Quinsigamond Community College

Internal Program Review

2002 - 2003

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Section I: Competitive Analysis and Regional Labor Market Demand

1. Market Influences

A. Provide a broad definition of this employment sector. List specific knowledge and skill requirements for employment in this field.

Response:
What is an Electronic Technician?
The US Bureau of Labor Statistics http://www.bls.gov/home.htm lists a number of occupations that fall under the general description of "Electronics Technician". These occupations involve a wide range of professional activities, including product design, development and testing, manufacturing, equipment installation and repair, manufacturing, and a variety of technical support positions. The specific occupations identified are listed here, followed by a brief description of the kinds of duties they perform:

Engineering Technicians (45% of these are Electrical and Electronic Engineering Technicians.)

- Engineering technicians use the principles and theories of science, engineering, and mathematics to solve technical problems in research and development, manufacturing, sales, construction, inspection, and maintenance. Their work is more limited in scope and more practically oriented than that of scientists and engineers. Many engineering technicians assist engineers and scientists, especially in research and development. Others work in quality control—inspecting products and processes, conducting tests, or collecting data. In manufacturing, they may assist in product design, development, or production.

Electrical and Electronics Installers and Repairers

- Businesses and other organizations depend on complex electronic equipment for a variety of functions. Industrial controls automatically monitor and direct production processes on the factory floor. Transmitters and antennae provide communications links for many organizations. Electric power companies use electronic equipment to operate and control generating plants, substations, and monitoring equipment. The Federal Government uses radar and missile control systems to provide for the national defense and to direct commercial air traffic. These complex pieces of electronic equipment are installed, maintained, and repaired by electrical and electronics installers and repairers.

Semiconductor Processors (Semiconductor processors is the only production occupation whose employment is expected to grow faster than the average for all occupations.)

- Electronic semiconductors—also known as computer chips, microchips, or integrated chips—are the miniature but powerful brains of high technology equipment. They are comprised of a myriad of tiny aluminum wires and electric switches, which manipulate the flow of electrical current. Semiconductor processors are responsible for many of the steps necessary to manufacture each semiconductor that goes into a personal computer, missile guidance system, and a host of other electronic equipment.

Computer, Automated Teller, and Office Machine Repairers

- Computer repairers, also known as data processing equipment repairers, service mainframe, server, and personal computers; printers; and disc drives. These repairers primarily perform hands-on repair, maintenance, and installation of computers and related equipment.

Radio and Telecommunications Equipment Installers and Repairers

- Telephones and radios depend on a variety of equipment to transmit communications signals. Electronic switches route telephone signals to their destinations. Switchboards direct telephone calls within a single location or organization. Radio transmitters and receivers relay signals from wireless phones and radios to their destinations. Newer telecommunications equipment is computerized and can communicate a variety of information, including data, graphics, and video.

The workers who set up and maintain this sophisticated equipment are radio and telecommunications equipment installers and repairers.

Electronic Home Entertainment Equipment Installers and Repairers

- Electronic home entertainment equipment installers and repairers, also called service technicians, repair a variety of equipment, including televisions and radios, stereo components, video and audio disc players, video cameras, and videocassette recorders. They also repair home security systems, intercom equipment, and home theater equipment, which consist of large-screen televisions and sophisticated, surround-sound systems.

Broadcast and Sound Engineering Technicians and Radio Operators

- Broadcast and sound engineering technicians install, test, repair, set up, and operate the electronic equipment used to record and transmit radio and television programs, cable programs, and motion pictures. They work with television cameras, microphones, tape recorders, lighting, sound effects, transmitters, antennas, and other equipment. Some broadcast and sound engineering technicians produce movie soundtracks in motion picture production studios, control the sound of live events, such as concerts, or record music in a recording studio.

Taken from the US Bureau of Labor Statistics web site
http://www.bls.gov/home.htm

What skills do electronic technicians need?

General Workplace Skills for the 21st Century

- Technology has radically changed the workplace during the last quarter of the 20th century, affecting all types of industries. This change has been felt mainly in the critical need for workers who are able to function in the workplace of the information age.

> "The demand for skilled workers is not some "future shock." American businesses know that the need for skilled workers increases every day. Fifty-six percent of establishments report that restructuring and the introduction of new technology have increased the skill requirements for non-managerial employees. Indeed, American employers increasingly seek employees with a portfolio of basic technical, organizational, and company-specific skills."
>
> Taken from the "21th Century Skills for 21th Century Jobs"
> A Report of the U.S. Department of Education, U.S. Department of Labor, National Institute of Literacy, and the Small Business Administration, January 1999

The following is a list of competencies that are necessary for workers to be effective in the modern workplace, regardless of their particular industry. These lay the foundation for the criteria used to define the term "skilled worker" in the 21st century:

Basic Skills:

The academic basics of reading, writing, and computation are needed in jobs of all kinds. Reading skills are essential as most employees increasingly work with information on computer terminals, forms, charts, instructions, manuals, and other information displays. Writing is an essential part of communication to guide others and to establish a permanent base of information. Computational skills are needed to organize data for analysis and problem solving.

Technical Skills:

Forty-two percent of production and non-supervisory employees in manufacturing and service establishments now use computers. Workers use an increasing variety of advanced information, telecommunications, and manufacturing technologies as employers turn to technology to boost productivity and efficiency, and to deliver services to customers in new ways. In addition, because information

technology changes rapidly, workers are required to upgrade their skills frequently to maintain competency in new generations of technology.

Organizational Skills:
More than half of non-managerial employees participate in regularly scheduled meetings to discuss work-related problems. This indicates the need for skills such as communication, analysis, problem-solving, and creative thinking. In addition, there is an increased emphasis on interpersonal skills such as negotiation, influencing, and self-management.

Company-Specific Skills:
New technologies, market changes, and competitors drive companies to innovate, to upgrade products and services, and to focus on continuous improvement of work processes. As a result, employees are under constant pressure to acquire new knowledge and skills specifically relevant to the company's products, services, production processes, and service delivery modes.

Taken from the "21th Century Skills for 21th Century Jobs"
A Report of the U.S. Department of Education, U.S. Department of Labor, National Institute of Literacy, and the Small Business Administration, January 1999

Industry-Specific Skill Standards

In addition to the general skill standards outlined above, specific standards have been developed for different occupational areas. In 1992, the Electronic Industries Foundation (EIF) and its parent organization, the Electronics Industries Association (EIA), initiated a cooperative effort between industry and government to define skill standards for entry-level electronics technicians.

> An individual who can meet these standards will be able to enter the workforce and, with a minimum of additional specialized training, move into one of eleven specialty occupations: general electronics, avionics, business machine service, consumer product service, biomedicine, microcomputer systems, microcomputer systems field service, industrial electronics, instrumentation, telecommunications, and automobile service.

Taken from "Raising the Standard: Electronics Technician Skills for Today and Tomorrow", A Project of The Electronic Industries Association and The Electronic Industries Foundation, June 1994

The EIA/EIF report provides a list of duties and tasks that entry-level electronics technicians are required to perform, and then lists the specific skills that are required in order to perform those tasks.

Duties and Tasks

- Duty Area: **Installation**
  - Install equipment per customer requirements
  - Initialize equipment per specification
  - Calibrate equipment per specification
  - Provide operational instructions and training

- Duty Area: **Maintenance**
  - Clean electrical connections
  - Calibrate as required
  - Tune process instrumentation and control systems
  - Clean or replace filters
  - Test for correct operation

- Duty Area: **Evaluation and Troubleshooting**
  - Evaluate electronic equipment per specification
  - Determine that functional requirements are met
  - Troubleshoot electronic equipment
    - To assembly level
    - To board level
    - To component level

- Duty Area: **Repair**
  - Evaluate electronic equipment per specification
  - Determine that functional requirements are met
  - Repair and test electronic equipment to specification
    - At assembly level
    - At board level
    - At component level
    - Upgrade electronic equipment per specifications

- Duty Area: **Manufacturing/Engineering Support**
  - Understand project requirements
  - Develop prototype or procedure
  - Test/evaluate and modify prototype or procedure
  - Test/evaluate manufactured components or products

- Duty Area: **Administration**
  - Record work performed
  - Use reference manuals to perform specific functions
  - Prepare service bills
  - Prepare machine maintenance reports
  - Communicate with customer
  - Instruct customer as to proper application of equipment
  - Instruct customer as to proper operation of equipment
  - Ensure customer satisfaction

Skill Standards (The following is a summary of each skill area. Full details are found in the document referenced at the end of this section.)

Behavior and Work Habits

- Work ethics and behavior: Assume responsibility for own actions, practice punctuality and time management, comply with company standards, display initiative
- Interpersonal relationships: Receive and give constructive criticism, exhibit positive behavior, treat people with respect
- Teamwork: Understand interactive relationships required for effective teamwork, adapt as necessary to complete team task

Technical Skills

- General: Demonstrate proper safety techniques, troubleshooting techniques, basic assembly skills, and use of technical reference material including schematics, technical drawings, tables and graphs.
- DC and AC Circuits: Analyze and troubleshoot DC and AC circuits containing resistors, inductors, capacitors, and transformers.
- Discrete Solid State Devices: Analyze and troubleshoot circuits containing diodes, transistors, optoelectronic devices, and thyristors.

- Analog Circuits: Analyze and troubleshoot circuits containing power supplies, operational amplifiers, filters, oscillators, power amplifiers, and fiber optics. Analyze and troubleshoot AM, FM, and microwave circuits.
- Digital Circuits: Analyze and troubleshoot circuits containing logic gates, flip-flops, registers, counters, clock circuits, multiplexers, demultiplexers, D/A and A/D converters, and display devices. Troubleshoot and solve power distribution problems.
- Microprocessors: Analyze and troubleshoot microprocessor interfaces. Analyze and create simple assembly language programs.
- Microcomputers: Install and configure computer operating systems. Troubleshoot computer operating systems and peripheral devices.

Test Equipment and Tools

- Demonstrate where, why, and how the following types of electronic test equipment and tools are used: breakout box, calibration standards, DC power source, dummy load, ESD meter, frequency counter, function generator, ground fault tester, hand tools, high voltage tester, isolation transformer, LASER power meter, light intensity meter, logic analyzer, logic probe, logic pulser, multimeters, oscilloscope, power tools, pressure gauges, RF power meter, RF signal generator, soldering and desoldering equipment, spectrum analyzer.

Basic Skills

- Technical Literacy: Use applications software such as word processors, database management, and spreadsheets. Maintain up-to-date skills through continuing education. Apply continuous improvement principles. Demonstrate knowledge of business products and services.
- Communicating on the Job: Communicate effectively with co-workers and customers using written, graphic and oral methods. Employ appropriate skills for gathering and retaining information. Interpret written, graphic and oral instructions.
- Solving Problems and Critical Thinking: Identify the problem, clarify purposes and goals, evaluate options, set priorities, implement decisions and predict outcomes.
- Reading: Read and apply various sources of technical information.
- Proficiency in Math: Solve problems using arithmetic, algebra, geometry and trigonometry. Convert between different units of measurement. Interpret output of measurement devices. Interpret and analyze data.
- Proficiency in Physics: Apply principles of mechanics, pneumatics, hydraulics and electricity.

Taken from "Raising the Standard: Electronics Technician Skills for Today and Tomorrow", A Project of The Electronic Industries Association and The Electronic Industries Foundation, June 1994

The Accreditation Board of Engineering and Technology's Program Requirements

The Accreditation Board of Engineering and Technology (ABET) specifically outlines the requirements for an electrical/electronic(s) engineering program. The following information is available on the ABET web page at www.abet.org. An analysis of the ABET criteria will be incorporated into the requirements for the Electronics Technology program, during the IPR Research Phase.

II.J. PROGRAM CRITERIA FOR ELECTRICAL/ELECTRONIC(S) ENGINEERING TECHNOLOGY AND SIMILARLY NAMED PROGRAMS
Submitted by The Institute of Electrical and Electronics Engineers, Inc. (Reviewed 1995)

- *II.J.1. Applicability.*
  These program criteria apply to engineering technology programs including "electrical," "electronic(s)," and similar modifiers in their titles, leading to either an associate or a bachelor's degree.
- *II.J.2. Curriculum.*
  - *II.J.2.a. Technical Sciences. (Amplifies criteria section I.C.1.)*

Technical science courses must be applications-oriented with a majority having an accompanying laboratory with emphasis on measurement, data collection and analysis, documentation, and written/oral report preparation/presentation. Course work must include the fundamentals of electricity/electronics and principles of circuit analysis.

- *II.J.2.b. Technical Specialties. (Amplifies criteria section I.C.2.)*
  - *II.J.2.b.(1). Technical skills and techniques courses must include topics, as appropriate, to meet the stated goals and objectives of the program.*
  - *II.J.2.b.(2). Courses at the associate degree level must prepare the student for immediate employment but must include sufficient foundation to enable the student to continue in upper-division studies without penalty. Upper-division course work must complement and expand on lower-division work.*
  - *II.J.2.b.(3). Technical design courses must stress the use of manuals, handbooks and material/equipment specifications, and computers where applicable.*
- *II.J.2.c. Basic Sciences and Mathematics. (Amplifies criteria section I.C.4.)*
  - *II.J.2.c.(1). The basic sciences must include physics (with laboratory) presented in a rigorous algebra/trigonometry environment (as a minimum).*
  - *II.J.2.c.(2). A minimum sequence in mathematics is college-level algebra, trigonometry, and an introduction to calculus. Baccalaureate programs must include differential/integral calculus, and instruction in applied differential equations is strongly encouraged. Linear programming, numerical methods, and probability/statistics are other appropriate electives.*

Taken from "Criteria for Accrediting Engineering Technology Programs: Effective for Evaluations During the 2002-2003 Accreditation Cycle", Technology Accreditation Commission, Accreditation Board for Engineering and Technology, Inc.

B. Using relevant labor statistics, indicate whether employment opportunities in this field are expected to increase or decrease over the next 3-5 years. Please cite the sources that you have used to make these predictions. (Note: It is easier for Admissions and Marketing Departments to refer to these predictions if they can quote the source)

Response:

Expected Employment Growth in Information Technology

The following tables indicate the employment outlook for Electrical Engineering Technicians at the statewide and national levels:

National Employment Outlook for Electronic Technicians through 2008:

Occupation	***Number of jobs***		***Percent Change***	***Total job openings due to growth and net replacements, 1998 - 2008***
	1998	2008		
Electrical and Electronic Technicians and Technologists	*335,000*	*391,000*	*16.8%*	*125,000*

Taken from the Monthly Labor Review, November 1999, Vol. 122, No. 11, p. 59, "Occupational employment projections to 2008", by Douglas Braddock, Economist, Office of Employment Projections, Bureau of Labor Statistics, available on the web at http://www.bls.gov/opub/mlr/1999/11/art5abs.htm

Massachusetts Outlook for Electronic Technicians through 2006:

Occupation	***Number of jobs***		***Percent Change***	***Total job openings due to growth and net replacements, 1998 - 2008***
	1996	***2006***		

Electrical and Electronic Technicians	*9520*	*10,690*	*12.3%*	*3670*

Taken from the Massachusetts Occupational Employment, Wages and Training Database, published by the Massachusetts Division of Employment and Training, available on the web at http://www.detma.org/lmi/lmi.htm

It is important to note that the actual numbers that appear in tables like the ones shown here depend heavily on how the occupational category "electronics technician" is defined. For example, semiconductor manufacturing technicians could fall under the category of "high-tech manufacturing technician" as well as "electronics technician". For this reason, different reports may indicate different numbers.

Another report on the employment outlook for jobs requiring an Associate's degree breaks the general term "electronics technician" into three categories and includes wage data:

Massachusetts Jobs Requiring an Associate's Degree – 1996 and projected 2006

Occupation	***Current Jobs***	***Growth Rate***	***Projected New Jobs***	***Replace-ment Jobs***	***Total Job Openings***	***Annual Salaries***	***Factors Driving the Job Growth***
Engineering Technicians	*24,600*	*5%*	*1270*	*5420*	*6690*	*$40,670*	*The growing use of computer- aided design (CAD) equipment and computer simulation will hold down job growth. However, large numbers of job openings will result from the need to replace engineering technicians who retire or become engineers.*
Broadcast Technicians	*860*	*23%*	*200*	*250*	*460*	*$31,040*	*As more labor saving technologies are implemented in radio and TV broadcasting, jobs for broadcasters should remain unchanged. Competition for jobs should remain keen because of the large number of people attracted to this relatively small profession.*
Computer Equipment Repairers	*2250*	*33%*	*740*	*710*	*1450*	*$30,150*	*Rapid job growth is expected as firms upgrade their computer systems to improve service and remain competitive.*

Taken from the Commonwealth of Massachusetts Labor Market Information Report on occupations requiring an Associate's Degree, available on the web at http://www.detma.org/forms/lmiforms1.htm

C. Review and analyze the most recent five years of institutional data to determine whether graduates of this program have found employment in their field and/or transferred to related four-year programs in their field within one year of graduation.

Response:
Number of graduates from the Electronics Technology program, 1993 – 2002, as of August 21, 2002:

Year	Electronics Associate Degree Graduates
1995	16
1996	9
1997	27
1998	13
1999	13
2000	10
2001	9
2002	12**

**Data from QCC Registrars Office*
***Graduates as of August 2002.*

The above table lists the number of graduates from the program since 1995. Unfortunately, there are no consistent records of how many graduates found employment after graduation. In general, students that wished to find employment were able to do so. The number of job offers has consistently exceeded the number of graduates over the last five years.

D. Please identify the specific occupations (and job titles, if possible) for which program graduates are prepared for. Identify the types of employers that have hired graduates of this program within the last 5 years.

