station, the Internet, networking hardware, software and tools, and consumable supplies.

Access to instruction from an individual with specialized knowledge and skills in computer networking.

Particular emphasis is given to safe processes for the installation of network cabling and connectors and to an understanding of how topology, cabling and connectors need to coexist in a network environment. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Supporting Course: NET2020: Workstation Technology & Operations

Outcomes: The student will:

1. **identify and describe the characteristics, standard names and applications for common network media and connectors**
    1.1 identify and describe the structural components and uses of major types of network cables including:
        1.1.1 coaxial; e.g., thick, thin
        1.1.2 twisted pair; e.g., unshielded, shielded
        1.1.3 fibre optic
    1.2 identify and describe the characteristics and uses of common media connectors including:
        1.2.1 registered jack 11 (RJ-11)
        1.2.2 registered jack 45 (RJ-45)
        1.2.3 attachment unit interface (AUI)
        1.2.4 British naval connector (BNC)
        1.2.5 small computer system interface (SCSI)
        1.2.6 single mode fibre optic connector; e.g., SC-type, ST-type

1.3 identify Institute of Electrical and Electronics Engineers (IEEE) standards for Ethernet cabling including:
- 1.3.1 bandwidth/speed
- 1.3.2 transmission mode
- 1.3.3 maximum segment length
- 1.3.4 cable type

1.4 identify and describe categories for unshielded twisted pair cable defined by the Electronics Industries Alliance and the Telecommunications Industry Association

1.5 describe the media and function of network backbones and segments

1.6 explain the relationship between media type, connector and topology in a network environment

1.7 choose an appropriate cable type and connector to add a client, given a practical network scenario

2. identify and explain the purpose, features and basic operation of network hardware components

2.1 explain the purpose of hardware components in:
- 2.1.1 connecting network devices
- 2.1.2 boosting data signals
- 2.1.3 determining data flow

2.2 demonstrate an understanding of the features, functionality and performance of basic hardware components including:
- 2.2.1 network interface card (NIC)
- 2.2.2 hub
- 2.2.3 repeater
- 2.2.4 switch
- 2.2.5 bridge
- 2.2.6 router
- 2.2.7 gateway
- 2.2.8 wireless access point
- 2.2.9 modem
- 2.2.10 new network technologies

2.3 describe the features and functionality of power fault-tolerance hardware including:
- 2.3.1 surge suppressor
- 2.3.2 power line conditioner
- 2.3.3 uninterruptible power supply

2.4 choose an appropriate hardware component to use or replace an existing device, given a practical network scenario

2.5 physically install a NIC and verify that the NIC is operational including:
- 2.5.1 Ethernet
- 2.5.2 Bluetooth
- 2.5.3 wireless
- 2.5.4 new technologies

3. demonstrate knowledge of cabling tools and procedures

3.1 demonstrate correct use of cabling tools including:
- 3.1.1 wire crimper
- 3.1.2 punch down tool

3.2 demonstrate appropriate use of basic test equipment including:
    3.2.1 media testers/certifiers
    3.2.2 crossover cable
    3.2.3 tone generator and probe; e.g., fox and hound
    3.2.4 optical testers
3.3 demonstrate the proper sequence of steps to crimp and test Ethernet cable
3.4 select the appropriate cabling tool and test equipment, given a practical cabling task

4. demonstrate ability to install network cabling, connectors and hardware components
4.1 demonstrate procedures for the compliant installation of:
    4.1.1 jacks and outlets
    4.1.2 cable and structured cable runs
    4.1.3 patch panels and patch cords
    4.1.4 network cards
    4.1.5 wired or wireless connections
4.2 demonstrate appropriate use of test equipment in checking for:
    4.2.1 continuity
    4.2.2 proper grounding
    4.2.3 correct cable termination
4.3 create a proposal for a new or refit cabling project
4.4 design, build and troubleshoot a small Ethernet network at the physical layer

5. demonstrate basic competencies
5.1 demonstrate fundamental skills to:
    5.1.1 communicate
    5.1.2 manage information
    5.1.3 use numbers
    5.1.4 think and solve problems
5.2 demonstrate personal management skills to:
    5.2.1 demonstrate positive attitudes and behaviours
    5.2.2 be responsible
    5.2.3 be adaptable
    5.2.4 learn continuously
    5.2.5 work safely
5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster
6.1 recognize and then analyze the opportunities and barriers in the immediate environment
6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE NET2050:   OPEN SYSTEM INTERCONNECTION

Level: Intermediate

Prerequisite: None

Description: Students develop knowledge of the Open System Interconnection (OSI)
                      reference model and its use as a conceptual framework for analyzing network
                      communication tasks.   They examine the OSI reference model
                      characteristics, the functions of each of its seven layers and how data moves
                      between layers of the reference model when computers establish a network
                      connection.

Parameters: Designed to be delivered in conjunction with other intermediate level courses
                      in computer networking systems. Schools have the option of delivering
                      courses in conjunction with one or more project courses if they wish to
                      extend learning and/or address other specific technologies.

                      Access to an appropriate computer work station, the Internet, networking
                      hardware, software and tools, and consumable supplies.

                      Access to instruction from an individual with specialized knowledge and
                      skills in computer networking.

                      Primary focus should be placed on the physical, data link, network and
                      transport layers of the OSI reference model, and on the real-world protocols
                      and networking devices that operate at each of these layers. Students model
                      and assume personal responsibility for ethical behaviour in their use of
                      networking technologies and in their access to electronic sources of
                      information. They also demonstrate an understanding of industry-based
                      policies regarding network use and security.

Outcomes: The student will:

**1. describe the general purpose and structure of the OSI reference model as a conceptual
     framework for network communication**
     1.1   explain the purpose of the OSI reference model as a blueprint for designing, implementing and
           operating network hardware and software
     1.2   identify the functions of each of the seven layers of the OSI reference model
     1.3   explain and diagram data transfer between layers of the OSI reference model
     1.4   explain processes of data encapsulation and de-encapsulation in the OSI reference model
     1.5   describe the process of data packet delivery and the function of a data frame
     1.6   match network components and connectivity devices to the layers of the OSI reference model at
           which they operate
     1.7   analyze networking tasks with respect to the OSI reference model

2. **explain and illustrate how hardware components, network protocols and encapsulation defined in lower layers of the OSI reference model move data across the network; i.e., physical layer data link layer, network layer, transport layer**

   2.1   identify physical layer components and their function including:
       2.1.1 cabling
       2.1.2 connectors
       2.1.3 network interface cards
       2.1.4 repeaters
       2.1.5 hubs

   2.2   describe data signalling at the physical layer

   2.3   identify Ethernet standards for media type and maximum segment length

   2.4   demonstrate ability to:
       2.4.1 select appropriate cables and connectors
       2.4.2 select, install and configure a network adapter
       2.4.3 terminate an Ethernet network
       2.4.4 test for connectivity

   2.5   given specific user requirements, do the following:
       2.5.1 design physical layer topology and components for a small Ethernet network
       2.5.2 create a plan for cabling based on Ethernet standards

   2.6   identify data link layer devices and their function; e.g., bridges, switches

   2.7   explain the effects of segmentation in switched networks

   2.8   identify data link sublayers and their function including:
       2.8.1 Logical Link Control (LLC) sublayer
       2.8.2 Media Access Control (MAC) sublayer

   2.9   outline Institute of Electrical and Electronics Engineers (IEEE) standards for the data link layer

   2.10 describe connectionless and connection-oriented services associated with the LLC sublayer

   2.11 explain the nature and limitations of physical addressing associated with the MAC sublayer

   2.12 explain applications of framing in the transport of data packets

   2.13 describe and illustrate the structure of a data frame

   2.14 explain the function of frame addressing and frame relay in the transport of data packets

   2.15 identify network layer devices and their function including a:
       2.15.1 router
       2.15.2 brouter

   2.16 explain the process of routing and the function of:
       2.16.1 routing metrics
       2.16.2 routing tables

   2.17 distinguish between:
       2.17.1 static and dynamic routing
       2.17.2 routable and nonroutable protocols

   2.18 identify common routing protocols and their function including:
       2.18.1 Open Shortest Path First (OSPF)
       2.18.2 Routing Information Protocol (RIP)
       2.18.3 Novell Netware Link Services Protocol (NLSP)

   2.19 compare physical addressing associated with the data link layer and logical addressing associated with the network layer

   2.20 identify logical addressing protocols and their functions including:
       2.20.1 Internet Protocol (IP)
       2.20.2 Internetwork Packet Exchange (IPX)
       2.20.3 new protocols for the Internet and other devices

2.21 identify and explain types of error checking performed at the transport layer including:
  2.21.1 cyclic redundancy checks
  2.21.2 parity bits
  2.21.3 checksum calculations
2.22 provide a rationale for flow control, and identify hardware and software solutions implemented at the transport layer
2.23 explain name resolution functions performed at the transport layer
2.24 identify common transport layer protocols and their function including:
  2.24.1 Transmission Control Protocol (TCP)
  2.24.2 User Datagram Protocol (UDP)
  2.24.3 Sequenced Packet Exchange (SPX)
  2.24.4 Apple Talk Transaction Protocol/Name Binding Protocol (ATP/NBP)
  2.24.5 Network Basic Input/Output System/NetBIOS enhanced user interface (NetBIOS/NetBEUI)
  2.24.6 new technologies and their associated protocols

3. explain the function of upper layers of the OSI reference model in providing client support; i.e., session layer, presentation layer, application layer
 3.1 identify modes of communication associated with the session layer including:
  3.1.1 simplex
  3.1.2 half-duplex
  3.1.3 full-duplex
 3.2 describe data compression and encryption processes associated with the presentation layer
 3.3 identify file formats that serve as standards for the presentation layer
 3.4 describe network services provided by the application layer including:
  3.4.1 message handling
  3.4.2 file transfer
  3.4.3 database queries
 3.5 identify upper layer application protocols and their function including:
  3.5.1 Simple Mail Transfer Protocol (SMTP)
  3.5.2 File Transfer Protocol (FTP)
  3.5.3 Simple Network Management Protocol (SNMP)

4. demonstrate established laboratory procedures and safe work practices
5. demonstrate basic competencies
 5.1 demonstrate fundamental skills to:
  5.1.1 communicate
  5.1.2 manage information
  5.1.3 use numbers
  5.1.4 think and solve problems
 5.2 demonstrate personal management skills to:
  5.2.1 demonstrate positive attitudes and behaviours
  5.2.2 be responsible
  5.2.3 be adaptable
  5.2.4 learn continuously
  5.2.5 work safely
 5.3 demonstrate teamwork skills to:
  5.3.1 work with others
  5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster
    6.1 recognize and then analyze the opportunities and barriers in the immediate environment
    6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE NET2060:   NETWORK PROTOCOLS

Level: Intermediate

Prerequisite: None

Description: Students acquire basic knowledge of upper-layer protocol suites that permit the
                      networking of computers. They examine reasons for the extensive use of the
                      Transmission Control Protocol/Internet Protocol (TCP/IP) in computer
                      networks, and develop knowledge and skills relevant to installing, configuring
                      and maintaining a TCP/IP client on a network.

Parameters: Designed to be delivered in conjunction with other intermediate level courses
                      in computer networking systems. Schools have the option of delivering
                      courses in conjunction with one or more project courses if they wish to extend
                      learning and/or address other specific technologies.

                      Access to an appropriate computer work station, the Internet, networking
                      hardware, software and tools, and consumable supplies.

                      Access to instruction from an individual with specialized knowledge and skills
                      in computer networking.

