Missouri Department of Higher Education

Building Missouri's future...by degrees

NEW PROGRAM PROPOSAL FORM

Sponsoring Institution(s): Jefferson College

Program Title: Biomedical Electronics Technician

Degree/Certificate: Associate of Applied Science in Biomedical Electronics Technician

Options: Not Applicable

Delivery Site(s): Jefferson College, Hillsboro Campus

CIP Classification: 15.0401 (Please provide a CIP code)

Implementation Date: Fall 2012

Cooperative Partners: NA

AUTHORIZATION:

Dr. Joyce Banjac, CAO	Joyce A. Banjac	3/30/12
Name/Title of Institutional Officer	Signature	Date

Mary Beth Ottinger	636-481-3467
Person to Contact for More Information	Telephone

1. Need:

i. Student Demand: Please see attached Form SE.

Year	1	2	3	4	5
Full Time	12	18	18	18	18
Part Time	6	1	1	1	1
Total	18	19	19	19	19

ii. Enrollment is currently limited to 19 students per class due to available space and resources with the desire for lower instructor to student ratios for lecture and laboratory time.

A. Market Demand:

Missouri has been aware of and committed to the need for excellence, for greater accountability, and to increased performance as a state for decades. Perhaps you will recall the Show-Me Standards which was adopted by the Missouri State Board of Education in 1996. In the introduction, it stated that "the success of Missouri students depends on both a solid foundation of skills and the ability of students to apply their knowledge and skills to the kinds of problems and decisions they will likely encounter after they graduate." That language is as pertinent today as in 1996. Student performance on state assessments has increased each year over the past two decades. Graduation rates continue to climb. The number of students leaving high school and going on for post-secondary training or education is higher than ever.

The 2011 State of the Workforce Report was developed as a planning tool for the Missouri Division of Workforce Development by the Missouri Economic Information Center (MERIC). It indicated that "Missouri had not been immune to the larger effects of the national recession that began in the last months of 2007. Many industries were greatly impacted and some of these industries may never return (6)." Promotion of new industries and the implementation of new strategies to create a newer and stronger economic climate are of primary concern. Analysis of local, regional, and state data indicates a justifiable need for a Biomedical Electronics Technician educational program. A Biomedical Electronics Technician trained in the repair of medical equipment is on the list of Missouri's "Hot Jobs" for 2008-2018. According to the Department of Elementary and Secondary Education (DESE), to be rated 'hot,' an occupation must be growing, have numerous openings, and offer better-than-average wages, according to the Missouri Economic Research and Information Center.

In 2007, the Missouri P-20 Council was create by then-Governor Matt Blunt, and consisted of the Department of Elementary and Secondary Education, the Department of Higher Education, and the Department of Economic Development. The Council's first initiative was "*Workforce 2025: Missouri's Labor Force of Tomorrow*." One of the recommendations in this report was "the need for a sustained pipeline of highly skilled, well-educated technicians and workers in high-tech/high demand industries." Consequently, building on the

recommendations of this council, current Governor, Jay Nixon, laid out five principles for his vision of Missouri in his 2009 State of the State Address. The first principle was economic and workforce development while the second principle is an increasingly stronger education system. A Biomedical Electronics Technician program at Jefferson College can merge both of these principles. Subsequently, in 2011 Governor, Jay Nixon in addressing the 50th Annual Cooperative Conference for School Administrators voiced his agreement on the topic of the Top 10 by 20 Initiative that the No.1 goal is, "All Missouri students will graduate college and be career ready." Jefferson College acknowledges the vision of the Department of Elementary and Secondary Education. A Biomedical Electronics Technician degree program is designed to fulfill the strategy voiced by the Top 10 by 20 Initiative's No. 1 goal. Jefferson College will fulfill the need for a technically skilled workforce by providing students with this excellent career choice.

Analysis provided by the Missouri Economic Research and Information Center (MERIC), Missouri Department of Economic Development ranks hospitals in their top ten employing industries. Demographically, the Healthcare Industry continues to create a growing need of highly trained workforce to service biomedical equipment. This trending translates into an ever evolving and technically sophisticated workforce. It is not surprising that the Missouri Economic Research and Information Center (MERIC) reports the Health Care Industry as one of few that will expand significantly in the next few years. Governor Jay Nixon launched the "Caring for Missourians" program in 2009 to train additional Missouri students to enter high-demand, critical-need health care fields. Governor Nixon announced "Caring for Missourians will help train the next generation of medical professionals to meet the health care needs of tomorrow while also helping turn the economy around today."

MERIC projects a 12.3% increase in the Health Care workforce statewide by 2016. The Missouri Career Report assigns grades to careers based on growth rates, average wages, and total openings over the next 10 years. It listed the middle skill occupation of Medical Equipment Repairers growing at 19.6% per year and rates it as "Above Average B+" in the "Top 10 Occupations by Projected Growth" category. In addition to employment growth, job openings will result from the need to replace workers who leave the occupation. According to the US Department of Labor State Wages, the 2010 Mean Annual Salary for Biomedical Electronics Technician is $41,020 and that amount can vary based on location and type of facility as well as number of years' experience. Jefferson College has a long standing track record of providing programs that are in step with our states visionaries. Helping Missouri to position itself as a leader in the new global economy and utilizing educational systems, business and industry to fill the jobs the new economy will bring is core to Jefferson College.