Response:
The US Bureau of Labor Statistics http://www.bls.gov/home.htm lists a number of occupations that fall under the general description of "Electronics Technician". These occupations involve a wide range of professional activities, including product design, development and testing, manufacturing, equipment installation and repair, manufacturing, and a variety of technical support positions. The specific occupations identified are listed here, followed by a brief description of the kinds of duties they perform:

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Taken from the US Bureau of Labor Statistics web site
http://www.bls.gov/home.htm

Hiring of QCC Graduates:
The following list is based on informal records kept by the program coordinator, and is a representative sampling of companies and positions filled by QCC graduates over the last five years:

Job Title	Company Name	Number of hires
IC Layout and Design Technician	Compaq Computer	10
Biomedical Technician	UMass Memorial	2
Equipment installation technician	Bell Atlantic	1
Quality Engineering Technician	Kidde-Fenwal, Inc.	1
Electronic Technician	ACT Manufacturing	2
Technician	Sierracom	1
Biomedical Technician	Medic RRN	1
Manufacturing Technician	Lucent Technologies	5
Technician	Polaris	4
Electronic Maintenance Technician	Lucent Technology	1
Electromechanical Technician	Intel Corporation	15
Computer Technician	Quinsigamond CC	10
Systems Technician	Quinsigamond CC	1
Technician	EMC Corporation	5

Customer Service Technician	Open Route	1
Computer Technician	Millville Elementary School	1
Biomedical Technician	St. Vincent Hospital	2

E. Identify the institutions to which students have transferred in the last three years.
Response:
The following table is a partial list of successful transfers to four-year institutions:

Four-year Institution	**Transfer Date**
University Of Massachusets At Lowell	Sep-01
Worcester State College	Sep-01
University Of Massachusets At Lowell	Sep-99
Worcester State College	Sep-99
Worcester State College	Jan-01
Worcester State College	Jan-01
Worcester Polytechnic Institute	Aug-01

F. Summary and Analysis: Market Influences
Response:
The Massachusetts Department of Employment and Training projects a 12.3% increase in job openings for Electronics Technicians through 2006. Nationally, the Bureau of Labor Statistics projects the increase in job openings for Electronics Technicians at 16.8%.

In addition, an individual with a background in Electronics is qualified for entry-level employment under a broad spectrum of technology occupations. Many of these positions would not carry the title of "Electronics Technician", but would require the same basic skills and abilities. Massachusetts, therefore, provides numerous opportunities for graduates of the Electronics technology program.

In fact, employers from all sectors – particularly but not limited to manufacturing and technical support – are desperately seeking to hire individuals who qualify as "technically literate". Many manufacturing companies such as Intel and Norton Co. (currently Saint-Gobain) have set up training programs for their employees that are based on electronics, because they recognize the pervasiveness of electronics in all of technology. The Electronics Technology program provides a strong foundation in technology that serves as a launching pad into a wide range of high-tech occupations.

Successful manufacturers and other companies have recognized that a technically literate workforce is a prerequisite for survival and prosperity in the 21st century. Local industries that have chosen to work with QCC through the CO-OP program or otherwise have realized the benefits of a win-win relationship.

2. Programmatic Currency

A. Describe how the program maintains curricular currency.

Response:
The Electronics Technology program draws upon a number of different sources for up-to-date equipment, curricula, and course delivery. Below is a list of organizations and sources that are instrumental in maintaining state-of-the-art curricula and lab equipment:

EIA
The Electronics Industry Association www.eia.org maintains a set of nationally recognized skill standards through the input of government and industry. The CEA (Certified Electronics Associate) certification is based on these skill standards, which are used by faculty as a benchmark for evaluating the currency and relevance of the Electronics Technology curricula.

ABET
The Accreditation Board for Engineering and Technology is a nationally recognized standard for engineering- and technology-based programs. The Electronics Technology program at QCC is positioned to achieve and maintain the quality, content, and balance that would qualify it for accreditation by ABET.

The Verizon Next Step Curriculum Committee for Telecommunications Technology
Verizon Communications sponsors the Next Step Program www.aboutnextstep.com, which allows their employees to complete an Associate of Applied Science in Telecommunications Technology at community colleges throughout New York state and New England. QCC has hosted such a program since 1998, involving the entire Electronics faculty in course development and delivery. The Next Step curriculum committee is composed of faculty from the various community colleges and representatives from the Telecommunications industry. The committee meets twice per year and maintains a running correspondence among its members for the purpose of maintaining an up-to-date and relevant curriculum. In addition to curricula, Verizon has provided $8000 annually for the purchase of equipment and supplies related to the program.

Experienced Based Education
The EBE office at QCC www.qcc.mass.edu/academicservices/ebe.htm serves as a clearinghouse for job opportunities in the field of Electronics. Although a CO-OP is not required for graduation from the Electronics Technology Option, all other related Electronics programs and options require students to complete one. For this reason, the EBE office is constantly connecting students with positions at local industries. Often these CO-OP positions lead to permanent full-time positions for students after graduation. As part of the CO-OP process, a faculty advisor is required to visit the work site at least once during the CO-OP and maintain communication with the student's supervisor(s). This creates continuous and varied points of contact between Electronics faculty and local industries, providing opportunities to evaluate the Electronics curriculum and laboratory equipment in light of the latest industry practices.

MATEC
The Maricopa Advanced Technology Education Center (MATEC) www.matec.org, located in Tempe, Arizona, is one of ten National Science Foundation Advanced Technology Education centers in various locations across the US. MATEC's charter is to provide curriculum and faculty development for college and high schools in the area of semiconductor manufacturing. QCC is recognized by MATEC as one of its Educational Partners, and as a result, is given access to curriculum materials and faculty training opportunities at a reduced price.

Intel Corporation
Intel Corp., the current global leader in semiconductor manufacturing, has a facility located in Hudson, MA, approximately 20 minutes from QCC. Intel has generously supported QCC's technology programs by donating equipment and computers, sponsoring faculty internships and benchmarking trips to other community colleges, and providing summer CO-OP opportunities for students.

Internet
The Internet is a valuable tool to learn about technology as well as programs offered at other colleges. The Web allows access to data about the latest advancements in the various fields of electronics and the most current approaches in training, which is the backbone for the future of modern industry.

B. Explain the existing mechanisms that allow for regular input from local employers or other relevant sources

Response:
The Verizon Next Step Curriculum Committee for Telecommunications Technology
Meetings provide a forum where faculty at community colleges and industry representatives around New England and New York State gather twice per year to critique and revise the Next Step program curriculum. Since the core of the Next Step program is electronics, curriculum committee discussions focus heavily on issues related to the electronics curriculum. The goal of these meetings is to constantly evaluate the curriculum according to how well it serves the telecommunications industry.

Experienced Based Education
The faculty CO-OP advising process establishes an effective mechanism for getting industry feedback into the program through faculty. Each time a faculty advisor visits a CO-OP site, he or she meets with the student's CO-OP supervisor to discuss the objectives of the company, the requirements of the job, the student's performance, and how well the curriculum prepares the student. Faculty advisors also witness first-hand the technology used in the workplace, and can use this information to evaluate the currency of lab equipment. The following table is a partial list of the CO-OP positions held by QCC students since 1997:

Electronics Technology Co-op Placements

Semester	Job Title	Company Name
FA00	ICT Debug Tech	Solectron
FA01	Hass/FT Operator	Solectron
FA01	Programming	Pegasus Communication
FA97	Technician	Galileo Corporation
FA97	Computer Technician	Polaris
FA97	Lab Technicion	Quinsigamond Community College
FA97	Computer Technician's Assistant	Quinsigamond Community College
FA97	Jr. Technician	Telecast Fiber Systems
FA98	Support Technician	Quinsigamond Community College
FA98	Field Service Technician	I.T.S. - Industrial Time & Systems, Inc.
FA98	Co-op Technician	Astra
FA98	Printer Maintenance	Intel
FA98	Network Services Technician	Quinsigamond Community College
FA98	Biomedical Technician	Memorial Hospital
FA99	Head of MIS Dept.	District Attorney's Office - Court House
FA99	P.C. Technical Assistant	Quinsigamond Community College
FA99	Assistant to Software Engineer	Data General
FA99	Field Service Technician	TEI Telephone Systems
FA99	Head of MIS Dept.	District Attorney's Office - Court House
FA99	PC Tech	Solutions Plus Inc.
FA99	Field Service Technician	TEI Telephone Systems

INT98	Computer Systems Support Tech	Astra USA
SP00	Engineering Assitant	Allegro Microsystems
SP00	Technician	Solectron
SP00	TLT Tester	Lucent Technologies
SP00	Information Analyst	New England Electric
SP00	Newtwork Administrator	Law Office of Bruce E. Hopper
SP00	Electronic Technician	ACT Manufacturing, Inc.
SP00	Field Technician	TEI Telephone Systems
SP02	PC Assistant Technician	Quinsigamond Community College
SP02	ICLayout Designer	Compaq Computer Corporation
SP02	Film Control Associate II	U. Mass Memorial Healthcare
SP02	Network Service	Care Insurance
SP98	Computer Tech	Astra USA
Semester	*Job Title*	*Company Name*
SP98	CSST Intern	Quinsigamond Community College
SP98	Sr. Operations Analyst	Digital Equipment Corporation
SP98	Computer Systems Support Tech	Astra USA
SP98	Lab Technician	Quinsigamond Community College
SP98	Systems Support Tech	Quinsigamond Community College
SP98	Computer Techician's Assistant	Quinsigamond Community College
SP98	Technician	MTS Microcomputer Technical Services
SP99	Assistant Network Technician	Quinsigamond Community College
SP99	Computer Technician	Technical Computer Solutions
SP99	Tester	Lucent Technologies
SP99	Computer Operator	Compaq Corporation
SP99	Y2K Intern	R.R. Donnelley Financial
SU100	Telecommunications Analyst	Worcester Polytechnic Institute
SU100	RTG/NCO Technician	Intel
SU101	Audio Systems Installer	Best Buy
SU198	IC layout designer	Digital Equipment Corporation
SU198	Systems Engineer, Project Leader	Digital Equipment Corporation
SU198	Manufacturing Technician	Digital Equipment Corporation
SU198	PC Technician	Competative Edge Services
SU199	PC Technician Assistant	Quinsigamond Community College
SU199	PC Technician Assistant	Quinsigamond Community College

MATEC

Since MATEC's charter is to provide curriculum and faculty development for college and high schools in the area of semiconductor manufacturing, they rely on the constant input of a cross section of semiconductor manufacturers for the maintenance of their curriculum materials. By using the MATEC curriculum materials, QCC benefits indirectly from up-to-date industry input.

Intel Corporation
Intel, Corp. has provided direct industry input through a number of avenues, listed here:

Equipment donations:
Intel donated 24 Pentium III for the Electronics laboratory, which are now integrated fully into Electronics laboratory activities. Intel has also donated various pieces of semiconductor processing equipment, intended primarily for use in the Electromechanical Technology Program, but which provide a valuable context for the principles studied throughout the electronics curriculum.

Faculty internships:
Intel has offered paid faculty internships during the summer months, where faculty can be immersed in the semiconductor manufacturing environment. This broadens the experience of faculty members and gives them valuable insights into the high-tech workplace, enhancing their effectiveness in the classroom and laboratory. Internship participants to date have been:

Jim Heffernan	Summer 1999
NT Izuchi	Summer 2001

Faculty benchmarking trips:
Intel has sponsored several benchmarking trips to several community colleges around the US that offer exemplary technology programs. Faculty members participating in these trips have gained first-hand knowledge of alternate laboratory design concepts and curriculum delivery methods. In addition, the trips provide faculty with valuable access to colleagues around the country for the sharing of ideas and information.

C. Describe how this input affects the program. (Note: It is helpful with our accreditation process if you can include some specific examples of input that have led to recent changes in the program.)

Response:
The Verizon Next Step Curriculum Committee for Telecommunications Technology
Meetings led to the following program changes**:**

- Electronics Workbench is now used in the laboratory as a complement to all of the core electronics courses. This introduces students to the use of computer simulation as an aid to analyzing circuit performance, an essential skill for the 21st century.
- The $8000 annual budget for equipment and supplies has been used to purchase up-to-date electronics bench equipment, hand tools, networking equipment and supplies, telecommunications training modules, and other essential materials.

Experienced Based Education
Meetings between faculty advisors and CO-OP supervisors have resulted in the following program changes and enhancements:

- Meeting with supervisors at Intel, Corp. since 1999 resulted in an increase in the use of computers throughout the Electronics curriculum and in the laboratory. Computers donated by Intel made this possible.
- Interactions with Allmerica Financial in 1998 prompted Electronics faculty to develop the CSET program by modifying the CSST program to focus on MCSE certification.
- Discussions with UMass, Memorial, Fallon, and St. Vincents hospital in the early 1990's led to the creation of the Biomedical Instrumentation Option for Electronics Technology.

MATEC
In the summer of 2001, MATEC selected QCC to host the Intel Institute for technology educators, a 2-day seminar designed to introduce faculty and administration to the semiconductor industry and its relevance to science and technology curricula. Faculty members in attendance were provided with curriculum materials and numerous classroom-ready ideas to incorporate into courses they are teaching.

Intel Corporation
Intel Corp., the current global leader in semiconductor manufacturing, has a facility located in Hudson, MA, approximately 20 minutes from QCC. Intel has generously supported QCC's technology programs in a number of ways, several of which directly impact the curricular currency of the Electronics program.

- **Equipment donations:**
  - Intel donated 24 Pentium III for the Electronics laboratory, which are now integrated fully into Electronics laboratory activities. Intel has also donated various pieces of semiconductor processing equipment, intended primarily for use in the Electromechanical Technology Program, but which provide a valuable context for the principles studied throughout the electronics curriculum.
- **Faculty benchmarking trips:**
  - A benchmarking trip sponsored by Intel in April 1999 initiated the complete redesign of the QCC Electronics Laboratory, now known as the Intel Technology Laboratory. The lab was expanded and completely refurbished to accommodate the new Electromechanical Technology Program. The new lab, complete with networked Pentium III computers on every bench, is equipped to deliver a broad spectrum of state-of-the-art curriculum.

D. Describe ways that the College could support program faculty's incorporating more area industry input.

Response:

- The College could build on the existing CO-OP program as a primary interface between education and industry. Since the industries that hire CO-OPs also hire QCC graduates, their input is of primary importance. The site visit process could be enhanced to include a more consistent mechanism for getting industry feedback on the curriculum. This could be done by drawing up a survey-type document to invite the CO-OP supervisor to critique the electronics curriculum. Part of the site visit could be spent going over the survey.
- The College could conduct site visits at other community colleges to learn how they maintain programmatic currency and contacts with industry.
- Many industries are facing a dire shortage of technicians and would directly benefit from more QCC Electronics graduates. The College could host a forum with a title such as "Cultivating 21st Century Technicians for 21st Century Jobs", inviting industry representatives, the general public, and QCC faculty. To start with, the CEOs of each company listed in the CO-OP placements table above could be invited.

E. Summary and Analysis: Currency

Response:
Program currency is maintained by:

- Aligning the curriculum with nationally recognized standards such as those maintained by the Electronics Industries Association (EIA) and The Accreditation Board for Engineering and Technology (ABET).
- Networking with other faculty from other community colleges in a forum such as the Next Step Curriculum Committee.
- Maintaining contact with local industry through CO-OP site visits to local industries.
- Using curriculum materials and information from organizations such as MATEC, which rely on constant input from industry.
- Cultivating and developing direct relationships with local industries such as Intel Corporation.

Electronics Technology is part of a constantly changing landscape: the 21st century technologically driven workplace. An effective technology program must strike a balance between instruction in technology – the particular implementations and inventions specific to a period in history – and science – the underlying principles that govern all physical behavior that will be operating the same way fifty or a hundred years from now. Without attention to current technology, a curriculum can lose its relevance and produce students who are unfamiliar with the tools of the modern workplace. Without attention to science, students

may be effective in the short run but unable to adapt their knowledge to the inevitable changes that will take place over time. In critiquing the Electronics Technology curriculum for currency and relevance, it is important to address both of these areas.

3. The Pipeline: QCC Feeders

A. Identify all feeders, both actual and potential, to the program. Identify any potential "customized " feeders the College might be able to develop.

Response:
Actual Feeders

- Career fairs, technology fairs, and college fairs
- Massachusetts Division of Employment and Training (DET)
- Articulation agreements with local and regional high schools
- Company site visits
- Tech Prep groups
- High school technology pipelines
- Plant tours by program students and faculty
- Professional societies
- Electronics Technology Web page
- Targeted mailings
- Advertising on radio and television

B. List all articulation agreements currently in place in this program (i.e., agreements with local secondary schools, community-based organizations, proprietary schools, etc.).

At this time, we have 6 schools that show a record of some type of Electronics articulation agreement with QCC.
These schools are:

- Assabet Valley Regional Vocational HS (5/80)
- Bay Path Vocational HS (10/83)
- Blackstone Valley Regional Vocational HS (1985)
- Clinton HS (2/98)
- Leominister HS (6/98)
- Worcester Vocational HS (6/94)

Some of these agreements are in need of review, due to the length of time since they were created and subsequent changes in the Electronics program. The Electronics Department is currently in the process of updating all Articulation agreements with local high schools.

C. Do program faculty regularly collaborate with their peers in local high schools, four-year colleges and universities, business and industry or community-based organizations on such activities as curriculum development, work-based learning, or professional development? Please cite examples from most recent three-year period. If no active collaboration at this time, please comment on how this type of collaboration might enhance the program. In what ways could the College provide faculty support in this area?

Response:
Quinsigamond Electronics faculty regularly collaborates with local high schools, four-year colleges and universities, business and industry, and community-based organizations on curriculum development, work-based learning, and professional development.
Recent and active collaborations include:

- The Verizon Telecommunication Program,
- Intel Corporation and the Electromechanical Program,
- EMC Corporation and discussions of a possible mass storage device training program,
- Compaq Computer and discussions of a possible program option in IC Layout and Design,
- Worcester public schools and the Women in Technology Program,
- Worcester public schools and the Tech Prep Program, the University of

- Massachusetts Amherst and Massachusetts State Colleges and an investigation of a possible new program in Computer Science.