                      Particular emphasis is placed on developing knowledge of TCP/IP and its suite
                      of protocols. Students model and assume personal responsibility for ethical
                      behaviour in their use of networking technologies and in their access to
                      electronic sources of information. They also demonstrate an understanding of
                      industry-based policies regarding network use and security.

Outcomes: The student will:

1. **describe and compare standard networking protocol suites with respect to function and
    addressing requirements, interoperability and naming conventions**
    1.1 describe the nature and purpose of a protocol and a protocol suite/stack within the context of
         computer networking
    1.2 describe and compare standard networking protocol suites including:
         1.2.1 TCP/IP
         1.2.2 Internetwork Packet Exchange/Sequenced Packet Exchange (IPX/SPX)
         1.2.3 NetBIOS extended user interface (NetBEUI)
         1.2.4 AppleTalk with respect to: function, routing, addressing requirements, interoperability,
                naming conventions, advantages and limitations
    1.3 match communication tasks performed within TCP/IP, IPX/SPX, NetBEUI and AppleTalk to
         communication tasks defined at different layers of the Open System Interconnection (OSI)
         reference model
    1.4 identify criteria involved in selecting a network protocol
    1.5 investigate emerging technologies and protocols

2. identify and explain reasons for the extensive use of the TCP/IP suite in computer networks, and identify and explain major protocols that operate within the TCP/IP suite
    2.1   describe the general characteristics and features of the TCP/IP suite
    2.2   compare and contrast the TCP/IP suite with the OSI reference model
    2.3   provide reasons for the extensive use of the TCP/IP suite including:
        2.3.1   universal interconnectivity
        2.3.2   conformity with the OSI reference model
        2.3.3   modularity
        2.3.4   Internet addressing
        2.3.5   interoperability
    2.4   identify the basic function of protocols operating within the TCP/IP suite including:
        2.4.1   TCP
        2.4.2   User Datagram Protocol (UDP)
        2.4.3   Ip
        2.4.4   Address Resolution Protocol (ARP)
        2.4.5   File Transfer Protocol (FTP)
        2.4.6   Simple Mail Transfer Protocol (SMTP)
        2.4.7   Post Office Protocol (POP)
        2.4.8   Internet Message Access Protocol (IMAP)
        2.4.9   Internet Control Message Protocol (ICMP)
        2.4.10 Routing Information Protocol (RIP)
        2.4.11 Open Shortest Path First (OSPF)
        2.4.12 Hypertext Transfer Protocol (HTTP)
    2.5   match TCP/IP protocols to the layers of the OSI reference model on which they operate
    2.6   compare and contrast TCP and UDP segment formats
    2.7   investigate emergent technologies and protocols

3. demonstrate basic knowledge of logical addressing and the use of subnets and subnet masks to maximize address utilization
    3.1   describe and illustrate conventions for IP addressing; e.g., structure and components, characteristics of Class A, B and C addresses
    3.2   convert between binary and decimal notation
    3.3   explain the purpose of subnetting and default gateways
    3.4   describe and compare classful and classless approaches to subnetting
    3.5   provide a rationale for implementing Classless Inter-domain Routing
    3.6   demonstrate processes for subnetting a Class A, B or C address into a given number of subnetworks
    3.7   determine the subnet mask for a subnetted network
    3.8   describe and compare static and dynamic approaches to IP addressing, and applications of dynamic host configuration protocol
    3.9   describe the concept of address resolution, and applications of ARP including:
        3.9.1   prepare a diagram on how ARP is used in address resolution
        3.9.2   describe gratuitous and proxy ARP
        3.9.3   interpret an ARP cache
    3.10 describe the concept of TCP and UDP port numbers including:
        3.10.1 define the function of a port
        3.10.2 identify the range of port numbers
        3.10.3 explain the function of well-known TCP/UDP ports
        3.10.4 investigate emergent technologies and protocols

4. demonstrate ability to install and configure TCP/IP on a user work station and validate, troubleshoot and manage a network connection using TCP/IP utilities
    4.1 identify criteria involved in:
        4.1.1 planning a network
        4.1.2 selecting a network protocol
    4.2 plan and construct a small peer-to-peer or server-based network
    4.3 install and configure a device for TCP/IP that:
        4.3.1 identifies options for obtaining IP addresses
        4.3.2 assigns a static IP address
        4.3.3 assigns a subnet mask to an IP address
    4.4 validate, troubleshoot and manage a network connection through the use of appropriate TCP/IP utilities including:
        4.4.1 Simple Network Management Protocol (SNMP)
        4.4.2 Packet Internet Groper (PING)
        4.4.3 Internet Protocol configuration (IPCONFIG)
        4.4.4 traceroute (TRACERT)
        4.4.5 network statistics (NETSTAT)

5. demonstrate established laboratory procedures and safe work practices

6. demonstrate basic competencies
    6.1 demonstrate fundamental skills to:
        6.1.1 communicate
        6.1.2 manage information
        6.1.3 use numbers
        6.1.4 think and solve problems
    6.2 demonstrate personal management skills to:
        6.2.1 demonstrate positive attitudes and behaviours
        6.2.2 be responsible
        6.2.3 be adaptable
        6.2.4 learn continuously
        6.2.5 work safely
    6.3 demonstrate teamwork skills to:
        6.3.1 work with others
        6.3.2 participate in projects and tasks

7. identify possible life roles related to the skills and content of this cluster
    7.1 recognize and then analyze the opportunities and barriers in the immediate environment
    7.2 identify potential resources to minimize barriers and maximize opportunities

COURSE NET2070:   LOCAL AREA NETWORKS

Level: Intermediate

Prerequisite: None

Description: Students extend their understanding of technologies used in a local area
                            network (LAN) and examine specifications for an Ethernet LAN. They
                            develop knowledge of a general strategy for network design and apply the
                            strategy to design, implement and troubleshoot a small LAN.

Parameters: Designed to be delivered in conjunction with other intermediate level courses
                            in computer networking systems. Schools have the option of delivering
                            courses in conjunction with one or more project courses if they wish to extend
                            learning and/or address other specific technologies.

                            Access to an appropriate computer work station, the Internet, networking
                            hardware, software and tools, and consumable supplies.

                            Access to instruction from an individual with specialized knowledge and skills
                            in computer networking.

                            Particular emphasis is placed on the Institute of Electrical and Electronics
                            Engineers (IEEE) standards for cabling, and on safe procedures for preparing
                            and connecting network media and devices. Students model and assume
                            personal responsibility for ethical behaviour in their use of networking
                            technologies and in their access to electronic sources of information. They
                            also demonstrate an understanding of industry-based policies regarding
                            network use and security.

Outcomes: The student will:

1. **describe and explain the nature and evolution of LAN technologies and the specific features
    that differentiate one LAN from another**
    1.1 describe the general structure and purpose of a LAN
    1.2 describe and compare past and present LAN technologies, with attention to their respective
         topologies, protocols and media including:
         1.2.1 attached resource computer network (ARCnet)
         1.2.2 LocalTalk
         1.2.3 Ethernet
         1.2.4 token ring
         1.2.5 fibre distributed data interface (FDDI)
         1.2.6 asynchronous transfer mode (ATM)
         1.2.7 wireless LAN (WLAN)
    1.3 describe new and/or emerging LAN technologies with respect to:
         1.3.1 physical characteristics and potential data capacities
         1.3.2 new applications and end-user benefits
         1.3.3 historical and/or business perspectives that drive development and adoption

2. explain and demonstrate characteristics of an Ethernet LAN and strategies for improving network performance

2.1 describe basic characteristics of a LAN including:
    2.1.1 topology or physical layout
    2.1.2 use of carrier sense multiple access with collision detection (CSMA/CD)
    2.1.3 specifications for LANs

2.2 identify and describe cabling and hardware devices that support data delivery across LAN including:
    2.2.1 cabling specifications and options
    2.2.2 data flow through hubs, repeaters, bridges and switches
    2.2.3 network interface card functions and options
    2.2.4 the function of terminating resistors

2.3 identify data transmission issues in LAN networking environments including:
    2.3.1 latency and bandwidth
    2.3.2 contention
    2.3.3 congestion and collision
    2.3.4 attenuation

2.4 explain the concept of segmentation and strategies used to design a collision domain by:
    2.4.1 describing segmentation of a collision domain by bridges, switches and routers
    2.4.2 illustrating the 5-4-3 rule used in 10Base-T networks
    2.4.3 designing and illustrating a small Ethernet collision domain network

2.5 explain applications of bridge and switch technology by:
    2.5.1 illustrating the function of learning bridges and the spanning tree protocol
    2.5.2 explaining the function of switches at the data link layer and network layers
    2.5.3 identifying different types of switching architecture including store-and-forward and cut-through data transport, and half-duplex and full-duplex network access

3. describe the characteristics, function and benefits of a virtual local area network (VLAN)

3.1 describe the structure and function of a VLAN

3.2 identify the benefits offered by a VLAN and specific circumstances in which a VLAN might be implemented

3.3 describe capabilities and functions of the following different types of VLANs:
    3.3.1 port-based
    3.3.2 address-based
    3.3.3 protocol-based

3.4 illustrate/diagram a simple VLAN configuration

4. design and implement a small LAN

4.1 outline a general strategy for network design that:
    4.1.1 considers the purpose of the network
    4.1.2 determines the overall size of the network
    4.1.3 selects a network topology
    4.1.4 determines the type of file system to be used
    4.1.5 selects network and client operating systems
    4.1.6 establishes a naming scheme and name conventions
    4.1.7 determines the level and type of fault-tolerance
    4.1.8 establishes the type and level of security required

4.2 design and implement a small Ethernet LAN suitable for home or office that adheres to the IEEE standards, given a specific set of network requirements including:
    4.2.1 select an appropriate topology and architecture
    4.2.2 recommend a hardware and connectivity solution

  4.2.3 implement the solution by following safe procedures for connecting cabling and hardware devices
  4.2.4 test the installation

5. analyze and troubleshoot basic problems related to LAN design and implementation
 5.1 describe and compare proactive and reactive approaches to troubleshooting
 5.2 outline a general strategy for troubleshooting network problems that:
  5.2.1 establishes the symptoms
  5.2.2 identifies the affected area
  5.2.3 establishes what has changed
  5.2.4 selects the most probable cause
  5.2.5 implements a solution
  5.2.6 tests the results
  5.2.7 recognizes the potential effects of the solution
  5.2.8 documents the solution
 5.3 identify common network problems related to:
  5.3.1 physical topology
  5.3.2 client connectivity
  5.3.3 wiring and infrastructure
 5.4 identify sources of support for troubleshooting including:
  5.4.1 hardware/software manuals and help files
  5.4.2 the manufacturer's Web site
  5.4.3 technical support via telephone/e-mail
  5.4.4 use the levels of the OSI model as a troubleshooting guide to isolate the source of the problem
 5.5 analyze and determine the cause of a LAN implementation problem

6. demonstrate established laboratory procedures and safe work practices

7. demonstrate basic competencies
 7.1 demonstrate fundamental skills to:
  7.1.1 communicate
  7.1.2 manage information
  7.1.3 use numbers
  7.1.4 think and solve problems
 7.2 demonstrate personal management skills to:
  7.2.1 demonstrate positive attitudes and behaviours
  7.2.2 be responsible
  7.2.3 be adaptable
  7.2.4 learn continuously
  7.2.5 work safely
 7.3 demonstrate teamwork skills to:
  7.3.1 work with others
  7.3.2 participate in projects and tasks

8. identify possible life roles related to the skills and content of this cluster
 8.1 recognize and then analyze the opportunities and barriers in the immediate environment
 8.2 identify potential resources to minimize barriers and maximize opportunities

COURSE NET2080: LAPTOPS & PERIPHERALS

Level: Intermediate

Prerequisite: None

Description: Students develop an understanding of laptops, portable devices, printers and scanners. They acquire knowledge of industry standards for network cables and gain practical experience through installing cabling, connectors and other hardware components.