The Economic Indicators section of the 2011 *Missouri State of the Workforce Report,* reports "in the past couple of decades, a much different picture of Missouri has emerged with a shift from a goods producing to a service producing economy. Health Care, Information Technology, Education and Professional & Technical Services are the new leading industries replacing traditional ones such as manufacturing (6)." Because "having a skilled and educated workforce that is ready and able to meet the demands of an evolving economy will be the key to sustaining and attracting new industries to the state (9)", new training programs, such as Jefferson College's Associate of Applied Science Degree in Biomedical Electronics

will assist in creation of this new workforce. The Workforce in Training Section of this same report states "Education and Training of Missouri's workforce needs to be the centerpiece of new economic policy to drive a more advanced and sophisticated workforce. There are forty-four two-year colleges in Missouri "that allow for faster workforce training and lower costs to the students (44)." However only two that currently offers a similar program. Again, a Biomedical Electronics Technician program at Jefferson College fits into this needs assessment. In an article titled, *Projections of Jobs and Education Requirements* by The Georgetown University Center on Education and Workforce projected, "By 2018, 59% of jobs in Missouri will require postsecondary education. This is 4 percentage points below the national average of 63% and Missouri ranks 34th in postsecondary education intensity for 2018 (61)."

From a national perspective, the U.S. Bureau of Labor Statistics (BLS), wage and salary employment in the healthcare industry is projected to grow 22 percent between 2006 and 2016. That translates into about 3 million new jobs—nearly 20 percent of the total number of jobs expected to be added to the economy over the projections' decade.
In the 2011 *Missouri State of the Workforce Report*, "between 2008 and 2018, Missouri's employment is projected to grow by over 3% across all occupations and there will be 829,000 job openings due to growth or replacement (17)". Growth openings are new jobs added to the economy while replacements are not new jobs, but rather created due to turnover or retirement. Almost 10% of the new growth jobs created will require an associate degree level of education and training. During this same period of 2008-2018, half (ten of twenty) of the occupations with the fastest projected growth are health care-related, including medical equipment repair. The Biomedical Electronics Technician is considered a middle skill occupation. These middle skill careers make up the majority of employment in Missouri, and most often have the most openings within the projections' time periods. These middle skill occupations make up 43.7% of the jobs in Missouri. Collectively, these middle-skill level occupations are expected to have 162,600 growth openings between 2008 and 2018 (18)". Due to the relatively short training period required, an Associate of Applied Science degree in Biomedical Electronics will provide a means of reemployment for dislocated workers who can then reengage in the workplace. While unemployment rates have been on the decline during 2011, eastern Missouri counties to include Jefferson County, St. Louis County, St. Louis City, Franklin, Washington, St. Francois, Ste. Genevieve, and Iron Counties continue to have unemployment rates ranging from 7.4-11% of their populations. These are the counties from which most of our student population would matriculate.

According to the Executive Summary in the 2011 *State of the St. Louis* workforce report, "employers must continue to partner with area education and training providers so that developed curricula packages technical expertise with academic competencies to ensure quality of future talent. In the dislocated worker survey included in this report, the third most reported barrier to committing to long-term training was the "lack of training/education program in my area." Again, a biomedical electronics technician program at Jefferson College could address the needs of training dislocated workers in the surrounding areas.

On a national level, Health Leaders Media Council reports in September 2011 that the healthcare sector has "again provided about the only bright spot in an otherwise drab report

on job growth from the U.S. Bureau of Labor Statistics. Healthcare employment rose 29,700 jobs in August (2011), and the sector has created 205,100 new jobs in the first eight months of 2011, accounting for 22% of the 930,000 non-farm payroll additions in the overall economy in 2011.

In his January 2011 State of the State address, Governor Nixon said, "We're fighting for every worker who needs a new skill to complete. We're fighting for every student who dreams of college and a career. And because we've been frugal, we have money to invest in the things that matter most to Missourians: jobs, education, health care, and law enforcement. To compete for twenty-first century jobs, we need a highly skilled and well-trained workforce. Our Training for Tomorrow and Caring for Missourians initiatives are preparing thousands more workers for the careers of tomorrow. We've invested millions in training workers to meet the growing demand in fields like computer technology, clean energy, automotive technology, and health care. Much of that training is taking place in our excellent community colleges, where the link between education and employment has always been strong. We've also invested $40 million in training more than 1,000 doctors, dentists, nurses, and other professionals through our Caring for Missourians initiative. With the booming demand for health care, they'll be ready to step into careers the minute they graduate."

In summary, a Biomedical Electronics Technician Program not only aligns with the mission of Jefferson College, but also Governor Nixon's vision for all of Missouri.

B. Societal Need:

Health care is an ever changing industry that must adjust to meet the needs of its ever-changing population. Medical equipment increasingly, integrates a medical device; an information system of hardware, software applications, and/or plug-in programs; and wired and/or wireless telecommunications networks into a total solution. The convergence of medical technology, information technology (IT), and telecommunications means that medical devices are more complex. Consequently, the skills required for procurement, integrating, managing, and servicing medical equipment is increasing as well.

In 2011, the first members of the Baby Boomer generation turned 65 years old. It is estimated that by 2030, those over the age of 65 will represent 20% of the population. Due to improvements in the practice of medicine as well as technology, adults who reach the age of 65 are likely to live an additional 19 years. Medical and technological developments have also permitted an increased percentage of trauma victims and newborns with birth defects to survive, creating added demand for therapy and rehabilitation services.

Experts' say, the increasing use of home healthcare is posing new challenges and opportunities for biomeds' who are responsible for servicing and maintaining the equipment. Speaking to attendees at AAMI's 2009 Annual Conference, the experts noted that many factors have led to more patients receiving care at home. "More and more people are receiving care at home because of the cost, wanting to live independently, and hospitals are discharging people more quickly," said Mary Weick-Brady, Senior Policy Analyst and Chair of the Homecare Committee for the U.S. Food and Drug Administration's (FDA) Center for

Devices and Radiological Health. An aging population is also increasing the demand for home care and medical technology that comes with it. Biomed departments in hospitals play a vital role in homecare by servicing and maintaining the equipment.