D. Explain the mechanisms in place within the program to insure that students who have been granted credit through articulation agreements transition smoothly into the QCC program. In what ways could the College increase its support in this area?

Response:
Tracking Of Students:

- self selection on admissions form (must check that they are tech prep)
- high schools will send over a list at the end of the school year of all the students who participated and eligible for tech prep credit (they will receive an award certificate)
- manually code students in CARS system for identification purposes (Perkins reports, etc.)

Verifify Eligibility

- will pull students high school transcript to see that they have obtained the stated grades (overall GPA) and course grades
- must have applied to QCC within 36 months of graduation from tech prep school agreement must be valid and up to date
- accepted in degree or certificate program at QCC
- Student must be enrolled in QCC program.

The following criteria must be met to receive Quinsigamond Community College course credit for completion of the high school portion of a Tech Prep Program.

- **The student will have:**
  - Graduated from high school and received a Tech Prep certificate of completion and/or a transcript designation.
  - Completed high school tech prep courses listed under the articulation agreement in which the student earned a grade of B (3.0 or better)
  - Minimum overall high school GPA of 2.0 ("C") on a 4.0 scale
  - Accepted in a degree or certificate program at Quinsigamond Community College within thirty-six (36) months of high school graduation. Special cases may be reviewed.
  - Met all Quinsigamond Community College admissions requirements and officially enrolled.
  - **Must be enrolled in QCC program before credit is awarded.**
  - **(Optional)** Met with the Quinsigamond Community College Tech Prep coordinator for review and approval of the transcript and Tech Prep Articulation.
- Upon high school graduation, the high school tech prep coordinator or guidance counselor must verify the courses completed by the student and list them on the Tech Prep Certificate. A copy of this certificate should be sent to the QCC Tech Prep Coordinator – if the student will be attending College
- The Request For Awarding Course Equivalency form will be completed with the necessary signatures and forwarded to the QCC Tech Prep Pathways Coordinator for completion.
- Verification and authorization by QCC Tech Prep Coordinator.
- Approved requests will be sent to the Registrar's office for processing.

*** NO FEES FOR CREDIT WILL BE CHARGED TO THE STUDENT AS A RESULT OF THIS COURSE EQUIVALENCY AWARDING***
COPIES WILL BE MADE AVAILABLE TO STUDENT, HIGH SCHOOL AND COLLEGE

E. Explain the program's involvement with the Tech Prep consortia or other educational collaboratives, if relevant.

Response:
QCC's involvement in this area has increased notably through the efforts of the Experience Based Education program. In addition, Marci Skillings is active in improving relationships and agreements with all members of the Tech Prep consortia as well as with other educational coalitions.
Some activities that have resulted from this effort are:

- campus tours for prospective students,
- breakfast meetings with to foster networking with Worcester County schools
- re-establishing agreements with Worcester County high schools.

The results of all these efforts are just now beginning to be tracked based on prior restraints to existing systems.

Other agreements are being explored with the non-credit programs of QCC to allow the Continuing Education students to transfer their course work into the Electronics Technology Program.

F. Summary and Analysis: The Pipeline: QCC Feeders

Response:
The pipelines and QCC feeders have been established and are beginning to flourish. An increase in enrollment is projected for the Fall 2002 semester. As the feeders in the Worcester community respond to our inquiries, the College will be able to offer courses in the Electronics area to serve their needs.

Established feeders for the Electronics Technology program are the activities of the Electronics program Faculty.

QCC Admissions has been notified that all students who are interested in the Electronics Technology program, but who have not met the current Electronics Technology Associate's Degree program requirements, should automatically become candidates for the Electronics Technology Certificate program. Having students registered under their program of interest will be a significant improvement in our ability to track every Electronics Technology student. This information will be essential as we help students maximize their academic experiences at QCC.

4. Role of the Program Advisory Committee

A. Is there an Active (meets at least once a year) advisory committee for this program?

Response:
Each career-oriented program at Quinsigamond is required to have a Program Advisory Committee. This Committee is composed of program faculty and representatives from the business or industry served by the program. The program advisory committee usually meets twice a year and provides input into matters related to course and curriculum development to meet the changing needs of industry.

There has not been a formal meeting of the advisory committee in the past year. Instead program faculty have met individually with representatives from industry for input into matters related to course and curriculum development. Through Coop site visits, Next Step Curriculum meetings with Verizon, curriculum discussions with Intel Corporation, and phone conversations with advisory board members the program has kept current with industry requirements.

The Advisory Committee should become active again with an annual or biannual breakfast or luncheon to thank active members and recruit new members to the committee.

5. Competition, Market, Strategies, and Enrollment Projections

A. Identify the program's primary competitors. Describe the process utilized and/or the rationale to determine the list of competitors.

Response:
The main competitors for participants in this program are:

- **Mass Bay Community College** Associate in Science Degree Program and Certificate Program in Electronics Technology (Framingham)
- **Springfield Technical Community College** Associate in Science Degree Program and Certificate Program in Electronics Technology (Springfield)
- **Middlesex Community College** Computer Electronics Technology (Lowell)
- **Mount Wachusett Community College** Associate Degree in Electronic Communications Technology (Gardner)

These first four listed are community colleges with similar Electronics Technology programs that are located within an hour's drive of QCC. They compete with QCC primarily for students who are willing to commute to either school.

UMass Lowell Certificate Program in Electronics Technology (Lowell)

- UMass Lowell is a four-year institution, but its Electonics certificate program may attract students who might otherwise go to QCC.

The Salter School Electrical and Electronics Equipment Installer and Repairer Certificate Program (Worcester)

- The Salter School does not offer an Associate Degree, but is located within two miles of QCC. Students looking for a short-term certificate option may choose to enroll there, although the tuition is much higher than at QCC.

New England Institute of Technology Associate in Science Degree Program and Certificate Program in Electronics Technology (Warwick, RI)

- NEIT, although an expensive private school located in Rhode Island, regularly engages in aggressive marketing campaigns, and maintains a high profile and a good reputation for technology education.

Worcester Polytechnic Institute (Worcester)

- Although WPI is a four-year engineering school and is not in direct competition with QCC, it attracts many high school students from the area that are interested in pursuing a technical career.

Other QCC technology programs

- that attract students with similar skill sets, such as Electromechanical Technology, Computer Systems Engineering Technology.

B. Identify QCC's program strengths and market niche with respect to these competitors. In other words, what makes QCC's program the first choice?

Response:
Strengths

Location:
Since community college students come from the surrounding communities and live within commuting distance, QCC's location would be one of the primary reasons area students would choose QCC instead of another community college.

The Intel Technology Laboratory:
With financial support from Intel Corp., the electronics laboratory was renovated in 1999 and equipped with Pentium III computers. This state-of-the-art laboratory provides students with a learning environment that closely parallels the high-tech workplace.

Other closely related degree options:
QCC offers two options within the Electronics program: the Electronics Technician Option and the Biomedical Instrumentation Option. In addition, three other programs – Electromechanical Technology, Telecommunications Technology, and Computer Systems Support Technology – share a common first year with Electronics. All of these programs emphasize the same core of technical skills. As a result, students have the flexibility to branch into their area of interest after completing the first year of the program.

CO-OP program:
A CO-OP is available to all students, giving those with no industry experience an opportunity to get a foot in the door at a local company.

Partnership with Intel Corporation:
As a result of the QCC/Intel partnership, electronics students are eligible for scholarships and summer CO-OP opportunities at Intel's Hudson plant.

Day and evening classes:
All first-year electronics courses are offered both in the day and evening, giving students flexibility in scheduling their education.

Job placement:
QCC graduates have had nearly 100% success in finding jobs.

Affordable tuition:
According to Fall 2002 data, QCC's tuition and fees are only $2250 per year, while NEIT is $12,645 and the Salter School is $11,500.

Certificate leading to Associate Degree:
As compared to certificate programs such as those at UMass Lowell and the Salter School, QCC offers a certificate as well, but all credits earned in the certificate program can be applied towards an Associate in Science Degree.

C. Explain the specific marketing strategies the College has employed with respect to this program over the last three to five years. Please do NOT list general marketing strategies here. Identify marketing efforts relevant to your program specifically.

Response:

- The specific marketing strategies have always started with faculty, especially in high tech programs. Initiatives start with faculty networking with companies and professional associations through person-to-person contact, direct-mailings of letters, and direct telephoning.
- Also, marketing consistently takes place through the Admissions Office. They implement recruiting initiatives directly through personal visitations to high school counselors and their respective offices in addition to personal contacts with students at school functions such as College Information and Career Awareness Days. These efforts directly promote electronics technology with other QCC programs as well. The Admissions Office also conducts two Counselor Breakfasts per year, at which all program information is highlighted including electronics.
- In addition, promotional pieces such as the College viewbook, enhanced with electronics program slip sheets or brochures placed in end-page pockets, and the Technology Programs book, are direct-mailed through leads from college fairs, business trade expositions, and adult learners telephoning the Admissions Office requesting program specific information. Also, as in the case

with the WTI programming transfer to QCC, a number of specific brochures were developed to promote the technology area including electronics.

- QCC has hosted open houses that specifically highlight technology programs. One such event was held in the spring of 2000.
- QCC's counseling and advising offices are also an important part of the mix. These offices promote specific areas such as electronics as potential students are counseled in the College's technology programming. Often students do not know enough about QCC's program offerings to make an intelligent choice until they have discussed their goals with a faculty member or advisor.
- Print and radio advertising have carried the message that QCC is the right choice for hands-on technology education. Here are some examples:
  - On radio, ads have focused on electronics along with one or two other technology programs.
  - Print ads include testimonials from industry representatives attesting to QCC's technology training capabilities.
  - News articles such as one that appeared June of 2000 in the Telegram and Gazette on the Electromechanical Technology program have raised the public profile of QCC's technology offerings.
  - Charter Media Channel 3 TV News (now taken over by NECN Channel 32 and called Worcester Nightly News) and Cable Access Channel 13, have also given airtime to electronics industry presentations held in Conference Rm. 107A.
  - Print ads specific to the Intel Corp. Scholarship Program have been running in the Worcester Business Journal and the Telegram and Gazette.
- Initiatives generated through QCC's Tech Prep program include promoting electronics and all other technology programs. The Tech Prep office arranges and conducts visits by high school students and other groups.
- The Admissions Office conducts "Women in Technology" college planning nights at local and regional high schools, which are attended by high-school age students as well as adult learners. These events are technology specific, targeting women to consider technological careers, and therefore promoting QCC's electronics program in the process.
- The Admissions Office also visits local and regional companies, targeting employees with information about QCC's programs. Many of these are technology or electronics companies, with a critical need to upgrade the skills and knowledge of their workforce. These adult learners, in many instances, ask for additional information for their junior and senior high school aged children, investigating QCC as one of their college options.
- The Electronics Technology program is also promoted on QCC's website. Electronics, along with the other technology programs, are linked to the Admissions Office, counseling, and advising web pages.

D. Describe how program faculty work with the admissions officers to recruit students into the program. If unknown, outline a recruitment plan with specific activities.

Response:

- **Open House:** The Admissions office organizes two open house events each year. Faculty representatives from the Electronics program are available at the event to promote the program and answer the questions of prospective students and parents.
- **Campus Tours:** The Admissions office periodically conducts tours of the campus for interested students, teachers, and/or parents. When the group arrives in the Electronics laboratory, admissions staff hand them off to an electronics faculty member, who can provide more thorough information and answer questions.
- **Visits to Industry:** If the Admissions office schedules a visit to a local industry, a faculty member will be asked to join them for the purpose of providing program-specific information.
- **Referrals:** When the admissions office receives an inquiry about the Electronics program but is unable to answer a question, the person is referred to a faculty member.

E. Is the need for this program expected to grow or decline over the next five years? Please base your response on specific data.

Response:
The Massachusetts Department of Employment and Training projects a 12.3% increase in electronics employment openings through the year 2006. And the Bureau of Labor Statistics is predicting a 16.8% increase through 2008. The majority of these openings will result from replacing personnel in existing positions that have been vacated due the retirement of an aging workforce. These vacated positions will have to be filled by new employees.

Modern industry has become a technology-driven field. Technologies in this are continually being upgraded and improved upon. The core of QCC's Electronics Technology program is designed to equip students with the tools they will need to be competent in the technological workplace. As long as industry exists, the need for technically-trained employees will continue to grow, and the Electronics Technology program is positioned to address this need.

F. Based on analysis of information presented in this section, prepare enrollment projections for the next five years. Please describe what you believe is the optimum program size.

Response:
Based on current levels of enrollment and recruitment efforts, the following table shows the projected numbers of students in the Electronics Technology Associate Degree program and the Certificate program.

Electronics Technology Enrollment Projections through 2006:

Program	2000- 2001	2001- 2002	2002- 2003	2003- 2004	2004- 2005	*2005- 2006*
Electronics Technology (AS Degree)	22	24	30	40	50	*60*
Electronics Technology (Certificate)	11	12	15	20	20	*20*
Total Students	**33**	**36**	**45**	**60**	**70**	***80***

The classrooms and laboratories are designed to accommodate a maximum of 20 students at one time. Under current laboratory, classroom and staffing levels, the Electronics Technology program is able to run two sections of each freshman level course during the day and one section during the evening. For senior level courses, one day section and one evening section could be run, although this may change from semester to semester depending on demand.

It is difficult to separate the certificate candidates from the Electronics freshmen, since they are enrolled in the same first-year courses. In addition, many certificate candidates opt to continue into a second year to earn an Associates Degree. For this reason, they are grouped together as first-year students.

Electronics Technology Optimal Enrollment Levels:

Students	Day Sections	Evening Sections	Total Students (20 per section)
First-year students Electronics Technology Associate Degree and Certificate	2	1	60
Second-year students Electronics Technology Associate Degree	1	1	40

G. Summary and Analysis: Marketing Strategies, and Enrollment

Response:
There are a number of area institutions that offer programs in Electronics at the Associate Degree and Certificate levels. Among these, QCC's program offers several unique advantages.

- **Location:** QCC's central location makes it easily accessible from anywhere in central Massachusetts.
- **Cost:** Compared to private institutions and even state colleges, QCC's tuition is much more affordable, bringing college within the reach of many people who would otherwise not have the opportunity.
- **State-of-the-art Laboratory:** A newly renovated electronics laboratory provides students with a 21st century learning environment.
- **Flexibility:** A cluster of closely related technology programs give students options when choosing their area of interest.
- **CO-OP program:** A well-supported CO-OP programs gives students a way to earn college credits, work experience, and money.
- **Partnership with Intel:** A vibrant partnership with Intel Corporation provides students with opportunities for scholarships, summer internships, and jobs.

The demand for a technically literate workforce continues to grow, despite fluctuations in the economy. Recent program graduates have consistently been able to find employment, even during the recent economic downturn. The mission of QCC's Electronics program is to continue to provide students with a bridge to the high-tech workplace. **A primary objective at this point is to bring more students into the program, thereby using existing classroom and laboratory resources to their full potential.**

In order to do this, marketing efforts need to bring the message of opportunity at QCC out to the general public. Since the student population at QCC is diverse both in age and ethnicity, marketing efforts need to reach not only students in high school but also the adult working public, many of whom need updated skills and educational credentials.

Given current staffing and laboratory limitations, the Electronics program could accommodate 80 full-time students. If the program were to grow beyond this point, additional space and faculty would have to be allocated. In addition, there are three other closely related programs – Electromechanical, Telecommunications, and Computer Systems Support Technology – all of which require the same first-year courses as Electronics. Any growth in the enrollment of these programs would directly impact the Electronics laboratory, classroom, and staffing resources.

According to data provided by the QCC registrar as of April 2002, there were 24 students enrolled in the Electronics Technology Associate Degree program and 12 in the certificate program. However, there are also 17 students in Electromechanical Technology, 24 students in Computer Systems Support Technology, and 6 in Telecommunications Technology. In addition, there are approximately 80 corporate students in the Verizon Next Step program earning an Associate of Applied Science in Telecommunications by attending classes one day per week. Each of these 160 students use the Electronics laboratory and attend classes taught by Electronics faculty, so an accurate picture of the enrollment in Electronics must include these numbers.

6. Opportunities for Program Expansion

A. Are there other directions this program might evolve in order to sustain currency and quality? Consider the following categories, but feel free to include other categories in your response:

- **New certificate options within the program**
- **New concentrations within the program**
- **Different career ladder options within the program**
- **New associate degree program possibilities**
- **Development of modularized courses**
- **Continuing/professional education in the field (i.e., CEU's, prep for recertification, etc.)**
- **Distance education course development**
- **More proactive job placement/ support post-graduation**
- **Other…**

Response:
Improvements to Certificate program – designed to increase marketability

Candidates for certificate programs are generally adults looking for short-term programs that will equip them with marketable skills. Unemployed people are eligible to collect unemployment benefits under Title 30 if they can complete within one year and if the total number of credits is under 30. In order to be marketable to this group, the certificate program should meet the following criteria:

- It should require less than 30 credits.
- It should be possible for a full-time student to complete the program within two semesters.
- It should provide the graduate with several options if they choose to continue.
- There should be course options within the certificate requirements to accommodate students of different backgrounds and interests.
- All credits earned in the certificate program should apply directly toward an associate degree in Electronics Technology.

The current Electronics Technology Certificate Program requires the following courses:

Certificate in Electronics Technology – Course requirements

Course No.	Course Name	Credits
CIS 111	Microcomputer Applications for Business	3cr
ELT 103	Electronics I	5cr
ELT 105	CAD for Technicians	3cr
ELT 121	Digital Computer Circuits	4cr
SPH 101	Speech Communication Skills	3cr
MAT 123	College Math I: Precalculus	3cr
CSC 141	Operating Systems I	3cr
ELT 104	Electronics II	4cr
	Total Credits:	**28cr**

The following are proposed changes to the current certificate program that will bring it more in line with the criteria listed above.