Parameters: Designed to be delivered in conjunction with other intermediate level courses in computer networking systems. Schools have the option of delivering courses in conjunction with one or more project courses if they wish to extend learning and/or address other specific technologies.

Access to an appropriate computer work station, the Internet, networking hardware, software and tools, and consumable supplies.

Access to instruction from an individual with specialized knowledge and skills in computer networking.

Particular emphasis is placed on Institute of Electrical and Electronics Engineers (IEEE) standards for cabling, and on safe procedures for preparing and connecting network media and devices. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Supporting Course: NET2020: Workstation Technology & Operations

Outcomes: The student will:

1. **identify the fundamental principles of using laptops and portable devices**
   1.1 identify names, purposes and characteristics of laptop-specific devices/hardware
   1.2 identify and distinguish between mobile and desktop motherboards and processors including throttling, power management and Wi-Fi
2. **install, configure, optimize and upgrade laptops and portable devices**
   2.1 configure power management options
   2.2 demonstrate the safe removal of laptop-specific hardware such as peripherals, hot-swappable devices and non-hot-swappable devices
3. **identify tools, basic diagnostic procedures and troubleshooting techniques for laptops and portable devices**
4. **identify and apply common preventive maintenance techniques for laptops and portable devices; e.g., cooling devices, hardware and video cleaning materials, operating environments including temperature and air quality, storage, transportation and shipping**

5. **identify the fundamental principles of using printers and scanners**
   5.1 identify differences between types of printer and scanner technologies; e.g., laser, inkjet, thermal, solid ink, impact
   5.2 identify names, purposes and characteristics of printer and scanner components; e.g., memory, driver, firmware, consumables such as toner, ink cartridge and paper
   5.3 identify the names, purposes and characteristics of interfaces used by printers and scanners including port and cable types
6. **identify basic concepts of installing, configuring, optimizing and upgrading printers and scanners**
   6.1 install and configure printers/scanners
   6.2 optimize printer performance including:
       6.2.1 printer settings; e.g., tray switching
       6.2.2 print spool settings
       6.2.3 device calibration
       6.2.4 media types
       6.2.5 paper orientation
7. **identify tools, basic diagnostic procedures and troubleshooting techniques for printers and scanners**
   7.1 gather information about printer/scanner problems
   7.2 review and analyze collected data
   7.3 identify solutions to identified printer/scanner problems
8. **demonstrate established laboratory procedures and safe work practices**
9. **demonstrate basic competencies**
   9.1 demonstrate fundamental skills to:
       9.1.1 communicate
       9.1.2 manage information
       9.1.3 use numbers
       9.1.4 think and solve problems
   9.2 demonstrate personal management skills to:
       9.2.1 demonstrate positive attitudes and behaviours
       9.2.2 be responsible
       9.2.3 be adaptable
       9.2.4 learn continuously
       9.2.5 work safely
   9.3 demonstrate teamwork skills to:
       9.3.1 work with others
       9.3.2 participate in projects and tasks
10. **identify possible life roles related to the skills and content of this cluster**
    10.1 recognize and then analyze the opportunities and barriers in the immediate environment
    10.2 identify potential resources to minimize barriers and maximize opportunities

COURSE NET2110:   **TELECOMMUNICATIONS 1**

Level: Intermediate

Prerequisite: None

Description: Students learn how to select and use various wired and wireless
telecommunication systems. By using the Internet, they investigate how
communication principles, bandwidth, telecommunication infrastructure and
wave spectrum affect telecommunication systems.

Parameters: Access to an appropriate computer work station, utility software, the Internet
and support materials.

Outcomes: The student will:

1. **use selected communication systems, protocols and techniques to transfer messages, do online activities and manage research**
   1.1   outline basic elements of a communication system
   1.2   describe the development of wired, wireless and Web-based communication systems
   1.3   identify key components of wired, wireless and Web-based telecommunication systems
   1.4   identify examples of how telecommunication systems are merging and connecting to improve
   service to various client groups
2. **describe the principles of wired, wireless and Web-based communication systems and how telecommunication systems are affected by bandwidth and wave spectrum**
   2.1   describe how computers send and receive various types of information/data; e.g., voice, data,
   documents, visuals, multimedia
   2.2   identify and describe telecommunication transmission systems in terms of bandwidth and wave
   spectrum including:
      2.2.1   wired; e.g., twisted pair telephone cable, coaxial cable, special data cables, fibre optics
      2.2.2   wireless; e.g., radar/microwave, radio, satellite data links
      2.2.3   digital versus analog
   2.3   describe various types of transmission systems including:
      2.3.1   type of information that can be transmitted; e.g., voice, pictures
      2.3.2   present installation base
      2.3.3   user cost
3. **compare and contrast key elements of a telecommunication infrastructure**
   3.1   identify key elements of an effective telecommunication infrastructure including:
      3.1.1   information and interactive applications/services; e.g., entertainment, education, cultural
      products, social services, business services, learning management systems
      3.1.2   transmission systems; e.g., links with/among homes, businesses, governments/education
      and institutions
      3.1.3   software applications; e.g., enable the operation of computers, manipulation of data,
      protection of data, transmission and reception of data and access to communication
      networks and their information such as social networks or learning management systems

3.1.4 standards and protocols that allow access to, or secure the contents of, information and networks

3.1.5 people/expertise needed to create the information, technology, equipment, peripherals, software and services, to provide the information, to construct the facilities and to educate others on its use and benefits

3.2 evaluate one or more telecommunication initiatives in terms of the key elements of an information technology infrastructure within one or more of the following areas:

3.2.1 personal; e.g., personal networks, interests, learning

3.2.2 electronic commerce; e.g., allows consumers/businesses to interact such as 1–800 numbers, electronic data interchange, data exchange

3.2.3 health care; e.g., remote diagnostics, patient information sharing, training

3.2.4 research

3.2.5 education and training; e.g., distance learning/course delivery via learning management systems

3.2.6 libraries; e.g., online

3.2.7 government services; e.g., federal, provincial

3.2.8 information services; e.g., information about government services, reports

3.2.9 technology-based process/procedures, filing income taxes electronically, electronic submissions of contract bids/tendering, teleconferencing

3.2.10 law enforcement services; e.g., international/national sharing of criminal data, teleconferenced parole hearings

3.2.11 labour force development; e.g., flexible, readily upgraded training programs

3.2.12 environmental monitoring

4. demonstrate established laboratory procedures and safe work practices

5. demonstrate basic competencies

5.1 demonstrate fundamental skills to:

5.1.1 communicate

5.1.2 manage information

5.1.3 use numbers

5.1.4 think and solve problems

5.2 demonstrate personal management skills to:

5.2.1 demonstrate positive attitudes and behaviours

5.2.2 be responsible

5.2.3 be adaptable

5.2.4 learn continuously

5.2.5 work safely

5.3 demonstrate teamwork skills to:

5.3.1 work with others

5.3.2 participate in projects and tasks

6. identify possible life roles related to the skills and content of this cluster

6.1 recognize and then analyze the opportunities and barriers in the immediate environment

6.2 identify potential resources to minimize barriers and maximize opportunities

COURSE NET2910: NET PROJECT B

Level:	Intermediate
Prerequisite:	None
Description:	Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.
Parameters:	Intermediate project courses must connect with a minimum of two CTS courses, one of which must be at the intermediate level and be in the same occupational area as the project course. The other CTS course(s) can be at any level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. **identify the connection between this project course and two or more CTS courses**
    1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
    1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. **propose the project and/or performance**
    2.1 identify the project and/or performance by:
        2.1.1 preparing a plan
        2.1.2 clarifying the purposes
        2.1.3 defining the deliverables
        2.1.4 specifying time lines
        2.1.5 explaining terminology, tools and processes
        2.1.6 defining resources; e.g., materials, costs, staffing
    2.2 identify and comply with all related health and safety standards
    2.3 define assessment standards (indicators for success)
    2.4 present the proposal and obtain necessary approvals

The student will:

3. **meet goals as defined within the plan**
    3.1 complete the project and/or performance as outlined
    3.2 monitor the project and/or performance and make necessary adjustments
    3.3 present the project and/or performance, indicating the:
        3.3.1 outcomes attained
        3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies
  4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
  4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
  4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster
  5.1 recognize and then analyze the opportunities and barriers in the immediate environment
  5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE NET2920: NET PROJECT C

Level: Intermediate

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Intermediate project courses must connect with a minimum of two CTS courses, one of which must be at the intermediate level and be in the same occupational area as the project course. The other CTS course(s) can be at any level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. **identify the connection between this project course and two or more CTS courses**
    1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
    1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. **propose the project and/or performance**
    2.1 identify the project and/or performance by:
        2.1.1 preparing a plan
        2.1.2 clarifying the purposes
        2.1.3 defining the deliverables
        2.1.4 specifying time lines
        2.1.5 explaining terminology, tools and processes
        2.1.6 defining resources; e.g., materials, costs, staffing
    2.2 identify and comply with all related health and safety standards
    2.3 define assessment standards (indicators for success)
    2.4 present the proposal and obtain necessary approvals

The student will:

3. **meet goals as defined within the plan**
    3.1 complete the project and/or performance as outlined
    3.2 monitor the project and/or performance and make necessary adjustments
    3.3 present the project and/or performance, indicating the:
        3.3.1 outcomes attained
        3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies
4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. identify possible life roles related to the skills and content of this cluster
5.1 recognize and then analyze the opportunities and barriers in the immediate environment
5.2 identify potential resources to minimize barriers and maximize opportunities

COURSE NET2950: NET INTERMEDIATE PRACTICUM

Level: Intermediate

Prerequisite: None

Description: Students apply prior learning and demonstrate the attitudes, skills and knowledge required by an external organization to achieve a credential/credentials or an articulation.

Parameters: This practicum course, which may be delivered on- or off-campus, should be accessed only by students continuing to work toward attaining a recognized credential/credentials or an articulation offered by an external organization. This course must be connected to at least one CTS course from the same occupational area and cannot be used in conjunction with any advanced (3XXX) level course. A practicum course cannot be delivered as a stand-alone course, cannot be combined with a CTS project course and cannot be used in conjunction with the Registered Apprenticeship Program or the Green Certificate Program.