Currently, about 80% of those over the age of 65 have one chronic condition, while 50% are living with two or more chronic conditions. Examples of chronic conditions include arthritis, high blood pressure, heart disease, diabetes, and osteoporosis. Manifestations of these chronic conditions, including functional impairments such as decreased strength, balance, and mobility can lead to falls and further disability. These chronic conditions and their resulting impairments lead to increased utilization of health care as evidenced by appointments with physicians and hospital stays, and other costs to society.

According to an article in 2007 in The Chronicle of Higher Education, this rapid aging of the population has caused the Federal Bureau of Labor Statistics to project that 3.5 million more health care workers will be needed to meet the increasing demand. This number is in addition to replacements for the two million health care workers who will leave their positions.

The Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 is spurring the healthcare industry to increase the use of electronic health records (EHRs). The HITECH Act, which was part of the fiscal stimulus bill known as the American Recovery and Reinvestment Act, included $19.2billion for EHR systems. The need for new roles is coming to the forefront as medical devices are being integrated with the electronic medical record, and physicians and clinicians are expecting a single, localized support team for a growing breadth of technologies.

Health care is beginning to shift toward wellness and prevention of common disease processes as evidenced by federal initiatives such as Healthy People 2010, Healthy People 2020, and The National Prevention Strategy: America's Plan for Better Health and Wellness, launched earlier this year. This latter initiative is a call to action for health care providers. The goal of this strategy is to "move the nation away from a health care system focused on sickness and disease to one focused on wellness and prevention." These strategies will improve the health of our nation and provide increasing opportunities for individuals across the lifespan and of all abilities."

The annual visit to a doctor's office for a check-up has long been seen as the key to preventive medicine. Now, inventive entrepreneurs are starting to develop personal medical devices that can monitor a person's condition during the months between doctor visits. The devices can send alerts to doctors or other caregivers when things start to go wrong and allow for much timelier interventions. These devices can improve patients' lives, control their medical conditions and in some instances, possibly avoid the high costs of emergency room visits. They can also add real-time data about patients' vital signs to electronic health records.

New devices such as the tablet-based home healthcare companion is designed to track vital signs like blood pressure, weight and glucose levels, remind patients to take their medication and allow for automatic video-conferencing with a doctor when help is needed. Meanwhile, a pocket-sized lab device screens patients' blood for bacterial infections and determines what

antibiotic to prescribe within 60 minutes. Additionally, development of products like the Wander ID can use biometrics like facial recognition to help rescuers identify lost and confused people who have wandered away from nursing homes or group care facilities.

In summary, a Biomedical Electronics Technician program at Jefferson College can positively impact society by educating students who can serve as advocates of healthy living as well as addressing the needs of a aging population. BMET students will be trained to maintain, adjust, calibrate, and repair electronic, electromechanical, and hydraulic equipment used in hospitals and other medical environments. They will use tools common to the electronics trade, such as multi-meters, oscilloscopes, and soldering irons as well as equipment specific to the field such as pressure monitors and various computer applications designed to perform diagnostic procedures, but because many also have mechanical and hydraulic components, being familiar with all of these systems is critical. BMET's also must be educated in the practices of maintaining careful, detailed logs of all maintenance and repair that they perform on each piece of equipment.

According to the U.S. Bureau of Labor and Statistics job opportunities in the BMET field are projected to grow at a rate much faster than average between 2008 and 2018, allowing for an excellent range of opportunities for those in the field who are qualified. With an extensive network of healthcare facilities in the Saint Louis region, these statistics should prove to be an accurate representation for prospective Jefferson College students.

Jefferson College is providing clear leadership by initiating a Biomedical Electronics program. These efforts will foster access, success and lifelong learning for all students while simultaneously advancing the state's interests in a skilled workforce and an educated citizenry.

C. Methodology Used to Determine Above Noted Demand and Need:

Research was conducted utilizing information, reports, and articles from sources including the United States Department of Labor, Missouri Economic Research and Information Center, the Office of Governor of Missouri, Missouri Hospital Association, American, Workforce Investment Boards, Occupational Outlook Handbook, Department of Elementary and Secondary Education.

2. Duplication and Collaboration:

St. Louis Community College at Florissant Valley is the only program offering an Associate of Applied Science in Biomedical Engineering Technology near Jefferson College. St. Louis Community College at Florissant Valley is located in St. Louis County, 55 miles north of Jefferson College. St. Louis Community College at Florissant Valley offers a Biomedical Engineering Technology program in a 73 hour curriculum format. In contrast, Jefferson College will offer a Biomedical Electronics Technician Program using a two year, integrated format in which the general education and technical courses occur together throughout the two years.

Linn State Technical College, in Jefferson City, is 113 miles from Jefferson College. This program structure has a range of 70-83 hour curriculum. This format has produced 5 graduates with the Electronics Engineering Technology - Biomedical Engineering Technology Option in 2011.