- The course SPH 101 has a prerequisite of ENG 101. Many students that apply to QCC assess at an English level too low to enroll in ENG 101 in their first semester. Because of this, these students are unable to complete the certificate within a year.

Offer course alternatives as shown in the following table.

Course No.	Course Name	Credits
CIS 115 OR ELT 105	Intro to Computer Apps in Telecom OR CAD for Technicians	3cr
ELT 103	Electronics I	5cr
ELT 121	Digital Computer Circuits	4cr
ELT 122 OR CSC 233	Microprocessors OR Computer Systems I	4cr
ELT 104	Electronics II	4cr
CSC 141	Operating Systems I	3cr
ENG 101	English Comp & Lit. I	3cr
MAT 123	College Math I: Precalculus	3cr
	Total Credits:	29cr

Linking with related programs to form different career ladders
QCC currently offers three other degrees that are closely related to Electronics. Electromechanical Technology, Telecommunications, and Computer Systems Support Technology all have first-year course requirements that are identical to Electronics. In addition, the second year of Electronics Technology offers a Biomedical Instrumentation Option and an Electronics Technician Option. Each of these five areas could be considered a specialization within the field of Electronics.

Except for the Biomedical Instrumentation and Electronics Technician options, these programs are currently presented in the catalog as if they are separate and unrelated. Because of this, students in the different areas are often unaware of the choices available to them. By grouping them together and showing the relationships between the Electronics-related areas, QCC can present this area of technology as a dynamic and multi-faceted career cluster built on a common foundation. This would improve its marketability, resulting in shared benefits for all programs.

With the new certificate requirements discussed above, the Electronics Technology program area could present the student with the following career ladder options:

Electronics career ladder:

- **Electronics Certificate:** Completion of foundational courses that equip students to enter a broad range of disciplines within the field of Electronics.
- **First year of Associate Degree Program:** Same requirements as the certificate plus English Comp. II and College Math II.
- **Second year of Associate Degree Program:** Specialization in an area that fits the student's interest and/or career plans.
    - Electronics Technician
    - Biomedical Instrumentation
    - Electromechanical Technology
    - Telecommunications Technology
    - Computer Systems Support Technology

Establishment of an Automation Technology Training Institute at QCC
Due to our involvement with MATEC and our partnership with Intel Corporation, QCC is uniquely positioned to take advantage of an opportunity to establish an Automation Technology Training Institute on the QCC campus. The objective of the institute would be to provide credit and non-credit instruction that prepares students for the highly automated, technology-driven workplace. This would greatly enhance both the Electromechanical and Manufacturing Technology Programs already being offered, and would raise the profile of QCC as a site for technology education.

Equipment for the Institute is being developed through an industry/education/government partnership that includes Intel Corporation, MATEC, the National Science Foundation, and SMC International Training. Participation in this pilot project will require the following from QCC:

- Dedication of approximately 500 sq. ft of lab space and 500 sq. ft of classroom space to house the equipment. (Classroom space may be made available for other uses as well.)
- Purchase of automation training equipment for half cost at $50,000. Schools are encouraged to raise part of this through grants and donations.
- Assignment of a lead faculty member to head the pilot program on campus.

The Technology division has already acquired approximately 1000 sq ft. of classroom and lab space in the lower floor of the Field House, and plans are being laid to convert an additional 2000 sq ft to academic. The area is intended for laboratory and classroom space for courses in Electromechanical Technology, Manufacturing Technology, and Physics.

New Associate's Degree program possibilities
Laser Electro-Optics/Photonics Technology is one of the more rapidly growing technical fields in America today. The trained technician can expect favorable job opportunities, promotion potential and rapid advancement. Graduates of a photonics program qualify for a wide range of employment opportunities both with established firms and with high-technology start-up companies that constitute much of the rapidly-expanding photonics industry.

This proposed new concentration could enhance the College's current offerings within the Electronics Technology Program. In this new curriculum, the student will learn about the laser both as an instrument and as an integral part of a system designed for industrial, medical and scientific application. The electronics used in generating and controlling the laser would be taught. It is recommended that the use of the laser in electronics production, testing, maintenance, research and development, be part of the curriculum. In the field of optics, the student would acquire a good working knowledge of light, geometrical and physical optics, optical components and optical systems.

Distance education course development
One of the primary goals of the Electronics Technology program is to provide scheduling flexibility for students, especially those who work full-time and are unable to attend day or evening classes. As Internet technology improves, more and more courses are being offered on-line, enabling students to complete coursework on their own schedules.

Several of the first-year courses in the Electronics Technology program are already being offered on-line. These include Introduction to Computer Applications in Telecommunications (CIS 115), College Math I (MAT 123), English Comp. & Lit. I (ENG 101) as well as other Math and English courses.

Courses that offer a lab component present a unique challenge for on-line delivery. Students need access to a laboratory in order to complete hands-on activities. One possible solution could be to schedule limited lab times but offer the rest of the course on-line. In other cases, it may be possible to require the students to purchase a lab kit that allows them to work at home, although this would be very limited compared to a fully equipped lab workstation. A third possibility would be to require students to use software such as Electronics Workbench to simulate the lab environment on their home computers.

More systematic collection of program graduate placement data
At this time there is no consistent method for collecting data about program graduates. The QCC placement office has records of students that are hired for full-time and CO-OP positions through them, but this does not account for students hired independently of the placement office. These records also do not differentiate between students who have graduated and those who have not. The following recommendations would improve this system, resulting in more reliable data for use in marketing and monitoring the effectiveness of the program:

- Via Email, send a link to all QCC graduates directing them to an on-line form. The form would then prompt them for their employment and/or continuing education status. The goal is to make the process as convenient as possible to maximize the percentage of graduates that respond.
- Students who did not respond by Email could be contacted by phone.

- Collect the data in a database that is accessible to the program coordinator and faculty members.

Distinctive scheduling on teaching corporations
QCC has run the Verizon Next Step Program since 1997, enabling employees of Verizon Communications to complete an Associate in Applied Science by attending classes one day per week for four years. QCC has also developed special scheduling for employees at Intel Corporation, allowing them to complete an Associate in Science in Electromechanical Technology by attending class on Fridays only.

Both of these programs demonstrate the ability of the QCC Electronics faculty to provide flexible scheduling and innovative programs to meet the needs of industry. Similar programs could be designed and developed in the future as the need arises.

Attaining national accreditation from Accreditation Board of Engineering and Technology (ABET)
The QCC Electronics Technology program already complies with national skill standards for the evaluation and maintenance of curricula. As a result, it is well positioned to move toward gaining accreditation status from the Accreditation Board of Engineering and Technology (ABET). ABET accreditation status would increase the credibility of the Electronics Technology program in the eyes of industry and other institutions, and significantly improve its marketability.

B. Summary and Analysis: Opportunities for Program Expansion

Response:
There are a number of ways in which the Electronics Technology program could be enhanced and expanded. Some of these enhancements can be accomplished by reorganizing existing offerings to appear more marketable to the general public.

The Electronics Technology Certificate can be a valuable tool to draw students into the department, but it must be designed to be accessible to people looking to fulfill short-term educational goals. Making a couple of minor changes to the existing certificate requirements can accomplish this.

Several possible new options within the field of Electronics already exist as separate programs. These programs share an almost identical first year, and are differentiated by the second year courses. By marketing these programs as a unit, the area of Electronics can be portrayed more accurately as a broad field with multiple career options built on a common core of skills.

Section II: Curriculum, Instruction, Assessment, Program Credentials and Faculty

1. Foundations of the Program

A. Describe the rationale for offering the degree with respect to environmental scan information (job outlook) and its unique niche in its particular Employment sector.

Response:
"21st Century Skills for 21st Century Jobs", a 1999 report written jointly by US government and industry, indicates the following essential core of skills required to be effective in the workplace of the information age. Since technical literacy permeates this core of skills, technology programs are of particular importance. The Electronics Technology program supports every one of these skill areas.

Basic Skills:
The academic basics of reading, writing, and computation are needed in jobs of all kinds. Reading skills are essential as most employees increasingly work with information on computer terminals, forms, charts, instructions, manuals, and other information displays. Writing is an essential part of communication to guide others and to establish a permanent base of information. Computational skills are needed to organize data for analysis and problem solving.

Technical Skills:
Forty-two percent of production and non-supervisory employees in manufacturing and service establishments now use computers. Workers use an increasing variety of advanced information, telecommunications, and manufacturing technologies as employers turn to technology to boost productivity and efficiency, and to deliver services to customers in new ways. In addition, because information technology changes rapidly, workers are required to upgrade their skills frequently to maintain competency in new generations of technology.

Organizational Skills:
More than half of non-managerial employees participate in regularly scheduled meetings to discuss work-related problems. This indicates the need for skills such as communication, analysis, problem-solving, and creative thinking. In addition, there is an increased emphasis on interpersonal skills such as negotiation, influencing, and self-management.

Company-Specific Skills:
New technologies, market changes, and competitors drive companies to innovate, to upgrade products and services, and to focus on continuous improvement of work processes. As a result, employees are under constant pressure to acquire new knowledge and skills specifically relevant to the company's products, services, production processes, and service delivery modes.

Taken from the "21th Century Skills for 21th Century Jobs"
A Report of the U.S. Department of Education,
U.S. Department of Labor, National Institute of Literacy,
and the Small Business Administration, January 1999

Despite the recent downturn in the economy, the long term demand for electronic technicians continues to grow steadily. The following tables indicate the employment outlook for Electrical Engineering Technicians at the statewide and national levels:

National Employment Outlook for Electronic Technicians through 2008:

Occupation	Number of jobs		Percent Change	Total job openings due to growth and net replacements, 1998 - 2008
	1998	2008		
Electrical and Electronic Technicians and Technologists	335,000	391,000	16.8%	125,000

Taken from the Monthly Labor Review, November 1999, Vol. 122, No. 11, p. 59, "Occupational employment projections to 2008", by Douglas Braddock, Economist, Office of Employment Projections, Bureau of Labor Statistics, available on the web at http://www.bls.gov/opub/mlr/1999/11/art5abs.htm

Massachusetts Outlook for Electronic Technicians through 2006:

Occupation	Number of jobs		Percent Change	Total job openings due to growth and net replacements, 1998 - 2008
	1996	2006		
Electrical and Electronic Technicians	9520	10,690	12.3%	3670

Taken from the Massachusetts Occupational Employment, Wages and Training Database, published by the Massachusetts Division of Employment and Training, available on the web at http://www.detma.org/lmi/lmi.htm

It is important to note that the actual numbers that appear in tables like the ones shown here depend heavily on how the occupational category "electronics technician" is defined. For example, semiconductor manufacturing technicians could fall under the category of "high-tech manufacturing technician" as well as "electronics technician". For this reason, different reports may indicate different numbers.

Another report on the employment outlook for jobs requiring an Associate's degree breaks the general term "electronics technician" into three categories and includes wage data:

Massachusetts Jobs Requiring an Associate's Degree – 1996 and projected 2006

Occupation	Current Jobs	Growth Rate	Projected New Jobs	Replace-ment Jobs	Total Job Opening	Annual Salaries	Factors Driving the Job Growth
Engineering Technicians	24,600	5%	1270	5420	6690	$40,670	The growing use of computer- aided design (CAD) equipment and computer simulation will hold down job growth. However, large numbers of job openings will result from the need to replace engineering technicians who retire or become engineers.
Broadcast Technicians	860	23%	200	250	460	$31,040	As more labor saving technologies are implemented in radio and TV broadcasting, jobs for broadcasters should remain unchanged. Competition for jobs should remain keen because of the large number of people attracted to this relatively small profession.
Computer	2250	33%	740	710	1450	$30,150	Rapid job growth is

Equipment Repairers							expected as firms upgrade their computer systems to improve service and remain competitive.

Taken from the Commonwealth of Massachusetts Labor Market Information Report on occupations requiring an Associate's Degree, available on the web at http://www.detma.org/forms/lmiforms1.htm

In addition, the first year of the Electronics Technology program is the core on which three other related Associate Degree programs are built. These include Electromechanical Technology, Computer Systems Support Technology, and Telecommunications Technology.

B. List degree or certificate objectives in measurable terms (6-8 overall statements)

Response:
All options in the Electronics Technology program share a common core curriculum for the first year. The core curriculum provides students with a background in both analog and digital electronics, as well as a broad general education that can be the foundation for further study at four-year colleges and universities.

Successful Graduates of the Electronics Technology program are expected to have knowledge of basic Electronics concepts, also abilities and skills to perform electronics fabrication, installation, and troubleshooting in a safe manner. With minimal training in specialty areas the Electronics Technician should become proficient in any area of electronics servicing.Specific measurable program goals are listed below:

Electronics Technology Program Mission
To train students to compete in a high performance, technologically driven market by demonstrating their ability to perform at a competent level. This is accomplished by adhering to national standards developed to measure and promote the competency of work-ready, entry-level electronics technicians.

Electronics Technology Program Goals and Objectives
To provide students with:

- An understanding of the fundamental concepts of electronics.
- An understanding of the concepts of motion control and process control.
- Fundamental circuit design and troubleshooting skills.
- The ability to use and maintain basic measurement instruments.
- Fundamental circuits and systems analysis skills.

Program Goal	How goal will be measured	How measurement will be made
Goal 1: Electronics Technology Program completers will obtain the knowledge and skills to attain entry-level employment.	90% of completers will be employed within six months of successful completion of the core curriculum.	Post-completion follow-up surveys designed by program faculty, QCC Administration, and Placement Resource Center personnel will be administered to successful completers as a campus wide activity of QCC on an annual basis. The results will be tabulated and analyzed by Placement Resource Center personnel.
Goal2: Electronics Technology Program completers will express satisfaction with the program.	90% of students receiving at least an Electronics Technology Certificate will express satisfaction with the level of training provided.	Post-completion follow-up surveys designed by program faculty, QCC Administration, and Placement Resource Center personnel will be administered to successful completers as a campus wide activity of QCC on an annual basis. The results will be tabulated and analyzed by Placement

		Resource Center personnel.
Goal 3: Employers will express satisfaction with Electronics Technology Program completers' competency levels.	90% of employers will express satisfaction with successful completers' performance on the job.	Post-completion follow-up surveys designed by program faculty, QCC Administration, and Placement Resource Center personnel will be administered to successful completers as a campus wide activity of QCC on an annual basis. The results will be tabulated and analyzed by Placement Resource Center personnel.
Goal 4: The Electronics Technology Program core curriculum prepares students for an industry certification examination.	80% of successful core completers who choose to sit for the exam will pass the CEA (Certified Electronics Associate) certification examination and/or the BEST (Basic Electronics Screening Tool).	This outcome will be measured by reported pass rates. These pass rates are available from CEA and BEST. The program faculty is responsible for acquiring this data and reporting it to the Placement Resource Center.

C. Define expected graduation competencies or student outcomes. Your response should include reference to general education outcomes, employability or "umbrella competencies", and career-related competencies or technical skills.

Response:
The expected competencies of Electronics Technology program graduates are based on the SCANS (Secretary's Commission on Achieving Necessary Skills) report.

SCANS Competencies: A Three-Part Foundation
Basic Skills:
Reads, writes, performs arithmetic and mathematical operations, listens and speaks

- Reading--locates, understands, and interprets written information in prose and in documents such as manuals, graphs, and schedules
- Writing--communicates thoughts, ideas, information, and messages in writing; and creates documents such as letters, directions, manuals, reports, graphs, and flow charts
- Arithmetic/Mathematics--performs basic computations and approaches practical problems by choosing appropriately from a variety of mathematical techniques
- Listening--receives, attends to, interprets, and responds to verbal messages and other cues
- Speaking--organizes ideas and communicates orally

Thinking Skills:
Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn, and reasons

- Creative Thinking--generates new ideas
- Decision Making--specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative
- Problem Solving--recognizes problems and devises and implements plan of action
- Seeing Things in the Mind's Eye--organizes, and processes symbols, pictures, graphs, objects, and other information
- Knowing How to Learn--uses efficient learning techniques to acquire and apply new knowledge and skills
- Reasoning--discovers a rule or principle underlying the relationship between two or objects and applies it when solving a problem

Personal Qualities:
Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty

- Responsibility--exerts a high level of effort and perseveres towards goal attainment
- Self-Esteem--believes in own self-worth and maintains a positive view of self
- Sociability--demonstrates understanding, friendliness, adaptability, empathy, and politeness in group settings.
- Self-Management--assesses self accurately, sets personal goals, monitors progress, and exhibits self-control
- Integrity/Honesty--chooses ethical courses of action

Five Workplace Competencies
Resources:
Identifies, organizes, plans, and allocates resources

- *Time*--Selects goal-relevant activities, ranks them, allocates time, and prepares and follows schedules
- *Money*--Uses or prepares budgets, makes forecasts, keeps records, and makes adjustments to meet objectives
- *Material and Facilities*--Acquires, stores, allocates, and uses materials or space efficiently
- *Human Resources*--Assesses skills and distributes work accordingly, evaluates performance and provides feedback

Interpersonal:
Works with others

- Participates as Member of a Team--contributes to group effort
- Teaches Others New Skills
- Serves Clients/Customers--works to satisfy customers' expectations
- Exercises Leadership--communicates ideas to justify position, persuades and convinces others, responsibly challenges existing procedures and policies
- Negotiates--works toward agreements involving exchange of resources, resolves divergent interests
- Works with Diversity--works well with men and women from diverse backgrounds

Information:
Acquires and uses information

- Acquires and Evaluates Information
- Organizes and Maintains Information
- Interprets and Communicates Information
- Uses Computers to Process Information

Systems:
Understands complex inter-relationships
Understands Systems--knows how social, organizational, and technological systems work and operates effectively with them
Monitors and Corrects Performance--distinguishes trends, predicts impacts on systems operations, diagnoses deviations in systems' performance and corrects malfunctions
Improves or Designs Systems--suggests modifications to existing systems and develops new or alternative systems to improve performance

Technology:
Works with a variety of technologies

- Selects Technology--chooses procedures, tools or equipment including computers and related technologies
- Applies Technology to Task--Understands overall intent and proper procedures for setup and operation of equipment

- Maintains and Troubleshoots Equipment--Prevents, identifies, or solves problems with equipment, including computers and other technologies

D. Describe how the program supports the College's mission and purposes

Response:
Three of QCC's Strategic Directions for FY 2001 are listed here, along with a description of how the Electronics Technology program supports each one:

Strategic Direction 1:
Implement the College's technology action plan to support and enhance all instructional, administrative, and communication functions and initiatives with state of the art technology.