Outcomes: The student will:

1. **perform assigned tasks and responsibilities, as required by the organization granting the credential(s) or articulation**
   1.1 identify regulations and regulatory bodies related to the credential(s) or articulation
   1.2 describe personal roles and responsibilities, including:
      1.2.1 key responsibilities
      1.2.2 support functions/responsibilities/expectations
      1.2.3 code of ethics and/or conduct
   1.3 describe personal work responsibilities and categorize them as:
      1.3.1 routine tasks; e.g., daily, weekly, monthly, yearly
      1.3.2 non-routine tasks; e.g., emergencies
      1.3.3 tasks requiring personal judgement
      1.3.4 tasks requiring approval of a supervisor
   1.4 demonstrate basic employability skills and perform assigned tasks and responsibilities related to the credential(s) or articulation
2. **analyze personal performance in relation to established standards**
   2.1 evaluate application of the attitudes, skills and knowledge developed in related CTS courses
   2.2 evaluate standards of performance in terms of:
      2.2.1 quality of work
      2.2.2 quantity of work
   2.3 evaluate adherence to workplace legislation related to health and safety
   2.4 evaluate the performance requirements of an individual who is trained, experienced and employed in a related occupation in terms of:
      2.4.1 training and certification
      2.4.2 interpersonal skills
      2.4.3 technical skills
      2.4.4 ethics

3. demonstrate basic competencies
    3.1 demonstrate fundamental skills to:
        3.1.1 communicate
        3.1.2 manage information
        3.1.3 use numbers
        3.1.4 think and solve problems
    3.2 demonstrate personal management skills to:
        3.2.1 demonstrate positive attitudes and behaviours
        3.2.2 be responsible
        3.2.3 be adaptable
        3.2.4 learn continuously
        3.2.5 work safely
    3.3 demonstrate teamwork skills to:
        3.3.1 work with others
        3.3.2 participate in projects and tasks

4. identify possible life roles related to the skills and content of this cluster
    4.1 recognize and then analyze the opportunities and barriers in the immediate environment
    4.2 identify potential resources to minimize barriers and maximize opportunities

COURSE NET3010: DIGITAL TECHNOLOGY 3

Level: Advanced

Prerequisite: NET2010: Digital Technology 2

Description: Students demonstrate and apply knowledge of digital principles by using
                        medium-scale transistor–transistor logic (TTL) and complementary metal-oxide
                        semiconductor (CMOS) integrated technology.

Parameters: Access to a digital logic trainer, a logic probe, an oscilloscope, a function
                        generator and related materials.

Outcomes: The student will:

1. **identify, interface and experiment with medium-scale integrated circuit families**
   1.1 explain the difference between typical and complex logic networks
   1.2 research and describe examples of typical and complex logic networks
2. **identify components, construct a prototype and experiment with typical medium-scale logic networks**
   2.1 design and fabricate digital circuitry using medium-scale integration
   2.2 construct, experiment with and solve real-world applications, using medium-scale integration
   2.3 measure and evaluate medium-scale integrated circuits
3. **demonstrate established laboratory procedures and safe work practices**
   3.1 explain and demonstrate how to avoid electrostatic discharges around integrated circuit chips, using static mats and grounding straps
   3.2 demonstrate an understanding of grounding, voltage and current rating of various integrated circuit families
4. **demonstrate basic competencies**
   4.1 demonstrate fundamental skills to:
        4.1.1 communicate
        4.1.2 manage information
        4.1.3 use numbers
        4.1.4 think and solve problems
   4.2 demonstrate personal management skills to:
        4.2.1 demonstrate positive attitudes and behaviours
        4.2.2 be responsible
        4.2.3 be adaptable
        4.2.4 learn continuously
        4.2.5 work safely
   4.3 demonstrate teamwork skills to:
        4.3.1 work with others
        4.3.2 participate in projects and tasks
5. **create a transitional strategy to accommodate personal changes and build personal values**
   5.1 identify short-term and long-term goals
   5.2 identify steps to achieve goals

COURSE NET3020:   DIGITAL APPLICATIONS

Level: Advanced

Prerequisite: NET2010: Digital Technology 2

Description: Students experiment with large-scale and very large-scale integrated circuits, and demonstrate their applications to practical situations.

Parameters: Access to logic probes, a logic analyzer, a signature analysis, oscilloscope and related materials.

Supporting Course: NET3010: Digital Technology 3

Outcomes: The student will:

1. identify applications and develop prototypes of large-scale integrated circuits (LSICs)
    1.1 research and investigate a complex digital system
    1.2 identify the function of integrated circuits in a large complex digital circuit
    1.3 explain, experiment with and demonstrate the differences among digital memories
    1.4 research memory configuration and organization
    1.5 construct various memory circuits
    1.6 explain and demonstrate the differences among various digital displays and drivers
    1.7 explain and demonstrate the differences among various support and advanced support integrated circuits
    1.8 identify the application of pinouts and use of complex integrated circuit chips from several manufacturers
    1.9 explain and demonstrate the differences among various digital interfacing devices
    1.10 construct circuits using LSICs
2. troubleshoot a digital system or prototype with digital equipment
    2.1 prototype and troubleshoot a digital system such as a calculator, computer, adder/subtractor, digital clock, frequency counter, alarm and game
    2.2 use one or more of the following instruments to analyze a complex digital circuit:
        2.2.1 logic probe
        2.2.2 pulser
        2.2.3 logic analyzer
        2.2.4 signature analyzer
        2.2.5 oscilloscope
3. demonstrate established laboratory procedures and safe work practices
    3.1 demonstrate correct handling and storage of LSIC and very large-scale integrated circuit (VLSIC) chips
4. demonstrate basic competencies
    4.1 demonstrate fundamental skills to:
        4.1.1 communicate
        4.1.2 manage information
        4.1.3 use numbers
        4.1.4 think and solve problems

4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values
5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE NET3030:   MICROPROCESSORS

Level: Advanced

Prerequisite: NET2010: Digital Technology 2

Description: Students compare the internal architecture of microprocessors and program
                             them using instruction sets.

Parameters: Access to a microprocessor trainer, a computer aided instruction (CAI)
                             program and related materials.

Supporting Courses: NET3010: Digital Technology 3
                             NET3020: Digital Applications

Outcomes: The student will:

1. **compare the internal architecture of various families of microprocessors**
    1.1 compare the difference in internal architecture between different families of microprocessors
    1.2 explain the differences between machine and assembly language and interpretative and compiled
         languages
    1.3 define the following terms:
         1.3.1 microprocessor
         1.3.2 input/output
         1.3.3 instruction set
         1.3.4 operand
         1.3.5 mnemonic
         1.3.6 opcode
         1.3.7 data/address
    1.4 describe and locate the types of microprocessor used in a computer or trainer
2. **program a microprocessor, using instruction sets**
    2.1 write and execute a simple straight program using mnemonic and opcodes
    2.2 demonstrate the uses and characteristics of different addressing modes by writing and analyzing
         assembly language programs
    2.3 compute the proper relative address for branching forward or backward from one point to
         another in a program
    2.4 write and execute a program that can:
         2.4.1 multiply by repeated additions
         2.4.2 divide by repeated subtractions
         2.4.3 convert binary to binary-coded decimal (BCD)
    2.5 write and execute simple programs that use indexed and extended addressing
    2.6 given an instruction, locate the opcode, calculate the number of machine cycles, find the number
         of bytes and give the final output
    2.7 write and execute a simple program that can store data in and retrieve data from the stack
    2.8 write and execute a program that uses the stack and indexing registers to move data between two
         places

3. **describe input/output operations in microprocessors**
   3.1 identify input/output pins of a microprocessor
   3.2 identify erasable programmable read-only memory (EPROMS), random-access memory (RAM), integrated circuits (ICs)
   3.3 identify memory read/write address and data pins on a memory chip
   3.4 write and execute various programs that use memory, input and output devices
   3.5 draw the symbols used in flowcharting and explain the purpose of each
   3.6 define and explain how the following are used in programming:
      3.6.1 inherent, immediate and direct addressing
      3.6.2 conditional and unconditional branching
      3.6.3 stack operation/pointer, cascade, pop push/pull instructions
      3.6.4 subroutines
      3.6.5 carry, negative, zero, overflow, flag operation
   3.7 explain the purpose of the following functional sections in a microprocessor:
      3.7.1 accumulator
      3.7.2 program counter
      3.7.3 instruction decoder
      3.7.4 controller
      3.7.5 data register
      3.7.6 address register
      3.7.7 stack pointer
      3.7.8 index pointer
   3.8 explain the evolution of architecture from 8-bit on
   3.9 draw a block diagram of an advanced microprocessor showing its internal architecture
   3.10 identify differences between data address, instruction, flag registers
   3.11 define a machine cycle
   3.12 relate clock frequency to microprocessor speed
4. **demonstrate established laboratory procedures and safe work practices**
   4.1 be aware of potential damage to integrated circuits by static electricity
   4.2 be aware of current and voltage requirements of computer trainers
   4.3 demonstrate proper safety procedures while testing microprocessor pins
5. **demonstrate basic competencies**
   5.1 demonstrate fundamental skills to:
      5.1.1 communicate
      5.1.2 manage information
      5.1.3 use numbers
      5.1.4 think and solve problems
   5.2 demonstrate personal management skills to:
      5.2.1 demonstrate positive attitudes and behaviours
      5.2.2 be responsible
      5.2.3 be adaptable
      5.2.4 learn continuously
      5.2.5 work safely
   5.3 demonstrate teamwork skills to:
      5.3.1 work with others
      5.3.2 participate in projects and tasks
6. **create a transitional strategy to accommodate personal changes and build personal values**
   6.1 identify short-term and long-term goals
   6.2 identify steps to achieve goals

COURSE NET3040:   **MICROPROCESSOR INTERFACE**

Level: Advanced

Prerequisite: NET3030: Microprocessors

Description: Students demonstrate how to interface microprocessors/microcontrollers with real-world applications.

Parameters: Access to a microprocessor trainer, an interfacing trainer, with an accompanying computer aided instruction (CAI) package, and related materials.

Supporting Course: ELT2080: Control Systems 2

Outcomes: The student will:

1. **describe and explain microprocessor interface output and input circuits and the operation of a serial interface device**
   1.1 describe the basic difference between system boards
   1.2 outline the memory allocations in a typical microcomputer system using random-access memory (RAM), read-only memory (ROM), erasable programmable read-only memory (EPROM), electrically erasable read-only memory (EEROM) and input/output (I/O)
   1.3 define I/O as they apply to microprocessors
   1.4 state the two main methods of I/O operation in microprocessors
   1.5 describe a simplified microprocessor interface device
   1.6 define the term "interrupt"
   1.7 explain the bus structure of a typical microprocessor system
   1.8 explain three-state logic
   1.9 draw a simplified block diagram of an interface device and explain the purpose of the data, control and data direction registers
   1.10 write a simple program that will configure an interface device in any I/O combination
   1.11 describe how serial data can be represented using both amplitude and frequency modulation techniques
   1.12 explain the difference between asynchronous and synchronous serial data transmission
   1.13 explain how to interface ROM, EPROM or RAM
   1.14 define the difference between a universal asynchronous receiver/transmitter (UART), BSRT and universal synchronous receiver/transmitter (USART) device
   1.15 write and execute a program to convert serial data to parallel data and parallel data to serial data
2. **interface a digital-to-analog (D/A) and analog-to-digital (A/D) converter to a microprocessor**
   2.1 research/experiment with some of the following concepts that apply to microprocessors:
       2.1.1 interface a D/A converter to a microprocessor system
       2.1.2 describe how D/A converters are used to control the direction of rotation, speed and position of DC motors
       2.1.3 define the function of a servo amplifier in a motor control circuit
       2.1.4 describe and provide an example of a microprocessor-based industrial control system
       2.1.5 construct a microprocessor-controlled thermometer
       2.1.6 construct a microprocessor-controlled silicon-controlled rectifier (SCR) or bidirectional triode thyristor (TRIAC) circuit

      2.1.7   explain how a microprocessor can control the effective current to a load using an SCR or TRIAC

      2.1.8   state the advantages of using an opto-isolator in a microprocessor control circuit

      2.1.9   design, construct and explain a microprocessor/stepper motor interface and control circuit

      2.1.10 explain how a microprocessor is used to control exhaust emissions and fuel economy in an automobile

      2.1.11 explain how microprocessors can be used to control a robot

2.2   explain how multiple microprocessors are used in advanced personal computer and business systems

2.3   describe several microprocessor applicators in the aviation and medical industries

2.4   explain several business applications of microprocessors including computers, word processors, copiers/printers, registers and inventory control