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STUDENT ENROLLMENT PROJECTIONS

Year	1	2	3	4	5
Full Time	12	18	18	18	18
Part Time	6	1	1	1	1
Total	18	19	19	19	19

www.dhe.mo.gov • info@dhe.mo.gov

205 Jefferson Street, P. O. Box 1469, Jefferson City, MO 65102 • (573) 751-2361 • (800) 473-6757 • Fax (573) 751-6635

PROGRAM STRUCTURE

A. Total credits required for graduation: 70-75

B. Residency requirements, if any: Course/program fees are assessed based on residency status.

C. General education: Total credits: 19-21

General Education is an aspect of the College's instructional program which enables a student to acquire general knowledge and intellectual skills: to achieve some level of basic competencies, to prepare for advanced work, and to develop the skills and knowledge needed to function in society. These General Education courses required for the Biomedical Electronics Technician Program consist of college-level (non-remedial) coursework, including all relevant prerequisites and/or necessary test scores.

The following are the Associate of Applied Science General Education, Institutional, and Biomedical Electronics Technician Program Requirements:

Written Communications (3)

ENG101* English Composition I (3)

Humanities or Communications (3)

SPD105 Oral Communication (3)

Social and Behavioral Sciences (6)

PSC102 U.S. and Missouri Governments and Constitutions (3)
Or HST103 U.S. History I (3)
PSY101 General Psychology (3)
PSY205* Human Development (3)

Mathematics and/or Natural Sciences (6)

BIO116 Anatomy and Physiology (3)
MTH128 Intermediate Algebra (3)

Computer Literacy (3)

CIS133 Microcomputer Software Applications (3)

First Year Experience (1-3)

COL101 Introduction to College: Strategies for Success
Or GUD136 Mastering the College Experience
Courses designated with a "*" have prerequisites or necessary test scores for registration.

D. Major requirements: 48-51 total credits

These courses contain fundamental theories, practical skills, and competency requirements that fulfill content and performance standards of biomedical electronics technicians' education programs. Students in this option will also become qualified to take the Association for the Advancement of Medical Instrumentation (AAMI) certification exam and/or the Electronics Technicians Association (ETA) International Biomedical Electronics Technician (BMD) certification exam.

ETC103 DC Circuits	(5)
ETC104 AC Circuits	(5)
ETC132 Semiconductors I/Lab	(5)
ETC133 Semiconductors II/Lab	(5)
BIT122 Medical Terminology	(3)
CIS150 Introduction to Computer Support	(3)
BET2xx Electronic Control Technology	(6)
BET2xx Lasers and Optics	(4)
BET2xx Diagnostic Imaging	(3)
BET2xx Diagnostic Instrumentation Systems	(6)
BET2xx Therapeutic Instrumentation	(3)
	48

E. Free elective credits:

There are no electives in the Biomedical Electronics Technician Program.

F. Requirements for thesis, internship or other capstone experience:

BET2xx Biomedical Electronics Technician Internship (3)

The internship is an optional work experience in a biomedical facility under the supervision of an experienced biomedical engineering technician. The student will assist in the performance of safety inspections, preventive maintenance, repairs and calibration of medical equipment. Supervision of the intern is shared by the working environment supervisor and the faculty advisor. Internist performance is evaluated in the working environment of the supervisor and faculty advisor. Topics include: problem solving, use of proper interpersonal skills, interpreting, work authorizations, identifying logistical support requirements, servicing biomedical instruments, and professional development.

G. Any unique features such as interdepartmental cooperation:

Certain classes may include group projects requiring interaction with students of other health occupations at the college.

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PROGRAM CHARACTERISTICS AND PERFORMANCE GOALS

Jefferson College
Biomedical Electronics Technician Program
March 28, 2012

Student Preparation:

Admission to the Biomedical Electronics Technician Program will require the following:

- Students will complete DC/AC circuits, Semiconductor I & II each with a grade of "C" or better.
- Students will need a minimum cumulative GPA of 2.5 or higher.
- Students will need standardized test scores from within the past two years. The minimum acceptable ACT composite score is 18 and no subscore below 18 will be allowed. The other acceptable standardized test is the COMPASS Test. The minimum acceptable Writing Score on this test is 70; the minimum acceptable Reading Score is 82; and the minimum acceptable Algebra Score is 42. These test results, combined with any necessary remedial coursework, will place the students at the necessary level to successfully complete the General Education requirements within the curriculum.
- Admission will be contingent upon a negative drug test, clear background check, and up to date physical and vaccinations.

Characteristics of a specific population to be served, if applicable:

The first sentence in the mission statement of Jefferson College includes a commitment "to providing an accessible, quality college experience as it strives to meet the diverse needs of the students and community." Therefore, the Biomedical Electronics Technician program will be open to recent high school graduates as well as those seeking a different career path for any number of reasons to include recent displacement, desire for increased job security or flexibility, etc.

Faculty Characteristics:

- All faculty of the Biomedical Electronics Technician program will meet all of the requirements of employment by Jefferson College.
- As per the requirements of the AAMI and ETA competency requirements, the program director of the Biomedical Electronics Technician program must hold a master's degree, have a minimum of five years of experience as a electronics service engineer in the appropriate environment that includes telecommunication, networking support, computer engineering.
- As per the requirements of a minimum of 3 years experience in curriculum development, and experience in a variety of areas of teaching.
- The program director and academic coordinator, along with any other academic and faculty, will be responsible for all initial and on-going accreditation requirements, development and assessment of curriculum, and program outcomes.