- The Intel Technology Laboratory provides students with access to the Internet, Email, the QCCLAN network and computer simulation programs that are used consistently throughout the curriculum. Electronics technology students are required to make use of available technology in all courses.

Strategic Direction 4:
Review, update and develop a curriculum responsive to the educational needs of those who must live and work as productive citizens in a new century.

- Technical literacy is essential to success in the modern workplace and therefore a critical component of a student's education. All Electronics Technology program graduates are required to demonstrate their mastery of technology.

Strategic Direction 6:
Review and update workforce development as a concept and a set of processes for meeting the needs of students, external organizations, the business community, and the community at large.

- The Electronics Technology program maintains strong ties with industry to ensure that the curriculum is relevant to the needs of the modern workforce.

F. Summary and Analysis: Foundations of the Program

Response:
As individuals, organizations, and businesses depend more and more on technology to survive in the 21st century marketplace, the high-technology employment sector will continue to grow. The Electronics Technology Program and its options have been designed with input from the Electronics industry to provide as thorough and comprehensive a program as possible, allowing the graduate to enter the workforce with a broad technical background, well prepared in both the theoretical and practical aspects required by industry.

2. <u>Curriculum Strengths and Areas Needing Enhancement</u>

A. Based on the analysis of regional labor market needs, evaluate the current curriculum strengths and identify those areas that you believe require enhancement.

Response:
N/A

B. Include the proposed curriculum for each of the current or proposed options in the program.

Response:
Electronics Technology Certificate: 2001-2002 Curriculum

	First Semester			***Second Semester***	
CIS 115	*Introduction to Computer Applications in Telecommunications*	*3cr*	*CSC 141*	*Operating Systems (DOS, Windows, UNIX)*	*3cr*
ELT 103	*Electronics I*	*5cr*	*ELT 104*	*Electronics II*	*4cr*
ELT 105	*CAD for Technicians*	*3cr*	*MAT 123*	*College Mathematics I: Precalculus*	*3cr*
ELT 121	*Digital Computer Circuits*	*4cr*	*SPH 101*	*Speech Communication Skills*	*3cr*
		15cr			***13cr***
Total credits required for certificate					***28cr***

Electronics Technology Certificate: Proposed Curriculum

	First Semester			***Second Semester***	
CIS 115 or ELT 105	*Introduction to Computer Applications in Telecommunications Or CAD for Technicians*	*3cr*	*CSC 141*	*Operating Systems (DOS, Windows, UNIX)*	*3cr*
ELT 103	*Electronics I*	*5cr*	*ELT 104*	*Electronics II*	*4cr*
ELT 121	*Digital Computer Circuits*	*4cr*	*ELT 122 or CSC 233*	*Microprocessors or Computer Systems I*	*4cr*
ENG 101	*English Composition & Literature*	*3cr*	MAT 123	College Mathematics I: Precalculus	*3cr*
		15cr			***14cr***
Total credits required for certificate					***29cr***

Rationale for Revision of Electronics Technology Certificate Program:
In general:
The objective of the recommended curriculum changes is to create a certificate that leads the student through almost all of the first year of the following Associate Degree paths:
Electronics Technology: Electronics Technology Option

- Electronics Technology: Biomedical Instrumentation Option
- Electromechanical Technology
- Telecommunications Technology
- Computer Systems Support Technology

Completing the new certificate requirements will bring students within two courses (MAT 124 and ENG 102) of completing the first year of the programs listed. The certificate therefore becomes a first step on the Electronics career ladder, with multiple choices for continuing education.

Drop: SPH 101 Speech Communication Skills
Many students who choose the certificate program are receiving Title 30 unemployment benefits, which covers up to 30 credits for one year. The requirement of SPH 101 makes it nearly impossible for many students to complete the certificate within one year. This is because SPH 101 requires ENG 101 as a prerequisite, making it necessary to complete ENG 101 in the first semester, even though it does not count directly toward the certificate.

Add: ENG 101 English Composition & Literature I
Completion of this course ensures that the student has attained college-level English skills.

Add: ELT 122 Microprocessors OR CSC 233 Computer Systems I
Students come to QCC with different interests and backgrounds. Giving students choices will better accommodate these differences.

Change: CIS 115 Intro to Computer Apps. in Telecom AND ELT 105 CAD for Technicians to CIS 115 OR ELT 105
The certificate program must include an entry-level course in computer applications. This gives students two ways to meet that requirement.

Electronics Technology: 2001-2002 Curriculum
The Electronics Technology program offers two options: Electronics Technology and Biomedical Instrumentation Technology. The first year of each option is identical.

Core Curriculum - FIRST YEAR

	First Semester			***Second Semester***	
ELT 103	*Electronics I*	*5cr*	*CSC 141*	*Operating Systems (DOS, Windows, UNIX)*	*3cr*
ELT 105	CAD for Technicians	*3cr*	*ELT 104*	*Electronics II*	*4cr*
ELT 121	*Digital Computer Circuits*	*4cr*	*ELT 122*	*Microprocessors*	*4cr*
ENG 101	*English Composition & Literature I**	*3cr*	*ENG 102*	*English Composition & Literature II*	*3cr*
MAT 123	*College Mathematics I: Precalculus*	*3cr*	*MAT 124*	*College Mathematics II: Trigonometry* **Via Computer strongly recommended*	*3cr*
		18cr			***17cr***
		Total credits required for certificate			***35cr***

ELECTRONICS TECHNOLOGY OPTION
Curriculum - SECOND YEAR

	First Semester			***Second Semester***	
ELT 211	*Electronics Instrumentation*[2]	*4cr*	*ELT 212*	*Communications Electronics*[1]	*4cr*
MAT 233	*Calculus*	*4cr*	*MAT 234*	*Calculus II*	*4cr*
PHY 101	*Physics I*	*4cr*	*PHY 102*	*Physics II*	*4cr*
	Social Science Elective	*3cr*		*Social Science Elective*	*3cr*
	Humanities Elective	*3cr*		*Technical Elective*	*3cr*
		18cr			***18cr***
		Total credits required for certificate			***36cr***
		Total credits required for degree			**71cr**

BIOMEDICAL INSTRUMENTATION TECHNOLOGY OPTION
Curriculum - SECOND YEAR

	First Semester			***Second Semester***	
BIO 111	*Anatomy & Physiology I*	*4cr*	*BIO 112*	*Anatomy & Physiology II*	*4cr*
ELT 211	*Electronics Instrumentation*[2]	*4cr*	*ELT 212*	*Communications Electronics*[1]	*4cr*
ELT 299	*Cooperative Work Experience & Seminar*	*3cr*	*PHY 102*	*Physics II*	*4cr*
PHY 101	*Physics I*	*4cr*		*Humanities Elective*	*3cr*
	Social Science Elective	*3cr*		*Social Science Elective*	*3cr*
		18cr			***18cr***
	Total credits required for certificate				***36cr***
	Total credits required for degree				***71cr***

Electronics Technology Proposed Curriculum:
CHANGES AFFECT - FIRST YEAR ONLY

	First Semester			***Second Semester***	
ELT 103	Electronics I	*5cr*	CSC 141	Operating Systems(DOS, Windows, UNIX)	*3cr*
CIS 115 Or ELT 105	*Introduction to Computer Applications in Telecommunications or CAD for Technicians*	*3cr*	ELT 104	Electronics II	*4cr*
ELT 121	Digital Computer Circuits	*4cr*	*ELT 122 Or CSC 233*	*Microprocessors or Computer Systems I*	*4cr*
ENG 101	English Composition & Literature I*	*3cr*	ENG 102	English Composition & Literature II	*3cr*
MAT 123	College Mathematics I: Precalculus	*3cr*	MAT 124	College Mathematics II: Trigonometry *Via Computer strongly recommended	*3cr*
		18cr			***17cr***
	Total credits required for certificate				***35cr***

Rationale for Revision of Electronics Technology Associate in Science Degree Program Curriculum:
In general:
The objective of the recommended curriculum changes is to link the first year of the program to the certificate requirements, so that the certificate can be used as a first step toward the Associate degree.

Give students a choice between ELT 122 Microprocessors and CSC 233 Computer Systems I
Students come to QCC with different interests and backgrounds. Giving students choices will better accommodate these differences.

Give students a choice between CIS 115 Intro to Computer Applications in Telecom and ELT 105 CAD for Technicians
The Associate degree program must include an entry-level course in computer applications. This gives students two ways to meet that requirement.

C. For each course in the revised curriculum, provide a description, statement of goals, major topics covered, primary tests or materials, and instructional technology used. (Please refer to the attached format.)

Response:

ELT 105 CAD for Technicians - 3 Credits

This introductory course provides necessary skills in a number of areas, the primary of which is an introduction to computer-aided design (CAD) using CADKEY. The Course will also cover laboratory safety techniques, schematic symbols and diagrams, and soldering techniques, and, as an introduction to the use of computers, Microsoft "Windows" will be introduced. Two hours lecture; three hours laboratory.

ELT 103 Electronics I - 5 Credits

This is a beginning course in the study of electronics for all electronic majors. The topics will include the study of resistances, capacitances, and inductances with DC and AC excitations, circuit theorems, use of meters, oscilloscopes and other test equipment, series and parallel resonance, and troubleshooting of electrical circuits and components. The student will breadboard series, parallel, and combinational circuits using resistors, capacitors, and inductors; troubleshoot such circuits to find malfunctioning components; use a variety of test equipment, such as analog and digital meters, oscilloscopes, and function generators; and analyze a variety of circuit configurations using experimental and mathematical techniques.
Prerequisites: MAT 099, ENG 100

ELT 121 Digital Computer Circuits - 4 Credits

This course provides a study of digital computer fundamentals, including number systems, digital code, logic gates, Boolean algebra, combinations logic, and flip-flops. Troubleshooting techniques are taught and used throughout the course. Explained are the functions of the basic computer circuits used in the operation of all computer systems. The student will interpret the operation of a digital electronic circuit; troubleshoot to the failing component of a digital electronic circuit; demonstrate an understanding of the binary, octal, and hexadecimal number systems; and demonstrate an understanding of Boolean rules and laws used to express gate networks. Three hours lecture; three hours laboratory.
Prerequisites: MAT 099, ENG 100

ENG 101 English Composition & Literature I - 3 Credits

This course emphasizes practice in the form and structure of the short essay. The student is exposed to several kinds of writing situations which incorporate various rhetorical modes, including, among others, comparison and contrast, analysis, definition, classification, etc. The course contains the following requirements:

- At least three in-class writings or essay examinations of increasing length and complexity (minimum word count range 1,200 to 1,500).
- At least three out-of-class writings of increasing length and complexity (minimum word count range 1,800 to 2,000).
- An original research paper demonstrating a synthesis of finding on a topic selected from the class text or chosen by the instructor; acknowledging all outside sources (including non-print and on-line materials) and incorporating parenthetical citations and annotations as approved by the Modern Language Association (minimum word count range 1,400 to 1,800).

The total minimum word count range for ENG 101 is 4,400 to 5,500. Upon successful completion of the course, the student will be able to write a college level essay with a clearly defined thesis, logical development, mature tone, and a minimum of grammatical errors. Following the process model of composing, the student should also generate an academic research paper exercising critical thinking and developing a point of view.
Prerequisite: ENG 100

MAT 123 College Mathematics I: Pre-calculus - 3 Credits

The student will expand a binomial using the binomial theorem, write any term in an expansion, use Pascal's triangle, and understand factorial notations; solve linear, nonlinear, and absolute value inequalities

graphing the solutions using open, closed, half-open, and infinite interval notation; work in the rectangular coordinate system, knowing the distance and mid-point formulas, equations of a linear function (point-slope, slope-intercept, and the standard form); graph an equation using symmetry and domain; explain the meaning of function in terms of domain, range, and one-to-one relation; recognize the identity function, constant function, even and odd functions, and increasing and decreasing functions; know how to shift a graph horizontally and vertically and to reflect and/or stretch a graph; recognize the equation of a circle, locating coordinates of the center and determining the radius; sketch the graphs of and work with piecewise functions; execute the arithmetic operations (addition, subtraction, multiplication, and division) on two functions; determine the composition of two given functions, whether a function is one-to-one, and the inverse of a one-to-one function; graph quadratic functions locating maximums or minimums; sketch rational, exponential, and logarithmic functions; and know the major properties of logarithms and exponents. Additional topics selected at the instructor's discretion may be presented if time permits.
Prerequisite: MAT 099

CSC 141 Operating Systems I - 3 Credits
This course provides the student with an introduction to a networked operating system at the desktop. Hands-on activities in the laboratory closely parallel classroom discussion to give the student practical experience with the use and management of a workstation operating system. Topics include operating system installation and configuration, file systems, resource management, user management, and security. The course will focus on a current Microsoft operating system and will prepare students to sit for the corresponding MCSE certification examination.
Prerequisite: CIS 111 or CIS 115, ENG 096

ELT 104 Electronics II - 4 Credits
This course presents topics such as theoretical and practical electronics, solid state fundamentals, transistors, power supplies, amplification systems, oscillators, pulse generators, and miscellaneous electronic circuitry. The student will understand the practical and theoretical behavior of electronic control devices such as diodes, transistors, Zener diodes, F.E.T.'s, thyristors, and logic gates. Additionally, the student will construct amplifiers, power supply circuits, oscillator circuits, and other circuits involving control devices. Three hours lecture; three hours laboratory per week.
Prerequisite: ELT 103

ELT 122 Microprocessors - 4 Credits
This course provides a study of the hardware and software associated with a particular 8-bit microprocessor -- the Motorola MC6800. The hardware portion of the course will cover the registers and bosses of the 6800 chip as well as its associated RAM, ROM, ACIA, and PIA chips. The software section will cover assembly and machine language programming of the 6800. An overview will be made of other microprocessor chips, such as MC68HCII and the MC68000. The student will understand the architecture of the MC6800; write, run, analyze, and debug assembly and machine language programs in the 6800; and interface the 6800 chip to a variety of peripheral devices.
Prerequisite: ELT 121

ENG 102 English Composition & Literature II - 3 Credits
In this course, the student will study various types of imaginative literature. Included will be themes of contemporary concern, including those of women, African Americans, Asian Americans, Native Americans, and Latinos/Latinas, among others. To ensure that the student is exposed to, and has a critical grasp of, the major literary genres, several in-class and out-of-class writing assignments of diverse length and rhetorical complexity are required. The student will write at least two in-class essays or essay examinations of increasing length and complexity, or develop a semester-long reader response journal to be checked periodically by the instructor (minimum 1000 words). The student will also write one longer, more ambitious critical evaluation, encompassing at least one mode of literary criticism (for example, psychological, historical, sociological, feminist, New Criticism, or any recognized mode of criticism the instructor deems appropriate). The length of the critical paper is minimally 1000 words; it requires correct annotation and bibliographic documentation in the MLA style. The minimum writing requirement for this course is 3500 words. The student will understand the basic criteria for good literature, become familiar

with text selections representing a sample of the best authors, commit this to cohesive written discourse, and understand the basics of literary research.
Prerequisite: ENG 101

MAT 124 College Mathematics II: Trigonometry - 3 Credits
The student will solve right and oblique triangles and related word problems; perform vector computations and use vector concepts to solve word problems; determine the values of trigonometric ratios of angles and the values of inverse trigonometric ratios of real numbers; work with angles measured in degrees-minutes-seconds or radians; solve uniform circular motion problems; know the traditional trigonometric identities and use them to prove other identities; sketch the graphs of variations of the six basic trigonometric functions; write equations to describe specific instances of harmonic motion; and solve trigonometric equations.
Prerequisite: MAT 123

ELT 211 Electronic Instrumentation - 4 Credits
This course presents practical "shop electronics", emphasizing the theory of operation and application of electronic instruments. The three main aspects of measuring systems are covered, including input/detector, processing, and output/display. Some attention is paid to analog and digital meters; DC and AC bridges (manual and automatic); potentiometers and potentiometric bridges; thorough familiarization of oscilloscopes (theory of operation and applications); A/D and D/A converters; transducers; operational amplifiers and analog computer circuits; fiber optics, and automatic test equipment. Included are exercises in calibration, troubleshooting, and measurements using common laboratory instruments. The student will also cover each aspect of measuring systems, input, processing, and output in detail. Three hours lecture; three hours laboratory.
Prerequisites: ELT 121, ELT 104

PHY 101 Physics I - 4 Credits
This course is a standard algebra-based college physics course. Basic concepts of measurement, kinematics, dynamics, work, energy, power, momentum, and special relativity are presented and re-enforced with appropriate problems and laboratory experiments. The student will use appropriate instruments to measure physical quantities in the SI system of units; state and explain the basic principles of kinematics, dynamics, work, energy, power, momentum and special relativity; apply these principles to solve related problems; perform related laboratory experiments; and write an acceptable laboratory report. Three hours of lecture and three hours of laboratory.
Prerequisite: MAT 123