2.5   list several other consumer product applications of a microprocessor

3. connect a microprocessor to a sensor device used in home, industrial and/or transportation applications

3.1   construct, connect, interface and operate a microprocessor with devices including:

      3.1.1   photo resistive

      3.1.2   temperature and optical sensors

      3.1.3   photo diodes and photo transistors

      3.1.4   optical interrupter and optical reflectors

      3.1.5   optocouplers

      3.1.6   Hall effect devices

      3.1.7   DC motors

3.2   construct a project incorporating a microprocessor/microcontroller to control the operation of:

      3.2.1   robots

      3.2.2   weather stations

      3.2.3   home environment systems

      3.2.4   security systems

      3.2.5   automotive applications

      3.2.6   modems/communication devices

3.3   construct a project using EPROM's memory and various interface devices

4. demonstrate established laboratory procedures and safe work practices

4.1   describe voltage/current transients in real-world applications that connect to low voltage computers

4.2   safely interface computers to real-world applications

5. demonstrate basic competencies

5.1   demonstrate fundamental skills to:

      5.1.1   communicate

      5.1.2   manage information

      5.1.3   use numbers

      5.1.4   think and solve problems

5.2   demonstrate personal management skills to:

      5.2.1   demonstrate positive attitudes and behaviours

      5.2.2   be responsible

      5.2.3   be adaptable

      5.2.4   learn continuously

      5.2.5   work safely

5.3 demonstrate teamwork skills to:
    5.3.1 work with others
    5.3.2 participate in projects and tasks
6. create a transitional strategy to accommodate personal changes and build personal values
    6.1 identify short-term and long-term goals
    6.2 identify steps to achieve goals

COURSE NET3050:   NETWORK OPERATING SYSTEMS

Level: Advanced

Prerequisites: NET2030: Network Structures
                         NET2040: Network Media & Devices
                         NET2050: Open System Interconnection
                         NET2060: Network Protocols
                         NET2070: Local Area Networks

Description: Students examine the features, advantages and disadvantages of major network
                         operating systems and the criteria involved in selecting network operating
                         systems that are appropriate in specific networking environments. They develop
                         the knowledge and skills required to install and configure different network and
                         client operating systems and develop a strategy for troubleshooting problems
                         resulting from the installation of operating system software.

Parameters: Designed to be delivered in conjunction with other advanced level courses in
                         computer networking systems. Schools have the option of delivering courses in
                         conjunction with one or more project courses if they wish to extend learning
                         and/or address other specific technologies.

                         Access to an appropriate computer work station, the Internet, networking
                         hardware, software and tools, and consumable supplies.

                         Access to instruction from an individual with specialized knowledge and skills in
                         computer networking.

                         Particular emphasis is placed on current versions of commonly used network
                         operating systems (e.g., Microsoft Windows, Novell NetWare, Apple Macintosh,
                         UNIX/Linux), and client operating systems (e.g., Microsoft Windows, Apple
                         Macintosh, UNIX/Linux). Students model and assume personal responsibility
                         for ethical behaviour in their use of networking technologies and in their access
                         to electronic sources of information. They also demonstrate an understanding of
                         industry-based policies regarding network use and security.

Outcomes: The student will:

1. **identify the generic functions and administrative tasks common to all network operating
   systems**
   1.1 compare and contrast peer-to-peer and server-based networks
   1.2 describe the role of a network operating system in server-based networks including:
        1.2.1   connect computers and peripheral devices and service requests for resources
        1.2.2   manage access to data and shared resources
        1.2.3   monitor performance and activities of the network
   1.3 identify generic tasks and administrative functions common to all network operating systems
        including:
        1.3.1   file services
        1.3.2   print services

1.3.3   directory services
1.3.4   security services
1.3.5   messaging services
1.3.6   routing services
1.3.7   network administrative services

2. **describe and compare the capabilities and functions of network operating systems in common use; e.g., Microsoft Windows, Novell NetWare, MAC OS, UNIX/Linux**
    2.1   describe and compare the:
    2.1.1   evolution and major features
    2.1.2   associated protocols and interoperability
    2.1.3   client support
    2.1.4   authentication and security
    2.1.5   file, print and directory services
    2.1.6   routing services

3. **identify and analyze criteria relevant to planning, selecting and implementing a network operating system**
    3.1   identify criteria involved in network planning including:
    3.1.1   the need for and benefits of network planning
    3.1.2   specific criteria and steps involved in network planning
    3.1.3   interoperability with the installed base and existing network standards
    3.2   explain criteria involved in selecting a network operating system including:
    3.2.1   client needs/required services
    3.2.2   user base and budget
    3.2.3   client software and associated protocols
    3.2.4   hardware requirements
    3.2.5   client licensing
    3.3   identify hardware devices and software tools used in network planning
    3.4   identify key differences among common network operating systems
    3.5   identify network operating systems that are appropriate in specific networking environments
    3.6   analyze the needs of a small company and recommend an appropriate network operating system

4. **demonstrate ability to install and configure two or more network operating systems and compatible network clients**
    4.1   install and configure two or more different network operating systems including:
    4.1.1   partition and format drive
    4.1.2   name server and network
    4.1.3   install and configure protocol
    4.1.4   select network services
    4.1.5   establish and confirm licensing
    4.1.6   set administrative passwords
    4.1.7   install peripherals
    4.1.8   share resources and set permissions
    4.2   install and configure a network client to interact with and access the resources of each network operating system that is installed including:
    4.2.1   configure an appropriate client operating system
    4.2.2   install and configure protocol
    4.2.3   assign computer/host name and user name
    4.2.4   select network services
    4.2.5   set an acceptable/secure password

4.3 identify the function of and configure common network services including:
    4.3.1 dynamic host configuration protocol (DHCP)
    4.3.2 bootstrap protocol (BOOTP)
    4.3.3 domain name service (DNS)
    4.3.4 network address translation/Internet connection sharing (NAT/ICS)
    4.3.5 Windows Internet Name Service (WINS)
    4.3.6 Simple Network Management Protocol (SNMP)
4.4 demonstrate processes for:
    4.4.1 sharing and accessing a folder
    4.4.2 assigning permissions
    4.4.3 sharing a printer
    4.4.4 sharing devices

5. demonstrate ability to analyze and troubleshoot connectivity problems related to the installation of operating system software
5.1 outline a general strategy for troubleshooting network problems by:
    5.1.1 establishing the symptoms
    5.1.2 identifying the affected area
    5.1.3 establishing what has changed
    5.1.4 selecting the most probable cause
    5.1.5 implementing a solution
    5.1.6 testing the results
    5.1.7 recognizing the potential effects of the solution
    5.1.8 documenting the solution
5.2 analyze and troubleshoot connectivity problems resulting from the installation of a network and/or client operating system by:
    5.2.1 using appropriate diagnostic commands and utilities
    5.2.2 interpreting visual indicators
    5.2.3 predicting the impact of adding, removing and/or modifying network services
5.3 use protocol analysis software to analyze basic network utilization and frame statistics

6. demonstrate established laboratory procedures and safe work practices

7. demonstrate basic competencies
7.1 demonstrate fundamental skills to:
    7.1.1 communicate
    7.1.2 manage information
    7.1.3 use numbers
    7.1.4 think and solve problems
7.2 demonstrate personal management skills to:
    7.2.1 demonstrate positive attitudes and behaviours
    7.2.2 be responsible
    7.2.3 be adaptable
    7.2.4 learn continuously
    7.2.5 work safely
7.3 demonstrate teamwork skills to:
    7.3.1 work with others
    7.3.2 participate in projects and tasks

8. create a transitional strategy to accommodate personal changes and build personal values
8.1 identify short-term and long-term goals
8.2 identify steps to achieve goals

COURSE NET3060: WIDE AREA NETWORKS

Level: Advanced

Prerequisites: NET2030: Network Structures
                        NET2040: Network Media & Devices
                        NET2050: Open System Interconnection
                        NET2060: Network Protocols
                        NET2070: Local Area Networks

Description: Students develop basic knowledge of the technologies employed in a wide area
                        network (WAN) and of how a WAN may be used to connect local area networks
                        (LANs) at different locations. Students gain practical experience in using WAN
                        technologies to establish remote network access and they analyze emerging
                        WAN technologies with respect to the impact on global networking.

Parameters: Designed to be delivered in conjunction with other advanced level courses in
                        computer networking systems. Schools have the option of delivering courses in
                        conjunction with one or more project courses if they wish to extend learning
                        and/or address other vendor-specific technologies.

                        Access to an appropriate computer work station, the Internet, networking
                        hardware, software and tools, and consumable supplies.

                        Access to instruction from an individual with specialized knowledge and skills in
                        computer networking.

                        Particular emphasis is placed on introductory level knowledge of WAN concepts,
                        and on the application of WAN technologies. Students model and assume
                        personal responsibility for ethical behaviour in their use of networking
                        technologies and in their access to electronic sources of information. They also
                        demonstrate an understanding of industry-based policies regarding network use
                        and security.

Outcomes: The student will:

1. describe the general structure, function and communication services provided by a WAN
   1.1 describe and illustrate the basic structure and function of a WAN
   1.2 compare and contrast the structure of and communication services provided by:
        1.2.1 LANs, metropolitan area networks (MANs) and WANs
        1.2.2 public networks, private networks and virtual private networks (VPNs)
   1.3 describe and give examples of:
        1.3.1 analog and digital carrier systems and services
        1.3.2 major standards for digital carrier services including: data signaling standards, T- and E-
               carrier standards
   1.4 describe basic processes of modulation, synchronization and multiplexing in a WAN

1.5 describe and compare:
    1.5.1 dial-up and dedicated connections
    1.5.2 asynchronous and synchronous modems
    1.5.3 new technologies for WAN connections including: Bluetooth, wireless, ultra wideband
1.6 identify common types of lease lines and the advantages and disadvantages associated with dedicated lease lines

2. explain, compare and contrast how typical circuit-switching and packet-switching sessions work
2.1 explain and illustrate how a typical circuit-switching and packet-switching session works
2.2 compare design features of switched virtual circuits and permanent virtual circuits
2.3 describe the physical characteristics (i.e., speed, capacity, media, basic functions and user services) including:
    2.3.1 common circuit-switching technologies; e.g., integrated services digital network (ISDN), digital subscriber line (DSL), wireless, new network technology
    2.3.2 common packet-switching technologies such as: x.25, frame relay, asynchronous transfer mode (ATM), synchronous optical network/synchronous digital hierarchy (SONET/SDH), new packet technology
2.4 define the concept of quality of service
2.5 compare the quality of service offered by selected circuit-switching and packet-switching technologies
2.6 explain WAN design considerations related to:
    2.6.1 committed information rate
    2.6.2 error rate and packet loss

3. demonstrate applications of WAN technology in providing network users with remote access
3.1 describe and compare different approaches used to provide network users with remote access including:
    3.1.1 dial-up connections
    3.1.2 VPN connections
    3.1.3 wireless
    3.1.4 new technologies
3.2 explain the function of a remote access server and common remote access protocols and services including:
    3.2.1 Serial Line Internet Protocol (SLIP)
    3.2.2 Point-to-Point Protocol (PPP)
    3.2.3 Point-to-Point Tunnelling Protocol (PPTP)
    3.2.4 Independent Computing Architecture (ICA)
    3.2.5 Multi-protocol Label Switching (MPLS)
    3.2.6 new protocols
3.3 recommend a remote access connectivity solution and select a remote access protocol/service, given a need for remote connectivity in a small office or home office scenario