- All academic faculty as a unit will have the qualifications and experience necessary to achieve program goals.
- All education faculty selected will meet set criteria to demonstrate the capacity to perform as a effective teacher.
- It is estimated that 100% of the credit hours will be assigned to full time faculty.
- All faculty in the Biomedical Electronics Technician Program will follow the policies and procedures as listed in the Jefferson College Faculty handbook in regard to workload responsibilities of teaching semester hours, contact hours, institutional service, conferences, and student advisement.
- The core faculty of the Biomedical Electronics Technician Program will be responsible for advisement of all students in the program once admitted to the program.
- All academic faculty will be encouraged to be members of Association for the Advancement of Medical Instrumentation (AAMI) and Electronics Technicians Association, International (ETA).
- The core Biomedical Electronics Technician Program faculty are expected to keep abreast of latest practice through frequent reading of the available professional literature and attending annual national conferences to enhance professional development. These faculty members are also expected to keep abreast of the latest best practices in teaching techniques by attending local workshops and other available faculty development activities.
- In keeping with the expectations and characteristics of the latest generation of students, all Biomedical Electronics Technician Program faculty are expected to utilize the technology available today, to include, but limited to eBooks, IClickers, SMART board technology, interactive CD-ROMS and DVDs for classroom and laboratory instruction and simulation of the clinical environment.

Enrollment Projections:

- It is estimated that by the end of five years, the number of full-time students majoring in the program will be (18x5) = 90.
- It is estimated that by the end of five years, the number of full-time and part-time students will be 94.

Student and Program Outcomes:

- At the end of three and five years after program implementation, the annual number of graduates will be 15.
- It is estimated that 90% of graduates from the program will pass the ETA Biomedical Electronics Technician certification exam.

- As per current, Association for the Advancement of Medical Instrumentation (AAMI) certification and/or the Electronics Technicians Association (ETA) International Biomedical Electronics Technician (BMD) certification exam competency requirements.

- Jefferson College requires an exit exam for all graduates to monitor and improve academic achievement. Because students, who successfully complete the Biomedical Electronics Technician Program, will receive an Associate of Applied Science degree, they will take the Electronics Technicians Association (ETA) International Biomedical Electronics Technician (BMD) certification exam.

- It is estimated that 90% of graduates will be placed in fields related to medical equipment repair. It is estimated that 10% of graduates will be placed in other fields, while 0% will be unemployed.

- It is estimated that 10% of students will transfer into another program or continue his/her education beyond the associate of applied science degree.

Program Accreditation: N/A

Alumni and Employer Survey:

- Every three months, Jefferson College conducts surveys via phone and mail to reach most recent graduates and alumni. The biomedical electronics technician program's graduates will be contacted in this same manner. It is estimated that 92% of those graduates surveyed will indicate both that they were well prepared for employment in the field and that they are satisfied with the program.

- As students complete the program and enter the workforce, employers will be surveyed via mail to assess their satisfaction with the students' and graduates' level of competence and preparedness for employment. Our goal is 92% of employers will indicate satisfaction with our graduates.

Institutional Characteristics:

- Jefferson College is well equipped to support the proposed Biomedical Electronics Technician Program because in the latest assessment of the mission "to meet the needs of the community", they recognize the need due to changes in healthcare systems as well as changes in the general health care industry. Missouri's economy is shifting away from manufacturing and moving toward service industries; therefore, Jefferson College wants to provide educational programs to members of the community who are interested in a career in medical equipment repair.

- Jefferson College has four campus locations in which students could complete some of the general education course requirements. In addition to the Hillsboro campus where the biomedical electronics technicians' courses will occur, there are campuses in Arnold, Imperial, and Cedar Hill.

- There is a multitude of student services and support available at Jefferson College to ensure student success. The Advising and Retention Center assists in long-term academic decision making and works together with the Career Development Center in career exploration and preparation for entry into the workforce. Academic Support Services offers peer and profession tutoring for students in need of academic assistance. There are also writing labs available, including one online, and a math lab for assistance in these specific subjects. The Learning Center offers courses which will help students develop essential skills necessary for college success. Students with disabilities can utilize available support services including and Assistive Technology Center.

- The campus library offers study rooms, a large collection of books, magazines, DVDs, videos, CDs, and databases as well as access to books from throughout the state of Missouri through the MOBIUS system.

- Project SUCCESS helps students develop academic skills and achieve set educational goals. This federally funded TRIO program provides free services including academic assistance, personal support, career and transfer counseling, financial guidance, and cultural enrichment. Students with low income, and/or documented disability, and/or first generation college students are eligible for this program.

- The Jefferson College Child Development Center enrolls children age two to twelve from students, faculty, staff, and the community. The center is accredited by the state of Missouri and provides developmentally appropriate activities for children in a safe environment.

- Jefferson College and the Cultural diversity committee offers a variety of concerts, dramas, exhibits, festivals, films, and guest lecturers in the evenings and on the weekend for the students and the community to enjoy.

- Jefferson College offers intercollegiate athletic programs in women's basketball, softball, and volleyball as well as men's baseball and soccer.

- The Office of Student Activities offers leadership opportunities for students to become involved both in and off of campus, including options for community service.
- Student housing is available is available in the form of 52 fully furnished apartments (two and four bedroom units), including a full service kitchen, on-site laundry facilities, and connections for telephone, cable, and internet.

Any Other Relevant Information:

- Jefferson College is a member of Electronics Technician Association (ETA) International. ETA is actively involved with a wide variety of electronics industry and professional organizations.

- Jefferson College is an ETA-approved examination site. The purpose of this is to align with a growing portion of the electronics education industry that is charged with providing electronics training that does not include the total content of traditional Basic Electronics courses.