ELT 212 Communications Electronics - 4 Credits
This course provides an introduction to transmitting and receiving AM, FM, and PM circuits, antennas, transmission lines, and microwave transmissions. Also presented are data transmissions, including lasers and fiber optics. Three hours lecture; three hours laboratory.
Prerequisites: ELT 121, ELT 104

PHY 102 Physics II - 4 Credits
This course is a continuation of Physics I. Selected topics from the areas of properties of materials, thermodynamics, waves, and vibrations, optics, and electromagnetism are studied. Problem-solving techniques are emphasized. Related laboratory experiments are performed. The student will state and explain basic principles in the listed areas of physics; solve more complex related problems; perform related laboratory experiments; write an acceptable laboratory report; and appreciate the relationship of physics to the natural world. Three hours lecture and three hours laboratory.
Prerequisite: PHY 101

Courses for Electronics Technology Option:
MAT 233 Calculus I - 4 Credits
This course begins with a review of the basic concepts of functions and function notation. Once the limit and continuity theorems are introduced on an intuitive basis, differentiation begins. The typical derivative formulae are applied to polynomial, rational, trigonometric, inverse trigonometric, implicit, exponential,

and logarithmic functions. The application topics include extrema, related rates, curve sketchings, compound interests, growth and decays, velocities, and accelerations. An introduction to integration as an antiderivative follows, and eventually integration rules and substitution are discussed as a technique of integration. Areas of closed regions are used to introduce Riemann sums, and the Fundamental Theorem of Calculus.
Prerequisite: MAT 124

MAT 234 Calculus II - 4 Credits
Calculus II is a typical integration course. All basic techniques of integration are discussed, along with the customary applications (area) volumes, work, fluid force, moments, centroids, arc lengths, and surfaces of revolution. L'Hospital's Rule and Improper integrals are then discussed. This is followed by infinite series with all of the customary convergence tests, and the Power, Taylor, and Maclauren series.
Prerequisite: MAT 233

Courses for Biomedical Instrumentation Technology Option:
BIO 111 Anatomy & Physiology I - 4 Credits
This course studies the concepts of cell structure and genetic regulation, chemical composition of the body, mechanisms of biochemical reactions, membrane transport and membrane potential, homeostasis and cybernetic mechanism, and the integumentary skeletal, muscular systems, and neuronal histology and physiology under normal and some pathological states. The student will gain an appreciation of, and lay the proper foundation for, a study in human anatomy and physiology; understand that the basic unit of structure and function in the human body is the cell; discuss major physiological and biochemical processes occurring in the body; describe several methods of transporting material into and out of the cell, and how this transportation of materials can result in a potential difference across the cell plasma membrane; describe how the nervous and endocrine systems play a vital role in the regulatory mechanisms maintaining the homeostasis of an individual; understand that the skin and its associated epidermal structures constitute the integumentary system; understand the organization, functions, and development of the human skeletal system, including body joints and movement; describe in detail structures and functions of muscles on the microscopic and macroscopic levels; and complete a study of the histology of nervous tissue and physiology of the neuron. Three hours lecture and three hours laboratory.
Prerequisite: High school chemistry or CHM 090, or CHM 101, or CHM 103
Corequisite: ENG 101

BIO 112 Anatomy & Physiology II - 4 Credits
This course is a sequel to BIO 111, stressing concepts of the nervous, cardiovascular, lymphatic, respiratory, digestive, and urinary systems under normal and some pathological states. The student will relate the anatomy of the brain, spinal cord, and the peripheral nervous systems with their functions; know the components of the cardiovascular and lymphatic systems, and relate the nature and composition of blood and lymph along with the cardiovascular physiology and the basic concepts involved in immunity; associate the organs of respiration with physiology of inspiration and expiration and the biochemistry of blood gases; understand the architecture of the digestive organs with reference to completion of chemical digestion and absorption of foodstuffs; relate how the kidney accomplishes the functions of filtration, reabsorption, and excretion of blood components and controls electrolyte, water and acid/base balance; associate the structure and physiology of male and female reproductive systems, and know the development of the fertilized ovum through embryological fetal development, including birth. Three hours lecture; three hours laboratory.
Prerequisite: BIO 111

ELT 299 Cooperative Work Experience & Seminar - 3-6 Credits
This course provides the student with a structured learning experience, while applying classroom theory to a practical work experience. A seminar will be conducted for students to exchange feedback about their work experience. The number of credits earned is determined by the number of weeks and hours per week required by the cooperative work experience and the objectives of the student's learning contract.
Prerequisites: ELT 104, ELT 122 or CSC 233

D. Describe the rational for the course sequence in the revised program. A rational of course sequence should be provided for the specific program related courses, the general education courses, electives, etc.

Response:
Electronics core courses (first year):
The three entry-level Electronics courses are ELT 105 CAD for Technicians, ELT 103 Electronics I and ELT 121 Digital Circuits.

- ELT 105 has a prerequisite English level equivalent to completing ENG 100 English Communication. The reason for this is to ensure that students have some proficiency with reading and writing English before they attempt a technical course.
- ELT 103 and ELT 121 require an English prerequisite of ENG 100 and a Math prerequisite of MAT 099 Intermediate Algebra. Students are required to write lab reports, so a command of written English and grammar are essential. The study of circuit theory requires the use of Algebra to analyze circuits and solve problems.
- ELT 104 Electronics II builds on the circuit theory concepts developed in ELT 103 while investigating transistors and other semiconductor devices.
- ELT 122 Microprocessors is the study of advanced digital circuits, and requires that students have a clear understanding of fundamental digital circuits such as binary numbers, logic gates, flip-flops, etc.

Advanced Electronics courses:
Once a student has completed ELT 121 and ELT 104, they have sufficient core knowledge of electronics to pursue ELT 211 Electronic Instrumentation or ELT 212 Communications Electronics.

General Education requirements:
The English sequence provides the essential skills of oral and written communication as well as critical reading and analysis. These skills are exercised continually throughout the Electronics curriculum through written lab reports.

- SPH 101 Speech Communication Skills further aids students in the development of oral communication and presentation skills.
- The first-year Math courses, MAT 123 and MAT 124, require students to develop core skills in Algebra and mathematical analysis, and prepare them for further study in Calculus (MAT 223 and MAT 224).

E. Explain how the general education components are integrated with the department specific courses.

Response:
The mathematical analysis of any electronics circuit is a critical part of the solution of any circuit. A student must be well versed in algebra and trigonometry as well as have an understanding of basic calculus to be able to function well as an electronic technician. All Electronics courses require and use high level mathematics. Electronics Technicians are problem solvers.

The English component is required to ensure that the student is capable of writing technical reports as well as being able to make technical presentations to customers, co-workers and supervisors. All of the Electronics courses require written formal lab reports are turned in weekly. This provides the students with the discipline and training needed to document the work and daily routines of an Electronic Technician.

The recommended Psychology course (interpersonal relationships) provides the student with insights on how to work with and deal with people in the work environment. A well-trained technician must be able to function well with co-workers, and more importantly, must be able to deal with all types of customers, particularly the occasional difficult customer always encountered in a technicians line of work.

F. Does the curriculum incorporate "writing across the curriculum"? Provide an illustration, if applicable.

Response:
All of the Electronics courses require written formal lab reports are turned in weekly. This provides the students with the discipline and training needed to document the work and daily routines of an Electronic Technician. The formal lab reports require an analysis and conclusion that are corrected and graded for both technical analysis and correct English. Students that have difficulty in writing the lab reports are referred to the Writing Lab for assistance.

G. Describe how the program meets the QCC philosophy of "high tech, high touch, high quality".

Response:
High Tech:
Electronics is at the very core of the technological revolution of the late 20th century. The recent upgrades in the Electronics Department lab facilities now provide total state of the art facilities for student use. New computers in the Intel Technology Laboratory allow for the use of Internet facilities as well as software such as Electronics Workbench for the student to use in both their technical courses and general education courses. Other laboratory components such as circuit breadboarding equipment, meters and oscilloscopes are constantly upgraded and replaced to keep the laboratories as current as possible.

High Touch:
The Electronics Technology program places a strong emphasis on hands-on learning. All Electronics courses have a required 3-hour weekly lab insuring the Electronics student has sufficient hands-on experience to be successful as an Electronic Technician.

High Quality:
Employers demand and depend on quality work from their employees. Electronics Technology students are evaluated according to the same standards used in the workplace, as well as the standards defined by the Board of Higher Education for degree-granting institutions.

H. Does the program structure provide students with at least one elective choice? Please explain your response: If no, is it possible to revise the curriculum so that there is at least one elective? Please explain your response.

Response:
Electives include 2 Social Science electives, 1 Humanities elective, and a Technical elective. The Technical elective allows the student to chose from a wide range of technical courses from courses in telecommunications, networking courses, or a technical coop to gain valuable industrial experience while earning college credits.

I. Summary and Analysis: Description of Curriculum

Response:
N/A

3. Relevance of Instructional Methodologies, Assessment Strategies and Program Credentials

A. Summarize the INSTRUCTION METHODOLOGIES utilized in the program. What are the strengths and challenges of these methodologies?

Response:

- Presentation of material in class lectures.
- In-class solution of example problems.
  - **Methods 1 - 2 strengths:** Efficient use of instructor's time. All students are present for the instructor's presentation and can ask questions if necessary.
  - **Methods 1 - 2 challenges:** Students have different learning styles that may not be compatible with instructor's presentation style. Quicker students must wait while instructor answers other students' questions.
- Assignment of practice problems with answers provided so that students may check their own work.
- Required laboratory activities apply concepts presented in class.
- Course materials are made available through shared network folders on campus.
- On-line course delivery.
  - **Methods 3 – 6 strengths:** All of these methods encourage students to become self-learners, which is probably the most important skill they can develop.
  - **Methods 3 – 6 challenges:** Instructors and/or lab tutors may not be available to address student questions

B. Provide recommendations for additional methodologies that would enhance students' learning. More specifically, are there additional ways in which instructional technology could enhance students' learning? Options for distance learning? Please explain your answer, and include how the College might support these efforts.

Response:

- Establish a *Technology Center* that would focus on tracking, supporting, and graduating a committed, diverse student population in the area of Technology and would be set up to operate as a student and faculty drop-in center with eight workstations.
- A technology tutor would be a great asset to the program.
- Electronic Tutorial software is available for many of the courses we offer and would be a great study tool/resource for the student
- The possibility of on-line courses has been discussed, and future plans include on-line offerings
  - *Availability of software such as Electronics Workbench in the Bookstore for student purchase would allow the student to work on more material at home*

C. Please provide a detailed assessment plan outlining the methodologies used for ongoing student assessment and final outcome assessment.

Response:
N/A

D. Describe the strengths and challenges of each of the assessment methodologies listed above.

Response:
While each instructor has different assessment methods, in general the following are common to all courses:
In-class written tests that measure a student's comprehension of the material.

- **Strength:** Provides a verifiable measurement of a student's comprehension.
- **Challenge:** May not be a complete and accurate reflection of student's overall ability to perform. Usually only tests a student's ability to solve problems and give short answers but not their communication skills.

Weekly lab reports outlining results and conclusions of laboratory experiments. Lab reports must be meaningful, accurate, and neat, and must use correct grammar and punctuation.

- **Strength:** The lab report is a comprehensive assignment that requires a student to apply all of the skills that they will need on the job.
- **Challenges:** It is impossible to be absolutely sure that students are submitting their own work.

Comprehensive final exam.

- **Strength:** Provides a verifiable measurement of a student's comprehension.
- **Challenge:** May not be a complete and accurate reflection of student's overall ability to perform. Usually only tests a student's ability to solve problems and give short answers but not their communication skills.

In addition, the following assessments may also be used:

- Practical lab exams where students demonstrate their lab skills in the presence of a lab instructor.
- Graded homework assignments.
- Projects
- Quizzes – (10-minute assessments)

E. Provide recommendations for additional methodologies to evaluate student achievement.

Response:
Students could be required to complete a project in one of their senior-level courses. The project would require the synthesis of technological skills and knowledge with communication, presentation, and teamwork skills.

F. Has the program been evaluated by an EXTERNAL ACCREDITATION organization within the last five years?

Response:
The Electronics Technology Program has not been evaluated within the last five years.

G. If yes, please provide name of the organization and date of last accreditation review. Did the program meet all of the accreditation requirements? If no, please explain. Attach the summary of the accrediting team's recommendations.

Response:
N/A

H. If the program has not been evaluated externally, list any appropriate professional accreditation or licensure for the program that the College should pursue. (E.g., Industry certifications, professional associations, etc.)

Responses:
Accreditation:
Accreditation for Engineering and Technology programs is provided by ABET. One of the goals of the Electronics Technology program is to become ABET accredited within the next five years. Criteria for ABET accreditation are listed here.

The Accreditation Board of Engineering and Technology's Program Requirements
The Accreditation Board of Engineering and Technology (ABET) specifically outlines the requirements for an electrical/electronic(s) engineering program. The following information is available on the ABET web page at www.abet.org. An analysis of the ABET criteria will be incorporated into the requirements for the Electronics Technology program, during the IPR Research Phase.

- *II.J. PROGRAM CRITERIA FOR ELECTRICAL/ELECTRONIC(S) ENGINEERING TECHNOLOGY AND SIMILARLY NAMED PROGRAMS Submitted by The Institute of Electrical and Electronics Engineers, Inc. (Reviewed 1995)*
- *II.J.1. Applicability.*
  These program criteria apply to engineering technology programs including "electrical," "electronic(s)," and similar modifiers in their titles, leading to either an associate or a bachelor's degree.
- *II.J.2. Curriculum.*
  - *II.J.2.a. Technical Sciences. (Amplifies criteria section I.C.1.) Technical science courses must be applications-oriented with a majority having an accompanying laboratory with emphasis on measurement, data collection and analysis, documentation, and written/oral report preparation/presentation. Course work must include the fundamentals of electricity/electronics and principles of circuit analysis.*
  - *II.J.2.b. Technical Specialties. (Amplifies criteria section I.C.2.)*
    - *II.J.2.b.(1). Technical skills and techniques courses must include topics, as appropriate, to meet the stated goals and objectives of the program.*
    - *II.J.2.b.(2). Courses at the associate degree level must prepare the student for immediate employment but must include sufficient foundation to enable the student to continue in upper-division studies without penalty. Upper-division course work must complement and expand on lower-division work.*
    - *II.J.2.b.(3). Technical design courses must stress the use of manuals, handbooks and material/equipment specifications, and computers where applicable.*
  - *II.J.2.c. Basic Sciences and Mathematics. (Amplifies criteria section I.C.4.)*
    - *II.J.2.c.(1). The basic sciences must include physics (with laboratory) presented in a rigorous algebra/trigonometry environment (as a minimum).*
    - *II.J.2.c.(2). A minimum sequence in mathematics is college-level algebra, trigonometry, and an introduction to calculus. Baccalaureate programs must include differential/integral calculus, and instruction in applied differential equations is strongly encouraged. Linear programming, numerical methods, and probability/statistics are other appropriate electives.*

Taken from "Criteria for Accrediting Engineering Technology Programs: Effective for Evaluations During the 2002-2003 Accreditation Cycle", Technology Accreditation Commission, Accreditation Board for Engineering and Technology, Inc.

Certification:
In addition to program accreditation, the Electronics Technician's Association offers nationally recognized professional certifications. These provide students with a way to validate their proficiency in Electronics independent of the degree requirements. Details on becoming certified are available at www.eta-sda.com. A summary is provided here:

THE ELECTRONICS TECHNICIANS ASSOCIATION
Since 1978 the Electronics Technicians Association International (ETA) Certified Electronics Technicians program has accredited electronics technicians worldwide who excel in areas of electronics equipment service and support. An electronics technician who successfully passes an ETA certification exam is professionally recognized as having the necessary knowledge and technical skills to meet international de facto electronics service industry standards. Even the best electronics schools in the world may differ in curriculum but without a doubt, a technician who passes an ETA certification exam is on an equal footing with other certified technicians anywhere in the world! Certification denotes proficiency in electronics, the ability to stand shoulder-to-shoulder with other certified electronics technicians worldwide, identifies you as a professional to your customers and peers, and improves your ability for advancement in the electronics industry.

Purpose of CET Certification
Becoming a Certified Associate, Journeyman, Senior, or Master Electronics Technician identifies you as a technician who has passed strict international electronics industry testing requirements.

Any electronics technician may take the ETA certification exam. Typically, technicians interested in certification work in the commercial or government sector, for an electronics retailer/distributor, for an independent service & support organization, are shop owners, educators, independent consultants, or military personnel.

I. What changes, if any, might need to be considered to foster enhanced program quality? Consider the following, but you need not limit your response:

- **change in admission requirements**
- **inclusion of an internship or other work-based learning experience**
- **introduction of 1 or 2 electives to allow students to self-select learning opportunities**
- **development of a capstone course to synthesize the learning experience**
- **varied instructional methodologies**
- **enhanced assessment of student competencies**
- **better integration of technology applications**
- **specific instructional aides/software etc.**
- **more coordination of faculty efforts, including the possibility of more full-time faculty**
- **attainment of program accreditation, certification, or licensure**

Response:

- Technology Careers Course (new course) – 1 credit
- New course in Technical writing (see attached)
- Evening Division support staff for technology students
  - Coordinator
  - Dean
  - Administrative assistant
  - Tutors
  - Open lab times – weekends
  - Email & Web boards
- Increase use of technology in the classroom
- Additional lab and storage space (RM217s)
- Certification

J. Summary and Analysis: Relevance

Response:

The Electronics Technology program has two primary goals:

- To provide people in the community with opportunities to develop the skills and knowledge they need to enter the technology workforce and/or continue their education.
- To meet the ever-increasing demand of local industries for technology graduates.