4. **identify and describe security issues in a WAN and the function of network security protocols and methods**
   4.1 identify internal and external security issues in a WAN
   4.2 identify the purpose and components of a network security policy
   4.3 describe/illustrate the purpose and function of the following common security protocols:
       4.3.1 Internet Protocol Security (IPSec)
       4.3.2 Kerberos
       4.3.3 Layer 2 Tunnelling Protocol (L2TP)
       4.3.4 Secure Sockets Layer (SSL)
       4.3.5 new protocols
   4.4 explain the purpose, characteristics and benefits of a:
       4.4.1 firewall
       4.4.2 proxy server
   4.5 predict the impact of implementing a particular security strategy on network functionality
5. **analyze emerging WAN technologies with respect to design, evolution and impact on global networking**
   5.1 identify and briefly describe five or more emerging WAN technologies
   5.2 analyze three or more emerging WAN technologies, including any of the following, with respect to elements of design, historical evolution and benefits to global networking:
       5.2.1 plain old telephone system (POTS), xDSL, Integrated Service Digital Network (ISDN) and cable, as examples of last mile solutions
       5.2.2 technologies designed to address bandwidth requirements
       5.2.3 Internet Protocol (IP) version 6
       5.2.4 tunnelling protocols
       5.2.5 VPN solutions
       5.2.6 wireless/satellite networks
       5.2.7 Internet telephony
       5.2.8 voice-over-Internet protocol
       5.2.9 ultra wideband networking
       5.2.10 emerging networking technologies
6. **demonstrate established laboratory procedures and safe work practices**
7. **demonstrate basic competencies**
   7.1 demonstrate fundamental skills to:
       7.1.1 communicate
       7.1.2 manage information
       7.1.3 use numbers
       7.1.4 think and solve problems
   7.2 demonstrate personal management skills to:
       7.2.1 demonstrate positive attitudes and behaviours
       7.2.2 be responsible
       7.2.3 be adaptable
       7.2.4 learn continuously
       7.2.5 work safely
   7.3 demonstrate teamwork skills to:
       7.3.1 work with others
       7.3.2 participate in projects and tasks
8. **create a transitional strategy to accommodate personal changes and build personal values**
   8.1 identify short-term and long-term goals
   8.2 identify steps to achieve goals

COURSE NET3070: ROUTING FUNDAMENTALS

Level: Advanced

Prerequisites: NET2030: Network Structures
NET2040: Network Media & Devices
NET2050: Open System Interconnection
NET2060: Network Protocols
NET2070: Local Area Networks

Description: Students extend their knowledge of wide area networks (WANs) by examining the process used to route information through an internetwork. They examine the major functions and components of a router, develop knowledge of common routing protocols and gain practical experience in basic router configuration.

Parameters: Designed to be delivered in conjunction with other advanced level courses in computer networking systems. Schools have the option of delivering courses in conjunction with one or more project courses if they wish to extend learning and/or address other specific technologies.

Access to an appropriate computer work station, the Internet, networking hardware, software and tools, and consumable supplies.

Access to instruction from an individual with specialized knowledge and skills in computer networking.

Particular emphasis is placed on introductory level knowledge of the processes used to route information through larger networks and on the Internet Protocol (IP) addressing scheme. Students model and assume personal responsibility for ethical behaviour in their use of networking technologies and in their access to electronic sources of information. They also demonstrate an understanding of industry-based policies regarding network use and security.

Outcomes: The student will:

1. describe the process of routing data through an internetwork, and describe the major functions of a router
  1.1 describe the characteristics of internetworks and the path determination function of a router
  1.2 compare and contrast the functions of bridges, switches, routers and gateways
  1.3 describe and illustrate basic router operations including:
    1.3.1 the routing of data packets from source to destination
    1.3.2 the sequence of encapsulation during routing
    1.3.3 functions of a routing information table
    1.3.4 the nature of commonly used routing metrics
  1.4 explain and give examples of:
    1.4.1 static and dynamic routing
    1.4.2 routable and nonroutable protocols
  1.5 construct a model of a router topology

2. explain and analyze the addressing and routing function of protocols operating at the network layer of the open system interconnection (OSI) reference model
    2.1   describe and illustrate the function of IP addresses in a routed network including:
        2.1.1 host addresses and broadcast addresses
        2.1.2 subnetting and default gateways
    2.2   explain and interpret standard conventions for IP addressing:
        2.2.1 IP version 4 (Class A, B and C) addresses and their default subnet masks
        2.2.2 classless inter-domain routing (CIDR) and the format for IP versions and addressing
    2.3   identify and describe ways in which new IP versions may affect routing
    2.4   explain and interpret the process of address resolution including:
        2.4.1 analyze the function of the address resolution protocol (ARP) and interpret an ARP cache
        2.4.2 describe the function and purpose of the reverse address resolution protocol (RARP)
    2.5   compare major features of local area network (LAN)-to-LAN routing and LAN-to-WAN routing
    2.6   describe and give examples of:
        2.6.1 distance-vector and link-state routing protocols
        2.6.2 interior and exterior routing protocols
    2.7   explain the basic architecture and operation of the following common routing protocols:
        2.7.1 Routing Information Protocol (RIP)
        2.7.2 Open Shortest Path First (OSPF)
        2.7.3 Border Gateway Protocol (BGP)
    2.8   explain and give examples of inter-autonomous, intra-autonomous and pass-through routing

3. demonstrate knowledge of router components, commands and configuration processes
    3.1   identify and describe external configuration sources and internal configuration components
    3.2   describe the uses of random-access memory (RAM) for working storage in a router
    3.3   identify and describe router modes
    3.4   identify and describe router help functions
    3.5   interpret and use:
        3.5.1 basic show and test commands
        3.5.2 startup sequence and setup commands
        3.5.3 configuration files and modes
    3.6   identify and describe the following routing protocols
        3.6.1 RIP
        3.6.2 OSPF
        3.6.3 Interior Gateway Routing Protocol (IGRP)/Enhanced Interior Gateway Routing Protocol (EIGRP)
        3.6.4 BGP
        3.6.5 Cisco Discovery Protocol (CDP)
        3.6.6 other protocols
    3.7   describe and configure access control lists (ACLs) including:
        3.7.1 standard and extended ACLs
    3.8   perform basic router configuration routines by:
        3.8.1 demonstrating router startup and login procedures
        3.8.2 using command history and editing features
        3.8.3 configuring and verifying IP addresses
        3.8.4 configuring RIPs
        3.8.5 configuring and modifying standard and extended ACLs
    3.9   demonstrate the ability to troubleshoot a routing loop

3.10   prepare a flowchart illustrating the router configuration process

3.11   configure a router for a standard five-router topology

4. describe and explain methods used to manage and monitor network routing

    4.1   describe Simple Network Management Protocol (SNMP) and its purpose in routing

    4.2   identify SNMP architecture and message formats

    4.3   describe management information base structure and name representation

    4.4   identify basic SNMP commands and security levels

5. demonstrate established laboratory procedures and safe work practices

6. demonstrate basic competencies

    6.1   demonstrate fundamental skills to:

        6.1.1   communicate

        6.1.2   manage information

        6.1.3   use numbers

        6.1.4   think and solve problems

    6.2   demonstrate personal management skills to:

        6.2.1   demonstrate positive attitudes and behaviours

        6.2.2   be responsible

        6.2.3   be adaptable

        6.2.4   learn continuously

        6.2.5   work safely

    6.3   demonstrate teamwork skills to:

        6.3.1   work with others

        6.3.2   participate in projects and tasks

7. create a transitional strategy to accommodate personal changes and build personal values

    7.1   identify short-term and long-term goals

    7.2   identify steps to achieve goals

COURSE NET3080: INTERNET PROCESSES

Level: Advanced

Prerequisites: NET2030: Network Structures
                           NET2040: Network Media & Devices
                           NET2050: Open System Interconnection
                           NET2060: Network Protocols
                           NET2070: Local Area Networks

Description: Students apply their knowledge of Wide Area Network (WAN) technologies to
                           an Internet environment. Course content focuses on the significance and utility
                           of Internet Protocol (IP) addressing schemes in Internet communication and on
                           the function of WAN protocols and services in providing Internet access.
                           Students develop knowledge of internetworking career paths and related
                           educational opportunities.

Parameters: Designed to be delivered in conjunction with other advanced level courses in
                           computer networking systems. Schools have the option of delivering courses in
                           conjunction with one or more project courses if they wish to extend learning
                           and/or address other specific technologies.

                           Access to an appropriate computer work station, the Internet, networking
                           hardware, software and tools, and consumable supplies.

                           Access to instruction from an individual with specialized knowledge and skills in
                           computer networking.

                           Particular emphasis is placed on reinforcing and applying previously developed
                           knowledge and skills in an Internet environment and on explaining how and why
                           particular technologies are employed. Students model and assume personal
                           responsibility for ethical behaviour in their use of networking technologies and in
                           their access to electronic sources of information. They also demonstrate an
                           understanding of industry-based policies regarding network use and security.

Outcomes: The student will:

1. **describe and analyze the historical roots, basic architecture and functions of the Internet in
   global communication**
   1.1 describe the origin and evolution of the Internet
   1.2 describe and illustrate the basic architecture of the Internet
   1.3 explain the nature and function of services provided by the Internet
   1.4 analyze the impact of the Internet on economic, social and political systems
   1.5 identify and explain contributions of emerging wired or wireless technologies in global Internet
        communication
2. **develop a rationale for, and demonstrate the use of, IP addressing schemes, subnets and subnet
   masks in Internet communication**
   2.1 explain the function of IP addressing, subnets and subnet masks in Internet communication
   2.2 describe methods for assigning an IP address

2.3 identify classes of IP addresses and the purpose of reserved address space
2.4 subnet a Class A, B or C address into a given number of subnetworks
2.5 determine the subnet mask for a subnetted network
2.6 optimize a host/subnet scheme
2.7 compare connectionless and connection-oriented networking processes
2.8 identify problems and solutions associated with traditional IP addressing
2.9 identify advantages of new IP

3. explain and compare the function of selected WAN protocols and services and their utility in providing access to the Internet
3.1 explain the significance of the Transmission Control Protocol/Internet Protocol (TCP/IP) suite within an Internet environment
3.2 describe common WAN protocols and services, including Dynamic Host Configuration Protocol (DHCP), Address Resolution Protocol (ARP), Domain Name Service (DNS), integrated Services Digital Network (ISDN), and Point-to-Point Protocol (PPP), with respect to:
   3.2.1 function
   3.2.2 architecture
   3.2.3 configuration
   3.2.4 benefits
   3.2.5 possible design issues

4. identify and assess methods for connecting a local network infrastructure with the Internet
4.1 identify criteria involved in network planning
4.2 identify and assess options for connecting a network to the Internet
4.3 describe current and investigate new methods for securing IP traffic between a local network and a service provider
4.4 explain applications of network address translation (NAT) in sharing an Internet connection
4.5 plan a strategy for Internet connectivity, given needs within a local network for access to the Internet

5. demonstrate established laboratory procedures and safe work practices

6. demonstrate basic competencies
6.1 demonstrate fundamental skills to:
   6.1.1 communicate
   6.1.2 manage information
   6.1.3 use numbers
   6.1.4 think and solve problems
6.2 demonstrate personal management skills to:
   6.2.1 demonstrate positive attitudes and behaviours
   6.2.2 be responsible
   6.2.3 be adaptable
   6.2.4 learn continuously
   6.2.5 work safely
6.3 demonstrate teamwork skills to:
   6.3.1 work with others
   6.3.2 participate in projects and tasks

7. create a transitional strategy to accommodate personal changes and build personal values
7.1 identify short-term and long-term goals
7.2 identify steps to achieve goals

COURSE NET3090: NETWORK MANAGEMENT

Level: Advanced

Prerequisites: NET2030: Network Structures
                            NET2040: Network Media & Devices
                            NET2050: Open System Interconnection
                            NET2060: Network Protocols
                            NET2070: Local Area Networks

Description: Students acquire knowledge of internal and external risks to a network and
                         develop strategies for protecting network data and securing a network. They also
                         develop and apply a general strategy for troubleshooting network problems and
                         acquire knowledge of the basic roles and responsibilities associated with network
                         maintenance and support.