STATE OF MISSOURI
DEPARTMENT OF ELEMENTARY AND SECONDARY EDUCATION
P.O. Box 480, Jefferson City, Missouri 65102-0480
Phone: (573) 751-3500 Fax: (573) 526-4261

Postsecondary Career Education Program Approval Request

WHEN SUBMITTING A CAREER EDUCATION PROGRAM APPROVAL REQUEST TO THE DEPARTMENT OF HIGHER EDUCATION, PLEASE RETURN THIS COMPLETED FORM TO THE COORDINATOR OF CAREER EDUCATION AT THE ABOVE ADDRESS

TO BE COMPLETED BY INSTITUTION

Institution Name: Jefferson College County District Code: 050007

Career Education Program Title: Biomedical Electronics Technician

Degree/Certificate: Associates of Applied Science in Biomedical Electronics Technician

Options: N/A

Proposed CIP Code: 15.0401

Implementation Date: August 2012

Date Proposal Submitted to DHE: March 28,2012

College Website for Course Listing: http://www.jeffco.edu/jeffco/content/category/9/20/116/

List all CTE courses that are part of this program.

ETC103 DC Circuits,ETC104 AC Circuits,ETC132 Semiconductors I, ETC133 Semiconductors II, BIT122 Medical Terminology,BET2xx Electronic Control Technology BET2xx Lasers and Optics, BET2xx Diagnostic Imaging,BET2xx Diagnostic Instrumentation Systems, BET2xx Therapeutic Instrumentation.

FOR DESE USE ONLY

☐ Approved by Coordinating Board Date:

☐ Approved by DESE Date:

☐ Entered into Division Program Directory Date:

Last Name First Name

Date of Birth

ASSOCIATE OF APPLIED SCIENCE
Degree Plan
Biomedical Electronics Technician

Effective 2012-2013

	COURSE TITLES	COURSE NUMBERS	DONE	NOW	NEED
Core Courses	D.C. Circuits (5)	ETC103			
	A.C. Circuits (5)	ETC104			
	Semiconductors I (5)	ETC132			
	Semiconductors II (5)	ETC133			
	Microcomputer Software Applications (3)	CIS133			
	Introduction to Computer Support (3)	CIS150			
	Electronic Control Technology (6)	BET2XX			
General Education & Institutional Reqr	Group I. *Communications* (3)	ENG101			
	Group II. *Humanities/Communications* (3)	SPD105			
	Group III. *Social/Behavioral Sciences* (3)				
	Constitution (3)				
	Group IV. *Math and/or Science* (6)	MTH128,BIO116			
	Group VI. *First Year Experience* (1-3)	COL101			
Biomedical & Instrumentation	Medical Terminology (3)	BIT122			
	Lasers and Optics (4)	BET2XX			
	Diagnostic Instrumentation Systems (6)	BET2XX			
	Diagnostic Imaging (3)	BET2XX			
	Therapeutic Instrumentation (3)	BET2XX			
	Biomedical Electronics Technician Internship (Optional) (3)	BET2XX			

Student Signature/Date

Advisor Signature/Date

Total Credit Hours: **70-75**

CORE GENERAL EDUCATION & INSTITUTIONAL REQUIREMENTS

Group I. Communications 3 hrs.
ENG101(H) English Comp. I **required**

Group II. Humanities/Communications 3 hrs.
SPD105 (3) **required**

Group III. Social/Behavioral Sciences 6 hrs.
Constitution: (3) HST103(H) or PSC102(H) **required**
Social/Behavioral Sciences: (3) **select one**
ECO; GEO; HST; PSC; PSY; SOC

Group IV. Math and/or Science 6 hrs.
BIO116,MTH128(3) **required**

Group V. Computer Literacy
CIS133 (3) **required**

Group VI. First Year Experience 1-3 hrs.
COL101 or GUD136 **required**

Associate of Applied Science
Biomedical Electronics Technician Degree Plan:

First Semester		**Hours**
COL101 Intro to College: Strategies for Success		1
ETC103 DC Circuits		5
ETC104 AC Circuits		5
ENG101 English Composition I		3
HST103 or PSC102		3
	Subtotal	**17**
Second Semester		
ETC132 Semiconductors I/Lab		5
ETC133 Semiconductors II/Lab		5
MTH128 Intermediate Algebra		3
CIS133 Microcomputer Software Applications		3
Social/Behavioral Science		3
	Subtotal	**19**
Third Semester		
BIT122 Medical Terminology		3
BET2xx Electronic Control Technology		6
SPD105 Oral Communications		3
BIO116 Anatomy & Physiology for Pre-Hospital		3
CIS150 Introduction to Computer Support		3
	Subtotal	**18**
Fourth Semester		
BET2xx Lasers and Optics		4
BET2xx Diagnostic Imaging		3
BET2xx Diagnostic Instrumentation Systems		6
BET2xx Therapeutic Instrumentation		3
	Subtotal	**16**
Optional:		
BET2xx Biomedical Electronics Technician Internship		3
	Subtotal	**3**
TOTAL		**70-73**

General Education & Institutional Requirements:

ENG101 English Composition I **(3 credit hours)**
Prerequisite(s): reading proficiency, COMPASS writing skills score of 70 or higher within the past two years, ACT English score of 18 or higher within the past two years, ENG099 with a grade of "C" or better, or ENG034 with a grade of "C" or better. English Composition I offers the student the opportunity to learn to write competent expository essays and to do preliminary research. Students will review grammar and mechanics, but the emphasis is on the writing process. Non-native speakers of English who do not qualify for ENG 101, based on the required test scores, must take ENG 031, English as a Second Language I; ENG 032, English as a Second Language II, ENG 033, English as a Second Language III; and/ or ENG 034, English as a Second Language IV. (F, S, Su, O)