Achieving these goals depends primarily on two factors: curriculum delivery and student assessment. In order for diverse groups of students to develop their skills, the Electronics Program delivers curricula in a variety of ways, including in-class lectures, on-line resources, one-on-one tutoring, and hands-on activities in a state-of-the-art laboratory. Accurate assessment of students ensures that students are graded according to their level of mastery, and is essential to maintaining credibility with those organizations that hire QCC graduates.

Program credibility could be further enhanced by seeking external accreditation by ABET – a third-party organization, and by encouraging graduates to sit for the CET certification exam.

4. Program Growth Opportunities

A. In your opinion, would it be beneficial to develop a common core curriculum along related career programs? E.g., computer education, business, administrative support, electronics, etc.) Please explain your answer.

Response:
Both options in the Electronics Technology Program currently have a common core curriculum in the first year. The Electromechanical Technology Program, the Telecommunications Technology Program, and the Computer Systems Support Technology Programs also share this same first year. This presents an excellent opportunity for an educational career ladder that encompasses the two Electronics Technology options and the three related programs identified here.

In addition, by making a few minor changes to the Electronics Certificate requirements, the certificate can be made to map directly into the first year core curriculum. This provides students with a number of career choices. If they can only commit to one year, they can complete the Certificate. If they choose to continue in the future, they have five directions that they can choose from, and all of the courses they have taken will apply directly to the course requirements of whichever path they choose.

Proposed structure of Electronics and related programs:
First year:

- Electronics Technology Certificate Prepares students with the Electronics, Math, and English skills required for all areas of Electronics.
  (plus MAT 124 and ENG 102)
- MAT 124 and ENG 102 are not required for the certificate, but are required for all of the Associate Degree programs listed here.

Second year:
Possible educational paths:

- Electronics Technology – Electronics Technology Option
  - Prepares electronic technicians for careers in manufacturing or technical support. Because this option includes Calculus I and II, it is geared toward students intending to continue toward a BS in Electronic or Electrical Engineering Technology.
- Electronics Technology – Biomedical Instrumentation Option
  - Prepares graduates for careers as biomedical technicians working with electronic medical equipment.
- Electromechanical Technology
  - Prepares students for high-tech manufacturing careers as equipment technicians working with automated processes and equipment.
- Computer Systems Support Technology
  - Prepares students for careers as computer and network support technicians.
- Telecommunications Technology
  - Prepares students for careers in telecommunications working with voice and data communications systems.

B. Describe, in detail, all potential areas for program growth. Include, but do not limit your response to the following:

- **Career Ladder Potential**
- **New Degree or Certificate Options**
- **Professional/continuing Education Opportunities**
- **Professional Recertification Preparation/Test**
- **Flexible Delivery Options**
- **Enhanced Instructional Methodologies**
- **Improving Assessment for Student Competencies**
- **Distance Learning Course Development**

Response:

- **Career Ladder Potential:**
  This has been described in part A above.
- **New Program Option – IC Layout and Design:**
  The physical layout and construction of microcircuits is an essential component of high-tech industry. There is a clear demand for Electronics technicians with an aptitude for microcircuit layout. By creating a second year that includes CAD courses in IC layout, this program could be built as a third option using the same first year core curriculum.
- **Flexible delivery options:**
  Many full-time employees have need of continuing education, but are restricted from normally scheduled classes due to their work schedules. To accommodate this population, a number of academic courses are currently being offered on-line, such as Math, English, and some Humanities courses. On-line delivery is more of a challenge for technology courses due to the hands-on laboratory component, but there is potential for developing hybrid on-line/scheduled courses that are significantly more flexible than conventionally scheduled classes.

C. Summary and Analysis: Program Growth Opportunities

Response:
Probably the most significant opportunity for program growth is in repackaging and streamlining the Electronics Certificate, the two Electronics Technology program options, and the three related Electronics programs. The goal is to present a career ladder to existing and potential students that shows the relationship between the certificate, the programs and options. The career ladder would look like this:

First year:

- Electronics Technology Certificate (plus MAT 124 and ENG 102)

Second year:
Possible educational paths:

- Electronics Technology – Electronics Technology Option
- Electronics Technology – Biomedical Instrumentation Option
- Electromechanical Technology
- Computer Systems Support Technology
- Telecommunications Technology

The relationship between these programs reflects the relationship between all the different technology career paths in the field of Electronics. These programs and options should be presented as a cohesive unit in the QCC catalog, on the QCC web page, and in all marketing efforts.

5. <u>Students and Program Assessment (Review relevant data over the last five year period.)</u>

A. What have been the incoming students' average scores on QCC placement tests each year for the last five years?

Response:
N/A

B. What is the graduation students' average college GPAs over the last five years? GPAs in major courses? Please describe the additional measures of central tendencies: i.e. median, mode, etc.

Response:

EL	1993	3.13	14
EL	1994	3.50	12
EL	1995	3.28	15
EL	1996	3.31	13
EL	1997	3.37	22
EL	1998	3.15	17
EL	1999	3.08	11
EL	2000	3.08	6

C. If relevant, how have students performed during their field placements or related work based learning experiences?

Response:
The company with whom they share the work experience almost always offers full time employment at the completion of the coop experience. QCC electronics coop students are heavily recruited by an ever-increasing number of local industries. The employer and the faculty advisor evaluate students on their coop experience. I have worked with coop students for over 18 years as their faculty advisor and I am very happy to report that a coop work experience is a great opportunity for both the student and industry.

D. Indicate the number of students who have transferred to four-year programs, if applicable.

Response:
There is no accurate data available. Most students enter the electronics program with the intention of entering the work force after graduation. Many continue their education at a four-year college or university while working full time in their new career.

E. Track the average earnings of program graduates each year for the three years immediately following graduation.

Response:
Program graduates start with an average first year income of $35,000. Average second year income is $42,000, and by the end of their third year graduates are earning an average income of $48,000. Many graduates do much better than the average and almost all graduates will earn more than the faculty within the first three years.

F. Provide a summary of the program's enrollment patterns over the last five years.

Response:
Enrollment by Program

Code	Program	Fall 1996	Spring 1997	Fall 1997	Spring 1998	Fall 1998	Spring 1999	Fall 1999	Spring 2000
EL	Electronics Technology	84	85	75	74	61	56	52	43
CE	Electronics Technology Certificate					6	4	6	9

Enrollment for the past five years has been steadily decreasing. I believe there are several reasons for this decline in enrollments.

- Unemployment has been at an all time low for the past several years. Many electronic students are recently unemployed workers changing careers.
- New programs in Electromechanical and Computer Systems Engineering Technology have been in direct competition for the same students.
- Students taking courses at night do not have to declare a major until they wish to graduate.

G. Indicate the program retention rate over the same period. Note: Consider two cohorts: fall to spring (same year); fall to Following Fall (one year).

Response:
N/A

H. Determine the average number of semesters it takes for students to complete the program.

Response:
N/A

I. Define indicators of program quality. Describe strategies used to assess the success of the program in achieving its stated objects.

Response:
The prime indicator of program quality is the overwhelming response that the Electronics Program has had from area industries. We are currently working with four groups of students from Verizon, we have an initial group of students from Intel on campus, and we will have representatives from companies such as Compaq, Intel and EMC visiting the campus to recruit our students for job placements in their companies.

Graduates from the Electronics technology program that continue their education have been very successful. We have many students that went on to graduate from WPI, Worcester State, Framingham State, and the University of Massachusetts.

J. Summary and Analysis: Program Assessment

Response:
The best indication of program effectiveness is the overall success that graduates have in finding employment, staying employed, and advancing their careers in the field of Electronics. Over the last five years, the number of jobs available to graduates has consistently been greater than the number of graduates. Once employed, graduates have been successful advancing their careers or continuing their education, demonstrating that the foundation they received at QCC was relevant and complete.

6. Faculty

A. Is the current faculty able to adequately address the instructional needs of all courses, both general and specialty, in the program?

Response:
With the addition of a new faculty member in September 2001, the instructional needs of all the Electronics Department programs will be well covered. Departmental staffing will consist of three full-time instructors and ten part-time instructors.

B. Is institutional support for upgrading faculty credentials required? If yes, please explain the kind of upgrade required and approximate cost associated with the upgrade?

Response:
Faculty may apply for up to $700 per year of professional development funding through the professional development office. If more than $700 is needed, grants or Technology Division funds may be available. In addition, private industries such as Intel or government organizations such as the National Science Foundation often offer professional development support for faculty.

C. Over the last five years, what has been the ration between full-time and part time faculty within this program?

Response:
30% full-time

D. Describe how adjunct faculty are integrated into the existing program.

Response:
Adjunct faculty are usually included in departmental meetings and are always informed by whatever means available of any departmental decisions that would affect them. Adjunct faculty credentials are screened to ensure that they have the knowledge and abilities necessary to teach their courses. Adjunct faculty are actively recruited from industry by the program coordinator to ensure students have an active current relationship with representatives from industry.

E. Should the College employ additional full or part-time faculty in this discipline? Provide a detailed rationale.

Response:
One new full-time faculty member will join the department in September 2001. The employment of additional part-time faculty is usually handled on a semester-by-semester basis.

F. Describe how all faculty members contribute to curriculum development and over all program cohesiveness. Do ALL faculty members, both full and part-time have an opportunity to contribute to curriculum development?

Response:
Although the development of individual classes is the responsibility of the individual instructor, the input of the entire Electronics Department faculty, both full-time and part-time is used for departmental curriculum development. Department meetings would be the primary avenue to gather information in regards to changing courses or developing new courses. When sufficient information has been brought together, a departmental consensus is usually arrived at for any changes or additions.

G. Does the current level of support staff meet the needs of the program faculty? Please explain your answer.

Response:
The current level of faculty and lab instructors adequately meets the needs of the program, however, the addition of a Technology tutor would greatly assist students having difficulties in the classroom and the laboratory.
A technical assistant for the work area of Electronics, Electromechanical, Computer Systems Support Technology, Telecommunications, and Computer Systems Engineering Technology is needed.

H. Summary and Analysis: Faculty

Response:
The dedicated, hard-working faculty and staff of the Electronics department are directly responsible for the tremendous success of the electronics program. Over twenty years of successfully training and placing students into high tech positions and more than twenty years of success in the industry by the graduates of the program. The faculty and staff of the electronics department report directly to the students in the program and companies in the Electronics industry. The faculty and staff have developed and maintained a close working relationship with local area industry, local area high schools, as well as four-year colleges and universities.

SECTION III: Institutional Support and Other Program Resources

1. <u>Program Support (Please note: Use this section to reflect upon what institutional supports would useful and why).</u>

A. List targeted program marketing and recruitment strategies employed over the last two years? In your opinion, are they appropriate to sustain strong enrollment?

Response:
QCC employs the following marketing and recruitment strategies. At this point there is not enough data to indicate that any of these strategies are ineffective, therefore it is recommended that all of these are continued:

- The specific marketing strategies start with faculty, especially in high tech programs. Initiatives start with faculty networking with companies and professional associations through person-to-person contact, direct-mailings of letters, and direct telephoning. This is probably the most effective recruitment strategy, however, faculty members have limited time and therefore cannot reach a large number of program candidates this way.
- Also, marketing consistently takes place through the Admissions Office. They implement recruiting initiatives directly through personal visitations to high school counselors and their respective offices in addition to personal contacts with students at school functions such as College Information and Career Awareness Days. These efforts directly promote electronics technology with other QCC programs as well. The Admissions Office also conducts two Counselor Breakfasts per year, at which all program information is highlighted including electronics.
- In addition, promotional pieces such as the College viewbook, enhanced with electronics program slip sheets or brochures placed in end-page pockets, and the Technology Programs book, are direct-mailed through leads from college fairs, business trade expositions, and adult learners telephoning the Admissions Office requesting program specific information. Also, as in the case with the WTI programming transfer to QCC, a number of specific brochures were developed to promote the technology area including electronics.
- QCC has hosted open houses that specifically highlight technology programs. One such event was held in the spring of 2000.
- QCC's counseling and advising offices are also an important part of the mix. These offices promote specific areas such as electronics as potential students are counseled in the College's technology programming. Often students do not know enough about QCC's program offerings to make an intelligent choice until they have discussed their goals with a faculty member or advisor.
- Print and radio advertising have carried the message that QCC is the right choice for hands-on technology education. Here are some examples:
    - On radio, ads have focused on electronics along with one or two other technology programs.
    - Print ads include testimonials from industry representatives attesting to QCC's technology training capabilities.
    - News articles such as one that appeared June of 2000 in the Telegram and Gazette on the Electromechanical Technology program have raised the public profile of QCC's technology offerings.
    - Charter Media Channel 3 TV News (now taken over by NECN Channel 32 and called Worcester Nightly News) and Cable Access Channel 13, have also given airtime to electronics industry presentations held in Conference Rm. 107A.
    - Print ads specific to the Intel Corp. Scholarship Program have been running in the Worcester Business Journal and the Telegram and Gazette.
- Initiatives generated through QCC's Tech Prep program include promoting electronics and all other technology programs. The Tech Prep office arranges and conducts visits by high school students and other groups.
- The Admissions Office conducts "Women in Technology" college planning nights at local and regional high schools, which are attended by high-school age students as well as adult learners.

These events are technology specific, targeting women to consider technological careers, and therefore promoting QCC's electronics program in the process.

- The Admissions Office also visits local and regional companies, targeting employees with information about QCC's programs. Many of these are technology or electronics companies, with a critical need to upgrade the skills and knowledge of their workforce. These adult learners, in many instances, ask for additional information for their junior and senior high school aged children, investigating QCC as one of their college options.
- The Electronics Technology program is also promoted on QCC's website. Electronics, along with the other technology programs, are linked to the Admissions Office, counseling, and advising web pages.

B. Provide recommendations for new or additional marketing or recruitment strategies.

Response:
It is recommended that the Electronics Technology program and related electronics programs are marketed together as a cohesive unit with a common first year core. This would tend to attract more students into the general field of Electronics, where they could then choose to focus on one of the following five specific areas in their second year:

First year:
Electronics Technology Certificate

- Prepares students with the Electronics, Math, and English skills required for all areas of Electronics.(plus MAT 124 and ENG 102) MAT 124 and ENG 102 are not required for the certificate, but are required for all of the Associate Degree programs listed here.

Second year:
Possible educational paths:
Electronics Technology – Electronics Technology Option

- Prepares electronic technicians for careers in manufacturing or technical support. Because this option includes Calculus I and II, it is geared toward students intending to continue toward a BS in Electronic or Electrical Engineering Technology.

Electronics Technology – Biomedical Instrumentation Option

- Prepares graduates for careers as biomedical technicians working with electronic medical equipment.

Electromechanical Technology

- Prepares students for high-tech manufacturing careers as equipment technicians working with automated processes and equipment.

Computer Systems Support Technology

- Prepares students for careers as computer and network support technicians.

Telecommunications Technology

- Prepares students for careers in telecommunications working with voice and data communications systems.

C. **Does the program have sufficient linkages with business, community-based organizations, other colleges and universities, or K-12 public schools? Please explain and cite specific examples. Present in chart form as explained in the guidelines for C & D, opposite page.**

Response:

Organization	Relationship to QCC Electronics Program
Intel Corporation	Funded the creation of the Intel Technology Laboratory, which is the laboratory used for all electronics courses. Purchased Pentium III computers for the laboratory. Provides scholarship funds for new students. Provides paid internship opportunities for students. Provides funding for faculty development opportunities.
Verizon Communications	Sponsors the Next Step Program for Verizon Employees. Hosts curriculum development meetings with faculty from all over New England and New York state. Provides money for purchasing lab equipment which is also used by regular QCC students.
EMC Corporation	Has employed graduates from the electronics program. Provides CO-OP positions for students. Provides valuable feedback on Electronics curriculum.
Tech Prep Program	Serves as a feeder into the Electronics program from local High Schools. Provides early identification of students who are interested in a career in technology.

D. Provide suggestions for improved program linkages. What, if any, assistance do the program faculty need in order to facilitate these linkages effectively?

Response:
The most meaningful linkages for the Electronics program are with organizations that represent the sources of QCC students and the destinations of program graduates. In order to create and maintain these linkages, the electronics faculty must work closely with the Admissions office, the Placement office, and the transfer coordinator.

Local industries are both the source of students – those that seek retraining – and the destination of graduates. The most effective way to create and maintain linkages with local industry is in cooperation with the QCC placement office. This is an activity that is ongoing and needs to continue.

Although QCC has strong relationships with local high schools through the Admissions office, targeting guidance counselors with information about career opportunities for Associate Degree graduates could strengthen these considerably.

Most Electronics graduates seek full-time employment after graduation, but a significant percentage continue to study full-time towards a Bachelor's Degree. In addition, most of those who become employed continue their education on a part-time basis. For this reason, it is important to create and maintain linkages with four-year institutions. This should be done in cooperation with the transfer coordinator at QCC.

E. Does the program have appropriate equipment to meet the instructional demands of the program? (e.g., medical equipment, laboratory supplies, computer hardware and/or peripherals)

Response:
Since the renovation of the Electronics laboratory, the lab has had an adequate amount of equipment and supplies to support the first-year core electronics courses. The yearly budget has also been sufficient to replace basic equipment as necessary.

The advanced courses, on the other hand, present more of a challenge in maintaining laboratory equipment. The following table lists the second-year electronics courses and the equipment needed to support each course.

Course	Equipment used	Status
ELT 211 Electronic Instrumentation	Computers with Electronics Workbench, Oscilloscopes, function generators, breadboards	Need function generators with faster rise time on square wave function.
ELT 212 Communications Electronics	Computers with Electronics Workbench, Oscilloscopes, AM generators, function generators, breadboards	Need to replace AM generators.
ELM 251 Industrial Electronics	Electromechanical device assemblies with motors, drives and sensors – designed and assembled by program coordinator. Oscilloscopes, function generators, sensors.	Electromechanical device assemblies are adequate but limited. Need to add pneumatics trainers to meet all course objectives.
ELM 255 Electromechanical Systems	Industrial process equipment, vacuum training system	Only one vacuum training system and one industrial process system exists – not adequate for more than 5 students at a time.
ELM 257 Intro to Programmable Logic Controllers	PLCs, Electromechanical device assemblies with motors, drives and sensors	We have only 6 PLCs. Need 4 more at approx. $700 each.
ELT 255 Telecommunications I	Computers with Electronics Workbench, Oscilloscopes, function generators, breadboards	Recommend purchase of TIMS training modules (also needed for ELT 212).