Parameters: Designed to be delivered in conjunction with other advanced level courses in
                         computer networking systems. Schools have the option of delivering courses in
                         conjunction with one or more project courses if they wish to extend learning
                         and/or address other specific technologies.

                         Access to an appropriate computer work station, the Internet, networking
                         hardware, software and tools, and consumable supplies.

                         Access to instruction from an individual with specialized knowledge and skills in
                         computer networking.

                         Particular emphasis is placed on risks and problems most common to a small
                         network and on the ability to apply troubleshooting strategies, tools and
                         commands in specific situations. Students model and assume personal
                         responsibility for ethical behaviour in their use of networking technologies and in
                         their access to electronic sources of information. They also demonstrate an
                         understanding of industry-based policies regarding network use and security.

Outcomes: The student will:

1. **provide a rationale for protecting network data and describe major components of a data
   backup strategy**
   1.1 give reasons for protecting data in a local area network (LAN)
   1.2 describe the nature, scope and source of potential risks to data in a LAN
   1.3 identify and describe major components of a data backup strategy including:
        1.3.1 redundancy
        1.3.2 fault-tolerance
        1.3.3 data backup
        1.3.4 uninterruptible power supply
   1.4 design an appropriate data backup strategy, given a small office or home office network scenario

2. analyze security risks in a LAN and describe steps that can be taken to secure a network
    2.1 give reasons for network security
    2.2 describe the nature, scope and source of internal and external security risks in a LAN environment
    2.3 identify the characteristics of threats imposed by:
        2.3.1 viruses, worms, Trojan horses and other new attack technologies
        2.3.2 direct attacks such as:
            2.3.2.1 eavesdropping
            2.3.2.2 password attacks
        2.3.3 Internet Protocol (IP) address spoofing
    2.4 identify and describe strategies for protecting a LAN from internal and external risks including:
        2.4.1 user authentication, access permissions and account options
        2.4.2 share permissions and user group access rights
        2.4.3 virus protection
        2.4.4 firewalls
        2.4.5 data encryption
    2.5 design an appropriate security plan, given a small office or home office network scenario

3. demonstrate an understanding of the functions and key roles of network maintenance and support in an organization
    3.1 outline considerations that are required to maintain and support an operating network including:
        3.1.1 anticipated activities
        3.1.2 data integrity
        3.1.3 hardware and software standards
        3.1.4 repair policies
        3.1.5 system monitoring
        3.1.6 training
    3.2 identify benefits associated with network maintenance and support
    3.3 identify and describe key functions and roles related to network maintenance and support activities including:
        3.3.1 network maintenance policies
        3.3.2 network documentation
        3.3.3 vendor upgrades
        3.3.4 system backup
    3.4 identify hardware devices/software tools used to gather information to assist network maintenance and support activities
    3.5 develop a plan to maintain and support an operating network

4. use appropriate strategies, tools and commands to troubleshoot common network problems
    4.1 describe the most common sources of network problems in a LAN including:
        4.1.1 user error
        4.1.2 software
        4.1.3 physical connectivity
    4.2 demonstrate the safe use of troubleshooting tools
    4.3 demonstrate the use of the following appropriate software commands to check configuration or connectivity:
        4.3.1 Internet Protocol configuration (IPCONFIG)
        4.3.2 Packet Internet Groper (PING)
        4.3.3 traceroute (TRACERT)

4.4 outline a general strategy for troubleshooting network problems that:
    4.4.1   establishes the symptoms
    4.4.2   identifies the affected area
    4.4.3   establishes what has changed
    4.4.4   selects the most probable cause
    4.4.5   implements a solution
    4.4.6   tests the results
    4.4.7   recognizes the potential effects of the solution
    4.4.8   documents the solution

4.5 use appropriate strategies, tools and commands, given a small office or home office network scenario, to troubleshoot common network problems related to:
    4.5.1   a particular physical topology
    4.5.2   client connectivity
    4.5.3   wiring and/or infrastructure
    4.5.4   remote connectivity

5. demonstrate established laboratory procedures and safe work practices

6. demonstrate basic competencies

6.1 demonstrate fundamental skills to:
    6.1.1   communicate
    6.1.2   manage information
    6.1.3   use numbers
    6.1.4   think and solve problems

6.2 demonstrate personal management skills to:
    6.2.1   demonstrate positive attitudes and behaviours
    6.2.2   be responsible
    6.2.3   be adaptable
    6.2.4   learn continuously
    6.2.5   work safely

6.3 demonstrate teamwork skills to:
    6.3.1   work with others
    6.3.2   participate in projects and tasks

7. create a transitional strategy to accommodate personal changes and build personal values

7.1 identify short-term and long-term goals
7.2 identify steps to achieve goals

COURSE NET3100: NETWORK MEDIA & DEVICES, SECURITY

Level: Advanced

Prerequisite: None

Description: Students develop an understanding of different connectivity strategies for
                      linking computers and security devices in a local area network (LAN). They
                      acquire knowledge of industry standards for network cables and gain practical
                      experience through installing cabling, connectors and other hardware
                      components.

Parameters: Designed to be delivered in conjunction with other intermediate and advanced
                      level courses in computer networking systems. Schools have the option of
                      delivering courses in conjunction with one or more project courses if they wish
                      to extend learning and/or address other specific technologies.

                      Access to an appropriate computer work station, the Internet, networking
                      hardware, software and tools, and consumable supplies.

                      Access to instruction from an individual with specialized knowledge and skills
                      in computer networking.

                      Particular emphasis is placed on Institute of Electrical and Electronics
                      Engineers (IEEE) standards for cabling, and on safe procedures for preparing
                      and connecting network media and devices. Students model and assume
                      personal responsibility for ethical behaviour in their use of networking
                      technologies and in their access to electronic sources of information. They also
                      demonstrate an understanding of industry-based policies regarding network use
                      and security.

Supporting Course: NET2020: Workstation Technology & Operations

Outcomes: The student will:

1. **identify and describe the characteristics, standard names and applications for common network media and connectors**
   1.1 identify and describe the structural components and uses of major types of network cables including:
       1.1.1 coaxial; e.g., thick, thin
       1.1.2 twisted pair; e.g., unshielded, shielded
       1.1.3 fibre optic
   1.2 identify and describe the characteristics and uses of common media connectors including:
       1.2.1 registered jack 11 (RJ-11)
       1.2.2 registered jack 45 (RJ-45)
       1.2.3 attachment unit interface (AUI)
       1.2.4 British naval connector (BNC)
       1.2.5 small computer system interface (SCSI)
       1.2.6 single mode fibre optic connector; e.g., SC-type, ST-type

1.3 identify IEEE standards for Ethernet cabling including:
    1.3.1 bandwidth/speed
    1.3.2 transmission mode
    1.3.3 maximum segment length
    1.3.4 cable type
1.4 identify and describe categories for unshielded twisted pair cable defined by the Electronics Industries Alliance and the Telecommunications Industry Association
1.5 describe the media and function of network backbones and segments
1.6 explain the relationship between media type, connector and topology in a network environment
1.7 choose an appropriate cable type and connector to add a client, given a practical network scenario

2. identify and explain the purpose, features and basic operation of network hardware components

2.1 explain the purpose of hardware components in:
    2.1.1 connecting network devices
    2.1.2 boosting data signals
    2.1.3 determining data flow
2.2 demonstrate an understanding of the features, functionality and performance of basic hardware components including:
    2.2.1 network interface card
    2.2.2 hub
    2.2.3 repeater
    2.2.4 switch
    2.2.5 bridge
    2.2.6 router
    2.2.7 gateway
    2.2.8 wireless access point
    2.2.9 modem

3. demonstrate knowledge of cabling tools and demonstrate the ability to install network cabling, connectors and hardware components

3.1 identify layers of the open system interconnection (OSI) reference model at which specific hardware components operate
3.2 describe the features and functionality of power fault-tolerance hardware such as:
    3.2.1 surge suppressor
    3.2.2 power line conditioner
    3.2.3 uninterruptible power supply
3.3 choose an appropriate hardware component to use or replace an existing device, given a practical network scenario
3.4 physically install a network interface card and verify that the card is operational
3.5 demonstrate the correct use of cabling tools; e.g., wire crimper, punch down tool
3.6 demonstrate the appropriate use of basic test equipment including:
    3.6.1 media testers/certifiers
    3.6.2 crossover cables
    3.6.3 tone generators and probes; e.g., fox and hound
    3.6.4 optical testers
3.7 demonstrate the proper sequence of steps to crimp and test Ethernet cable
3.8 select the appropriate cabling tool and test equipment, given a practical cabling task

4. **demonstrate established laboratory procedures and safe work practices**
    4.1 demonstrate procedures for compliant installation of:
        4.1.1 jacks and outlets
        4.1.2 cable and structured cable runs
        4.1.3 patch panels and patch cords
        4.1.4 network cards
        4.1.5 a wired or wireless connection
    4.2 demonstrate the appropriate use of test equipment in checking for:
        4.2.1 continuity
        4.2.2 proper grounding
        4.2.3 correct cable termination
    4.3 create a proposal for a new or refit cabling project
    4.4 design, build and troubleshoot a small Ethernet network
5. **identify the fundamental principles of networks**
    5.1 describe basic networking concepts including:
        5.1.1 addressing
        5.1.2 bandwidth
        5.1.3 status indicators
        5.1.4 protocols; e.g., Internet Protocol Suite (TCP/IP) including Internet Protocol (IP), classful subnet, Internetwork Packet Exchange/Sequenced Packet Exchange (IPX/SPX) including network basic input/output system
        5.1.5 full-duplex, half-duplex
        5.1.6 cabling; e.g. twisted pair, coaxial cable, fibre optic, RS-232, USB, IEEE 1394/Firewire
        5.1.7 networking models including peer-to-peer and client/server
    5.2 identify names, purposes and characteristics of the common network cables including:
        5.2.1 plenum/PVC
        5.2.2 unshielded twisted pair (UTP); e.g., CAT3, CAT5/5e, CAT6
        5.2.3 shielded twisted pair (STP)
        5.2.4 fibre; e.g., single-mode and multi-mode
    5.3 identify names, purposes and characteristics of network connectors; e.g., RJ-45, RJ-11, ST/SC/LC, MT-RJ
    5.4 identify names, purposes and characteristics (e.g., definition, speed, connections) of the following technologies for establishing connectivity:
        5.4.1 LAN/Wide Area Network (WAN)
        5.4.2 Integrated Services Digital Network (ISDN)
        5.4.3 broadband; e.g., Digital Subscriber Line (DSL), cable, satellite
        5.4.4 dial-up
        5.4.5 wireless standards, all 802.11
        5.4.6 infrared
        5.4.7 Bluetooth
        5.4.8 cellular
        5.4.9 Voice over Internet Protocol (VoIP)
6. **identify the fundamental principles of security**
    6.1 identify names, purposes and characteristics of hardware and software security including:
        6.1.1 hardware deconstruction/recycling
        6.1.2 smart cards/biometrics; e.g., key fobs, cards, chips, scans
        6.1.3 authentication technologies; e.g., password, biometrics, smart cards
        6.1.4 malicious software protection; e.g., viruses, Trojans, worms, spam, spyware, adware, grayware