MTH128 Intermediate Algebra **(3 credit hours)**
Prerequisite(s): reading proficiency, ACT Math with score of 18 or MTH002 Beginning Algebra with minimum grade of C or COMPASS Algebra with score of 42.
This course continues the development of the algebraic skills introduced in Basic Algebra. This course counts as an elective toward the Associate of Arts degree. All placement scores must be earned within the past two years. (F, S, Su)

CIS133 Microcomputer Software Applications **(3 credit hours)**
Prerequisite: reading proficiency.
This course gives practical experiences using widely utilized microcomputer software application programs: word processing (Word), spreadsheet (Excel), database (Access), and presentation (PowerPoint). Students will also learn basic Windows functions and briefly explore the Internet. Students may need to work in the computer laboratory outside of class in order to complete the assignments. This course fulfills the computer literacy graduation requirement for degree-seeking students. (F, S, Su)

CIS150 Introduction to Computer Support **(3 credit hours)**
Prerequisite: reading proficiency and CIS-133.
This course will train students to perform tasks such as installation, configuration, diagnosing, preventive maintenance and basic networking. It will begin to prepare students for the A+ 220-701 exam, the first of two exams required for CompTIA A+ Certification. (S)

BIO116 Anatomy & Physiology for Pre-Hospital **(3 credit hours)**
Prerequisite: reading proficiency.
Anatomy & Physiology for Pre-Hospital Healthcare covers vital human bodily functions and associated structure. An overview of cells, tissues, organs and organ systems and their correlation to normal physiology is emphasized. Interactions of organ systems are also explored. (F, S)

BIOMEDICAL CURRICULUM:

ETC103 DC Circuits **(5 credit hours)**
Prerequisite: reading proficiency , COMPASS Algebra score of at least 42, ACT math score of 18 or higher or MTH002 with a grade of C or better.

This course is a study of electrical units of measure, direct current theory, circuit theorems and analysis techniques, and equipment and procedures common to the analysis of DC circuits. (F)

ETC104 AC Circuit (5 credit hours)
Prerequisite: reading proficiency and ETC103.
This course is a study of time constants, alternating current theory, waveform parameters, reactive components, circuit analysis techniques, transformers, resonance, and filters, and equipment and procedures common to the analysis of AC circuits.(F)

ETC132 Semiconductors I (5 credit hours)
Prerequisite(s): reading proficiency and a grade of "C" or better in ETC104.
This is a study of basic semiconductor physics, diode applications, bipolar transistors, transistor biasing techniques, transistor amplifiers, field transistors, FET biasing techniques, FET amplifiers, and frequency analysis. (F, S)

ETC133 Semiconductors II (5 credit hours)
Prerequisite(s): reading proficiency and a grade of "C" or better in ETC132.
This is a study of semiconductor devices and circuits to include operational amplifiers, active filters, oscillators, regulated power supplies, and thyristors. (F, S)

BIT122 Medical Terminology (3 credit hours)
Prerequisite: reading proficiency.
This course provides a broad survey of the language of medicine and health technologies. Students learn to accurately spell and define common medical terms related to major disease processes, diagnostic procedures, laboratory tests, abbreviations, drugs, and treatment modalities. The class emphasizes the formation, definition, and pronunciation of medical terms and the use of reference materials. A brief presentation of anatomy and physiology precedes the content concerning disorders. (F, S)

BET2xx Lasers and Optics (4 credit hours)
Prerequisite: reading proficiency and a grade of "C" or better in ETC133.
This course introduces the fundamentals of lasers and optics. It provides an introduction to the nature and properties of light, optical handling and positioning, light sources, laser safety, basic geometric optics, basic physical optics, principles of laser operation and the relevant aspects of a communications system. Other topics include signals and their spectra, noise, amplitude, frequency, angle and pulse modulation, transmission and reception, digital-to-analog and analog-to-digital conversions associated with communications techniques of laser and fiber optic theory. They will be introduced to optoelectronic components for triggering and sensing circuits, fiber optics for data transfer and optical alignments and will have a basic knowledge of laser to computer communication. (S)

BET2xx Electronic Control Technology (6 credit hours)
Prerequisites: reading proficiency and a grade of "C" or better in ETC133.
This course has 3 components:
Digital Electronics: Logic design, combinational logic circuits, sequential logic circuits, timing concepts, digital arithmetic operations and circuits, integrated circuit logic families, MSI/LSI logic circuits, memory devices and circuits, microprocessor architecture, instruction types and addressing modes and memory organization.
Industrial Electronics: Operational amplifiers, linear integrated circuits, introduces A/D and D/A conversion, DC motors and generators, control devices and circuits, power control devices and circuits, optical control devices, temperature and humidity transducers, control applications and circuits, pulse modulation techniques,

data acquisition, and data communication, sequential process control and control logic and programmable controllers.
Programmable Logic Devices: Introduce basic programmable logic device array structure and the architecture of programmable logic devices. Describe PLD programming and verification process and student will program generic array logic (GAL) device and verify the operation. Students use ladder logic and apply it to several industrial control applications. (F)

BET2xx Diagnostic Imaging (3 credit hours)
Prerequisites: reading proficiency and a grade of "C" or better in BET2xx Electronic Control Technology.
This course covers the theory of diagnostic imaging including x-ray, computer aided tomography, nuclear imaging and ultrasound. Components and safety of nuclear imaging systems are included. Safety aspects of x-ray are also taught. (F, S)