F. If no, provide a list of required equipment purchases or upgrades. Please present this list in prioritized fashion and identify immediacy of the priority.

Response:

Priority	Recommended Equipment or Software	Courses that will use equipment	Approx. cost
1	**(QTY 4) ALB1764START1500E Micrologix 1500 PLC Training Kits** PLCs allow students to write their own control programs to perform a variety of functions using motors, sensors and switches. There are currently six of these training kits in the lab, but there is a need for five more units to support larger class sizes.	ELM 257	$3500
2	**HAS-200 Highly Automated Systems Training Simulator** This system is being developed through an industry/education/federal government partnership, with the objective of delivering an effective teaching tool for students of automation technology. The HAS-200 is a completely automated system that integrates motor control, robotics, sensor feedback, pneumatics, systematic troubleshooting, PLC programming and control, statistical process control, data collection, etc. Even more importantly, it allows the student to monitor and control the process through a software interface. Students will gain direct exposure to all aspects of an automated manufacturing environment.	ELM 251 ELM 255 ELM 257 MNT 110 MNT 115 MNT 210 MNT 216 MNT 250	$50,000
3	**Automation Studio – 15 licenses** This software allows students to simulate the design, testing and troubleshooting of almost any automated system on a PC. Due to	ELM 251 ELM 255 ELM 257	$17,000

	cost and space constraints, the use of real equipment actual equipment This complements rather than replaces actual equipment.	MNT 110 MNT 115 MNT 210 MNT 216 MNT 250	
4	**(QTY 5) Electropneumatic Training Stations** Pneumatic systems are found throughout the automated environments of high-tech industry. SMC corporation is a worldwide leader in pneumatic training equipment.	ELM 251 ELM 255 ELM 257 MNT 110 MNT 115 MNT 210 MNT 216 MNT 250	$40,000
5	**MKS-VTS-1B Vacuum Training System** Vacuum technology is heavily integrated into the high-tech manufacturing environment. QCC has one of these systems, which can support a team of 5 students at a time in the lab. An additional system is needed to support more students.	ELM 255 MNT ???	$15,000

G. Summary and Analysis: Program Supports

Response:
The Electronics Technology program would benefit from the following enhancements:

- Marketing the electronics and related programs as a cohesive unit and targeting appropriate audiences.
- Continuing to establish and maintain linkages with local industries, high schools and 4-year institutions.
- Upgrading the laboratory equipment used in the program.

2. Academic Supports

A. Are there sufficient instructional/research resources to support student learning in this program?

Response:
The following resources are available to students and instructors:

- Library – currently small and not used often by students or instructors.
- Internet access in laboratory and throughout campus.
- Classrooms equipped with computer screen projectors for instructor lectures.
- Access to shared folders provided by instructors.

B. Assess the overall currency of the current collection of books, periodicals, and audiovisual materials in the library. Recommend new acquisitions and/or periodical subscriptions. In addition, please work with the library staff to weed outdated materials from the library's current holdings.

Response:
Members of the Electronics faculty have recently worked with the library staff to weed out the Electronics collection in the library in preparation for the move to the new QCC library. In addition, Electronics faculty are given a budget allocation for the purchase of new and updated library materials each year.

C. Are there sufficient technology resources, specifically software and hardware resources? Are these resources available and accessible to students? To faculty?

Response:
Students have access to networked computers in the Electronics laboratory with Internet access, Microsoft Office, Electronics Workbench, Microprocessor simulation, and other software. Throughout the QCC campus, there are networked classrooms and laboratories that are open for student's use.

In addition to the resources identified above, each faculty member has an office computer. Faculty also have access to data projectors for use in the classroom. Some classrooms have data projectors permanently installed. For those that do not, mobile projectors are available.

D. Provide a list of recommended technology acquisitions (i.e., software, hardware, PC projection units, etc.) Please prioritize this list and identify the immediacy of the priority.

Response:
See response to question 2. F. above.

E. Does the Individualized Learning Center provide ample academic support services for students in the program?

Response:
The ILC currently has some limitations. There are a small number of computers, so the stations can fill up quickly. Also, much of the software used in the Electronics area (such as Electronics Workbench) is not installed in the ILC. Electronics students generally use the Intel Technology Lab during open lab times to complete assignments when necessary.

F. Provide recommendations for improved academic support services.

Response:
Many students entering the technology programs are not adequately aware of the spectrum of opportunities that are available to them, and how each technology program fits into the big picture. The QCC admissions and advising offices have general information about all QCC programs, but do not address the technology

area with enough detail to serve interested students. One way to address this would be to establish a Technology Advising Center, specifically for technology students.

G. Summary and Analysis: Academic Supports

Response:
N/A

3. Student Supports

A. How do your students explore career opportunities and prepare to access them?

Response:
The Placement Office at QCC exists for this purpose, providing students with job postings, lists of companies that employ QCC grads, resume writing workshops, and mock interviews. The Placement Office also coordinates on-campus recruitment events for specific companies or groups of companies. In addition, students go through the Placement Office to set up CO-OP positions, which often leads to full-time employment.

B. Provide recommendations for enhancing students' career exploration and planning.

Response:
Continue the activities now performed by the QCC Placement Office.

C. Are current student support services adequate to support the teaching and learning process? Consider:

- **Counseling Services**
- **Disability Services**
- **Health/Wellness Center**
- **Transfer Information**
- **Other Services (as listed in QCC catalog)**

Response:
A major challenge faced by all technology programs, including Electronics, is that making an intelligent program choice requires a level of technical literacy that most people do not have until they have had an opportunity to study and/or work in the field. This presents a catch-22 to students and career counselors. As a result, the advising staff at QCC do not have sufficient background to advise technology students.

D. Provide recommendations for additional services that would be beneficial to your students.

Response:
A Technology Advising Center would be of great benefit to the Electronics students as well as all technology students. The advising center would serve as a career counseling/exploration center for students.

E. Summary and Analysis: Student Supports

Response:
In general, the needs of seniors and graduates are being addressed well through the QCC Placement Office. Placement services have consistently proven themselves to be effective at helping students to find and apply for CO-OP positions and permanent employment. QCC is weakest in the area of counseling and advising new technology students to help them find an educational path that fits their interests, abilities, and aptitudes. A Technology Advising Center would provide this function.

4. Physical Facilities

A. Are the current physical facilities sufficient from an instructional perspective? If no, explain and provide recommendations.

Response:
With current enrollment levels, the classroom and lab space is adequate, although they are heavily scheduled. If, however, any of the two Electronics options or the three related programs that share the first year courses were to experience an increase in enrollment, the current lab and classroom space would quickly become inadequate.

B. Are the current physical facilities sufficient from a competitive perspective? If no, explain and provide recommendations.

Response:
Although the Intel Technology Laboratory is well-equipped and well-managed, its primary disadvantage is that ALL electronics laboratories, first and second year, are currently held there. The result is that the work areas are sometimes overcrowded. Also, some of the semiconductor processing equipment installed in the lab is surrounded by a minimum of work space, making it difficult to work with more than 4 students at a time. Other community colleges, such as STCC in Springfield, have several different electronics laboratories, each serving only two or three different courses. However, it is necessary to have strong enrollments to support the larger number of rooms.

C. Given enrollment projections, will additional classrooms or laboratories be required? If yes, please specify the requirements and identify immediacy of the need.

Response:
The daytime scheduling capacity of the Intel Technology Laboratory is limited to 15 lab periods: three lab periods per day (8:00 – 11:00, 11:00 – 2:00, and 2:00 – 5:00) Monday – Friday. However, it is necessary to schedule open lab times for students, as well as unscheduled lab times for the lab manager to address logistical details without students in the lab. The usable daytime scheduling capacity for the lab is 10 periods per week, with 12 periods as an absolute maximum.

If enrollments in Electronics, Electromechanical, Computer Systems Support, and Telecommunications were to all become fully enrolled with full-time students (20 day students per program), there would be between 80 and 100 first-year students all needing to take the same core electronics courses. This would require 4 or 5 laboratory sections for each of the two fall semester Electronics courses, requiring 8 to 10 lab periods – almost the entire laboratory schedule. Senior-level courses and off-cycle courses (courses normally offered in the spring that are offered in the fall and vice-versa) would need to be held in a different room.

Even at 75% enrollment for all programs, there would be 60 – 75 first-year students, requiring 6 – 8 lab periods, and leaving only 2 – 4 periods for other courses. In short, a significant increase in enrollment would require another laboratory space, and consequently more laboratory equipment.

D. Summary and Analysis: Physical Facilities

Response*:*
The primary limiting factor on enrollment capacity is the newly renovated Intel Technology Laboratory. While this laboratory is well equipped and serves the needs of the program for the time being, a significant increase in enrollments in the Electronics and related programs would quickly strain the lab beyond its limits. Any efforts at improving the marketing of these programs should be accompanied by an eye to future expansion possibilities.

One solution could be to create new lab space that could be shared with other technology programs and courses such as Manufacturing and/or Physics.

5. Program Financing

A. Has the program's funding been sufficient over the last five years? Please explain your response.

Response:
In general, the program budget has been adequate in maintaining basic lab equipment and supplies over the last five years. However, a number of very significant program enhancements would not have been possible without generous support from private industry. The following were funded by Intel Corporation:

- The creation of the Intel Technology Laboratory through extensive renovation of the electronics laboratory.
- The purchase of 24 Pentium III computers for the Intel Technology Laboratory.
- The purchase of the MKS VTS-1B Vacuum Training System for the Electromechanical Technology Program.
- The installation of semiconductor processing equipment in the Intel Technology Laboratory

Other equipment and lab furniture was acquired during the adoption of the WTI Electromechanical Technology program. These include:

- The acquisition of 10 lab benches.
- The acquisition of 10 new 100 MHz 4-channel oscilloscopes.

In short, while the program budget has been adequate in maintaining the program, any major enhancements, such as acquiring new lab space and/or equipment, require other funding sources.

B. Provide an analysis of the cost of this program. Be sure to include ALL costs. (For example, costs associated with instructional salaries, space, lost opportunity costs, equipment rentals and/or maintenance, etc.

Response:
N/A

C. Based on your enrollment projections, are there projected increases or decreases in the budgetary requirements of this program over the next five years?

Response:
N/A

D. Summary and Analysis: Program Financing

Response:
N/A

Section IV: Executive Summary of Findings

A. Briefly summarize the program highlights and recommendations for program improvement (2-4 pages). Provide a summary of action steps that prioritize what needs to be done with an estimated timeline for completion. Remember that this document will be presented to the QCC Board of Trustees and the President's staff as a tool for negotiating necessary program resources.

Response:
The Electronics Technology program at Quinsigamond Community College is well positioned to serve the general public and the business community in Central Massachusetts. The mission of this program is to provide a bridge that meets students where they are and gives them an affordable means to access the high-tech workplace.

An examination of local industries, careers, and the employment outlook reveals that a high premium is placed on individuals who acquire and demonstrate technical literacy. Technology has become woven into the fabric of the 21st century economy, presenting opportunities to graduates beyond the obvious careers in Electronics and into areas such as manufacturing, sales, and office support.

The Electronics Technology program, along with three other related programs – Electromechanical Technology, Computer Systems Support Technology, and Telecommunications Technology – provide an array of career choices for students interested in the field of Electronics.

The primary goals of the Electronics Technology program are:

- To prepare students for careers in technology, requiring them to develop and demonstrate analytical skills, communication skills, professional work habits and interpersonal skills.
- To guide students through job searches, resume writing and developing interviewing skills.
- To prepare students to continue their education at the Bachelor's level.

In order to accomplish these goals in the present and continually improve the program's effectiveness in the future, there must be strong ties to the community as well as an awareness of the technological marketplace at the state, national, and global levels. Looking into the future, the following forces will be used to guide program design and revision:

- Input from local industry representatives
- Nationally recognized skill standards maintained by the Electronic Industries Association.
- Recognized academic standards from both the Board of Higher Education and from independent accrediting bodies such as ABET.
- Requirements of Bachelor's level programs where graduates are likely to continue their education.

The following list highlights the strengths of the Electronics Technology program, taking into account the proposed curriculum:

- A curriculum that requires students to develop and demonstrate analytical skills, communication skills, professional work habits and interpersonal skills.
- A career ladder consisting of a common core curriculum in the first year and five possible choices for the second year. Students may enter and exit at different levels, depending on their individual requirements.
- A newly renovated laboratory that provides students with a learning environment that reflects the 21st century workplace.
- A dedicated faculty who bring extensive educational background and real-world experience into the classroom.
- State-of-the-art laboratory equipment.
- Ongoing support from Intel Corporation in the form of lab equipment, scholarships, and summer internships for students.

Instruction within the program is accomplished by combining classroom lectures with hands-on laboratory assignments. Students demonstrate their mastery of the material through written in-class tests and producing high quality lab reports. Lab reports are evaluated according to the standards of professional documents used in industry.

The following is a list of areas needing improvement:

- Overall program enrollment management needs to be more effective to address low enrollments.
- Scheduling of classes needs to be more flexible to allow more working students to participate in the program.
- New students need access to better advising before they make critical decisions about their educational path.
- Equipment and software in the laboratory need to be continually upgraded in order to keep pace with developments in technology.
- The Electronics Technology Program needs to seek ABET accreditation.
- The college must be prepared to expand laboratory space in the event of significant increases in enrollment.

The following is a list of action items, in order of priority, designed to address the areas needing improvement that are listed above. These action items are divided into two sections, general and equipment-related.

General action items:

IP
- Develop an enrollment management plan that involves the following:
  - Collect data from all people who inquire about the program. Particularly important is noting how they heard about the program. This would give an indication of the most effective marketing methods.
  - Advertise to high school tech prep students, employees at local companies, and students at QCC who have not yet chosen a clear educational path.

HP
- Explore ways in which Electronics courses could be delivered partially on-line to accommodate students' work schedules. Develop a pilot on-line course for Electronics I that delivers curriculum primarily over the Internet but requires students to be on campus weekly or bi-weekly to complete lab work.

HP
- **Establish an Automation Technology Training Institute at QCC (This is partly equipment-related. See action item below for purchase of HAS-200 system.)**

  Due to our involvement with MATEC and our partnership with Intel Corporation, QCC is uniquely positioned to take advantage of an opportunity to establish an Automation Technology Training Institute on the QCC campus through an industry/education/government partnership that includes Intel Corporation, MATEC, the National Science Foundation, and SMC International Training. Participation in this pilot project will require the following from QCC:
  - Dedication of approximately 500 sq. ft of lab space and 500 sq. ft of classroom space to house the equipment. (Classroom space may be made available for other uses as well.)
  - Purchase of automation training equipment for half cost at $50,000. (See action item below.) Schools are encouraged to raise part of this through grants and donations.
  - Assignment of a lead faculty member to head the pilot program on campus.

  The Technology division has already acquired approximately 1000 sq ft. of classroom and lab space in the lower floor of the Field House, and plans are being laid to convert an additional 2000 sq ft to academic use. The area is intended for laboratory and classroom space for courses in Electromechanical Technology, Manufacturing Technology, and Physics.

IP
- Establish a Technology Center that would focus on tracking, supporting, and graduating a committed, diverse student population in the area of Technology and would be set up to operate as a student and faculty drop-in center with eight workstations.

IP
- Establish a Technology Advising Center for the Technology Division.

IP
- Investigate the requirements for ABET accreditation and begin the process of becoming accredited.

Equipment-related action items:

Priority	Recommended Equipment or Software	Courses that will use equipment	Approx. cost
HP	• **(QTY 5) ALB1764START1500E Micrologix 1500 PLC Training Kits** PLCs allow students to write their own control programs to perform a variety of functions using motors, sensors and switches. There are currently six of these training kits in the lab, but there is a need for five more units to support larger class sizes.	ELM 257	$3500
EP	• **HAS-200 Highly Automated Systems Training Simulator** This system is being developed through an industry/education/federal government partnership, with the objective of delivering an effective teaching tool for students of automation technology. The HAS-200 is a completely automated system that integrates motor control, robotics, sensor feedback, pneumatics, systematic troubleshooting, PLC programming and control, statistical process control, data collection, etc. Even more importantly, it allows the student to monitor and control the process through a software interface. Students will gain direct exposure to all aspects of an automated manufacturing environment.	ELM 251 ELM 255 ELM 257 MNT 110 MNT 115 MNT 210 MNT 216 MNT 250	$50,000
EP	• **Automation Studio – 15 licenses** This software allows students to simulate the design, testing and troubleshooting of almost any automated system on a PC. Due to cost and space constraints, the use of real equipment actual equipment This complements rather than replaces actual equipment.	ELM 251 ELM 255 ELM 257 MNT 110 MNT 115 MNT 210 MNT 216 MNT 250	$17,000
EP	• **(QTY 5) Electropneumatic Training Stations** Pneumatic systems are found throughout the automated environments of high-tech industry. SMC corporation is a worldwide leader in pneumatic training equipment.	ELM 251 ELM 255 ELM 257 MNT 110 MNT 115 MNT 210 MNT 216 MNT 250	$40,000
EP	• **MKS-VTS-1B Vacuum Training System** Vacuum technology is heavily integrated into the high-tech manufacturing environment. QCC has one of these systems, which can support a team of 5 students at a time in the lab. An additional system is needed to support more students.	ELM 255 MNT 110 MNT 115 MNT 210 MNT 216 MNT 250	$15,000