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6.1.5 software firewalls
6.1.6 file system security; e.g., file allocation table (FAT)32 and Windows NT File System (NTFS)
6.2 identify names, purposes and characteristics of wireless security including:
6.2.1 wireless encryption; e.g., Wired Equivalent Privacy (WEP), Wi-Fi Protected Access (WPA), client configuration
6.2.2 access points; e.g. disable Dynamic Host Configuration Protocol (DHCP)/use static IP, change service set identifiers (SSID) from default, disable SSID broadcast, Media Access Control (MAC) filtering, change default user name and password, update firmware, firewall
6.3 identify names, purposes and characteristics of data and physical security
6.3.1 data access; e.g., basic local security policy
6.3.2 encryption technologies
6.3.3 backups
6.3.4 data migration
6.3.5 data/remnant removal
6.3.6 password management
6.3.7 locking work station; e.g., hardware, operating system
6.4 describe the importance and process of incidence reporting
6.5 recognize and respond appropriately to social engineering situations
6.6 install, configure, upgrade and optimize hardware, software and data security including:
6.6.1 Basic Input/Output System (BIOS)
6.6.2 smart cards
6.6.3 authentication technologies
6.6.4 malicious software protection
6.6.5 data access; e.g., basic local security policy
6.6.6 backup procedures and access to backups
6.6.7 data migration
6.6.8 data/remnant removal
6.7 implement software security preventive maintenance techniques such as installing service packs and patches and training users about malicious software prevention technologies
6.8 diagnose and troubleshoot hardware, software and data security issues including:
6.8.1 BIOS
6.8.2 smart cards, biometrics
6.8.3 authentication technologies
6.8.4 malicious software
6.8.5 file system; e.g., FAT32, NTFS
6.8.6 data access; e.g., basic local security policy
6.8.7 backup
6.8.8 data migration

7. demonstrate basic competencies
7.1 demonstrate fundamental skills to:
7.1.1 communicate
7.1.2 manage information
7.1.3 use numbers
7.1.4 think and solve problems

7.2 demonstrate personal management skills to:
    7.2.1 demonstrate positive attitudes and behaviours
    7.2.2 be responsible
    7.2.3 be adaptable
    7.2.4 learn continuously
    7.2.5 work safely
7.3 demonstrate teamwork skills to:
    7.3.1 work with others
    7.3.2 participate in projects and tasks

8. create a transitional strategy to accommodate personal changes and build personal values
8.1 identify short-term and long-term goals
8.2 identify steps to achieve goals

COURSE NET3110: TELECOMMUNICATIONS 2

Level: Advanced

Prerequisite: NET2110: Telecommunications 1

Description: Students demonstrate knowledge of telecommunication systems by designing a new system. They use the Internet in researching and developing their design and for comparing and contrasting various telecommunication initiatives. Students analyze the effect this is having on the individual and society.

Parameters: Access to an appropriate computer work station, utility software, the Internet and support materials.

Outcomes: The student will:

1. **use appropriate telecommunication systems, protocols and techniques to transfer messages and manage research**
   1.1 create a telecommunication solution that improves communication options for individuals, business and society
   1.2 compare and contrast various types of transmission systems including:
      1.2.1 type of information that can be transmitted
      1.2.2 present installation base
      1.2.3 ability to connect with other systems
      1.2.4 future and potential in the telecommunication industry
      1.2.5 cost-benefit
   1.3 describe how common standards allow telecommunication systems to merge and connect
   1.4 identify the types of transmission protocols and common languages used in telecommunication systems and describe how and when they are used
2. **describe how telecommunication systems are evolving, merging and connecting**
   2.1 compare and contrast key elements of an effective computer infrastructure in two or more applications including:
      2.1.1 transmission systems
      2.1.2 information and interactive applications/services
      2.1.3 software applications
      2.1.4 standards and protocols
      2.1.5 people and expertise
   2.2 identify and analyze key challenges facing computer-mediated communications; e.g., regulation versus open systems, equity of access
   2.3 describe cost implications to establish and maintain a telecommunication system
3. **design a telecommunication solution that improves communication for an individual, a business or society**
   3.1 identify key social challenges in managing telecommunication technologies in our society including:
      3.1.1 regulation versus open systems
      3.1.2 personal privacy
      3.1.3 ease and equity of access; e.g., usability, costs
      3.1.4 legal/ethical considerations

   3.1.5 courtesies/protocols

   3.1.6 viruses

  3.2 describe economic challenges and benefits of a growing telecommunication industry

4. demonstrate established laboratory procedures and safe work practices

5. demonstrate basic competencies

  5.1 demonstrate fundamental skills to:

   5.1.1 communicate

   5.1.2 manage information

   5.1.3 use numbers

   5.1.4 think and solve problems

  5.2 demonstrate personal management skills to:

   5.2.1 demonstrate positive attitudes and behaviours

   5.2.2 be responsible

   5.2.3 be adaptable

   5.2.4 learn continuously

   5.2.5 work safely

  5.3 demonstrate teamwork skills to:

   5.3.1 work with others

   5.3.2 participate in projects and tasks

6. create a transitional strategy to accommodate personal changes and build personal values

  6.1 identify short-term and long-term goals

  6.2 identify steps to achieve goals

2 / CTS, BIT: NET3110   Advanced

2009

COURSE NET3910: NET PROJECT D

Level: Advanced

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Advanced project courses must connect with a minimum of two CTS courses, one of which must be at the advanced level and be in the same occupational area as the project course. The other CTS course(s) must be at least at the intermediate level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. identify the connection between this project course and two or more CTS courses
    1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
    1.2 explain how these outcomes are being connected to the project and/or performance deliverables

2. propose the project and/or performance
    2.1 identify the project and/or performance by:
        2.1.1 preparing a plan
        2.1.2 clarifying the purposes
        2.1.3 defining the deliverables
        2.1.4 specifying time lines
        2.1.5 explaining terminology, tools and processes
        2.1.6 defining resources; e.g., materials, costs, staffing
    2.2 identify and comply with all related health and safety standards
    2.3 define assessment standards (indicators for success)
    2.4 present the proposal and obtain necessary approvals

The student will:

3. meet goals as defined within the plan
    3.1 complete the project and/or performance as outlined
    3.2 monitor the project and/or performance and make necessary adjustments
    3.3 present the project and/or performance, indicating the:
        3.3.1 outcomes attained
        3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies
4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values
5.1 identify short-term and long-term goals
5.2 identify steps to achieve goals

COURSE NET3920: NET PROJECT E

Level: Advanced

Prerequisite: None

Description: Students develop project design and management skills to extend and enhance competencies and skills in other CTS courses through contexts that are personally relevant.

Parameters: Advanced project courses must connect with a minimum of two CTS courses, one of which must be at the advanced level and be in the same occupational area as the project course. The other CTS course(s) must be at least at the intermediate level from any occupational area.

Project courses cannot be connected to other project courses or practicum courses.

All projects and/or performances, whether teacher- or student-led, must include a course outline or student proposal.

Outcomes:

The teacher/student will:

1. identify the connection between this project course and two or more CTS courses
   1.1 identify the outcome(s) from each identified CTS course that support the project and/or performance deliverables
   1.2 explain how these outcomes are being connected to the project and/or performance deliverables
2. propose the project and/or performance
   2.1 identify the project and/or performance by:
       2.1.1 preparing a plan
       2.1.2 clarifying the purposes
       2.1.3 defining the deliverables
       2.1.4 specifying time lines
       2.1.5 explaining terminology, tools and processes
       2.1.6 defining resources; e.g., materials, costs, staffing
   2.2 identify and comply with all related health and safety standards
   2.3 define assessment standards (indicators for success)
   2.4 present the proposal and obtain necessary approvals

The student will:

3. meet goals as defined within the plan
   3.1 complete the project and/or performance as outlined
   3.2 monitor the project and/or performance and make necessary adjustments
   3.3 present the project and/or performance, indicating the:
       3.3.1 outcomes attained
       3.3.2 relationship of outcomes to goals originally set

3.4 evaluate the project and/or performance, indicating the:
    3.4.1 processes and strategies used
    3.4.2 recommendations on how the project and/or performance could have been improved

4. demonstrate basic competencies
  4.1 demonstrate fundamental skills to:
    4.1.1 communicate
    4.1.2 manage information
    4.1.3 use numbers
    4.1.4 think and solve problems
  4.2 demonstrate personal management skills to:
    4.2.1 demonstrate positive attitudes and behaviours
    4.2.2 be responsible
    4.2.3 be adaptable
    4.2.4 learn continuously
    4.2.5 work safely
  4.3 demonstrate teamwork skills to:
    4.3.1 work with others
    4.3.2 participate in projects and tasks

5. create a transitional strategy to accommodate personal changes and build personal values
  5.1 identify short-term and long-term goals
  5.2 identify steps to achieve goals

COURSE NET3950: NET ADVANCED PRACTICUM

Level:　　　　　　　Advanced

Prerequisite:　　　None

Description:　　　　Students apply prior learning and demonstrate the attitudes, skills and knowledge required by an external organization to achieve a credential/credentials or an articulation.

Parameters:　　　　This practicum course, which may be delivered on- or off-campus, should be accessed only by students continuing to work toward attaining a recognized credential/credentials or an articulation offered by an external organization. This course must be connected to at least one CTS course from the same occupational area and cannot be used in conjunction with any introductory (1XXX) level course. A practicum course cannot be delivered as a stand-alone course, cannot be combined with a CTS project course and cannot be used in conjunction with the Registered Apprenticeship Program or the Green Certificate Program.

Outcomes:　　　　　The student will:

1. **perform assigned tasks and responsibilities, as required by the organization granting the credential(s) or articulation**
    1.1　identify regulations and regulatory bodies related to the credential(s) or articulation
    1.2　describe personal roles and responsibilities, including:
        1.2.1　key responsibilities
        1.2.2　support functions/responsibilities/expectations
        1.2.3　code of ethics and/or conduct
    1.3　describe personal work responsibilities and categorize them as:
        1.3.1　routine tasks; e.g., daily, weekly, monthly, yearly
        1.3.2　non-routine tasks; e.g., emergencies
        1.3.3　tasks requiring personal judgement
        1.3.4　tasks requiring approval of a supervisor
    1.4　demonstrate basic employability skills and perform assigned tasks and responsibilities related to the credential(s) or articulation
2. **analyze personal performance in relation to established standards**
    2.1　evaluate application of the attitudes, skills and knowledge developed in related CTS courses
    2.2　evaluate standards of performance in terms of:
        2.2.1　quality of work
        2.2.2　quantity of work
    2.3　evaluate adherence to workplace legislation related to health and safety
    2.4　evaluate the performance requirements of an individual who is trained, experienced and employed in a related occupation in terms of:
        2.4.1　training and certification
        2.4.2　interpersonal skills
        2.4.3　technical skills
        2.4.4　ethics

3. demonstrate basic competencies
    3.1 demonstrate fundamental skills to:
        3.1.1 communicate
        3.1.2 manage information
        3.1.3 use numbers
        3.1.4 think and solve problems
    3.2 demonstrate personal management skills to:
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        3.2.5 work safely
    3.3 demonstrate teamwork skills to:
        3.3.1 work with others
        3.3.2 participate in projects and tasks

4. create a transitional strategy to accommodate personal changes and build personal values
    4.1 identify short-term and long-term goals
    4.2 identify steps to achieve goals