BET2xx Diagnostic Instrumentation Systems (6 credit hours)
Prerequisites: reading proficiency and a grade of "C" or better in BET2xx Electronic Control Technology.
Topics taught in this course are sensors, transducers, and electronic circuits associated with biomedical instrumentation. Operation, maintenance, diagnostics and calibration of various types of biomedical instrumentation will be performed. Origination of biopotentials will be discussed. Electrodes and circuitry used to record electroencephalograms, electromyography, and electrocardiograms will be analyzed. This course includes laboratory work to reinforce topics covered in the lectures. (S)

BET 2xx Therapeutic Biomedical Instrumentation (3 credit hours)
Prerequisite: reading proficiency and a grade of "C" or better in BET2xx Electronic Control Technology.
This course is focused on biomedical equipment that is used in the branch of medicine that is concerned with the treatment and care of a patient for the purpose of both preventing and combating disease or alleviating pain or injury. Students are introduced to functional systems of specific medical devices designed to measure, monitor and/or deliver therapeutic applications. (S)

BET2xx Biomedical Electronics Technician Internship (3 credit hours)
Prerequisite: reading proficiency and student grade point average of 3.0 or Instructor approval.
The internship is an optional work experience in a biomedical facility under the supervision of an experienced biomedical electronics technician. The student will assist in the performance of safety inspections, preventive maintenance, repairs and calibration of medical equipment. Supervision of the intern is shared by the intern supervisor and the faculty advisor. Topics include: problem solving, use of proper interpersonal skills, interpreting, work authorizations, identifying logistical support requirements, servicing biomedical instruments, and professional development. (S)

JEFFERSON COLLEGE

COURSE SYLLABUS

BET2xx

Electronic Control Technology

6 Credit Hours

Prepared by: Scott Sebaugh
Date: 3/20/2012

Mary Beth Ottinger, Division Chair
Elizabeth Check, Dean, Career & Technical Education

BET2xx Electronic Control Technology

I. CATALOGUE DESCRIPTION

A. Prerequisite: reading proficiency and a grade of "C" or better in ETC133.

B. Credit hour award: 6

Description: This course has 3 components:
Digital Electronics: Logic design, combinational logic circuits, sequential logic circuits, timing concepts, digital arithmetic operations and circuits, integrated circuit logic families, MSI/LSI logic circuits, memory devices and circuits, microprocessor architecture, instruction types and addressing modes and memory organization.
Industrial Electronics: Operational amplifiers, linear integrated circuits, introduces A/D and D/A conversion, DC motors and generators, control devices and circuits, power control devices and circuits, optical control devices, temperature and humidity transducers, control applications and circuits, pulse modulation techniques, data acquisition, and data communication, sequential process control and control logic and programmable controllers.
Programmable Logic Devices: Introduce basic programmable logic device array structure and the architecture of programmable logic devices. Describe PLD programming and verification process and student will program generic array logic (GAL) device and verify the operation. Students use ladder logic and apply it to several industrial control applications. (F)

II. EXPECTED LEARNING OUTCOMES/CORRESPONDING ASSESSMENT MEASURES

Expected Learning Outcomes	Assessment Measures
Introduction to Digital Electronics: Identify developments of digital electronics. Identify uses of digital electronics. Describe input and output conditions for digital circuits. Identify the AND, OR, and NOT functions. Recognize the digital truth table. Recognize the AND, OR, and NOT Boolean equations. Observe the operation of various digital gates. Read a truth table.	Class Discussion/Activity Summative Examination and observation of lab performance
Digital Electronics Hardware: Define integrated circuit. Identify three forms of integrated circuit packaging. Identify markings associated with integrated circuits.	Class Discussion/Activity Summative Examination and observation of lab performance
Digital Test Equipment: Identify the signals produced by the clock generator. Identify the basic components of a clock generator. Operate a logic probe.	Class Discussion/Activity Summative Examination and observation of lab performance
Introduction to Integrated Circuits:	Class Discussion/Activity

Identify the different IC construction classifications. Identify integration classifications. Explain the construction of a basic IC. Understand the various IC packaging arrays. Describe the special handling, identification, packaging, and protection requirements for electrostatic sensitive devices.	Summative Examination and observation of lab performance
Construct an AND gate truth table. Construct an OR gate truth table. Construct a NOT gate truth table. Construct a NAND gate truth table. Construct a NOR gate truth table. Construct truth tables for XOR and XNOR gates. Measure the input and output waveforms of a AND, OR, NOT, NAND, NOR, XOR, XNOR gate.	Evaluate by written exams, quizzes and observation of lab performance
<u>Introduction to Registers and Memory:</u> Describe the terms data, bit, and byte. Describe serial data transfer. Describe parallel data transfer. Identify the purpose of a register. Describe storage and shift registers.	Class Discussion/Activity Summative Examination and observation of lab performance
<u>Introduction to Microprocessors:</u> Describe a brief development of microprocessors. Identify the major parts of a microprocessor system. Define common terms associated with microprocessors.	Evaluate by written exams, quizzes and observation of lab performance
<u>Basic Microprocessor Operations</u>: Identify parts of a microprocessor and describe microprocessor operation. Define and describe internal registers and counters. Understand the configuration caches, conventional, extended, upper, high, and expanded memory.	Class Discussion/Activity Summative Examination and observation of lab performance
<u>Microprocessor Number Systems:</u> Identify different mathematical numbering systems. Describe and perform number system conversions. Describe and perform binary addition and subtraction. Describe and perform multiplication and division. Understand the use and manipulation of binary, hexadecimal, and decimal numbering systems. Understand ASCII and BCD data encoding.	Class Discussion/Activity Summative Examination
<u>Introduction to Conversion and Data Circuits:</u> Identify the purpose of conversion circuits. Recognize basic A/D and D/A circuits.	Class Discussion/Activity Summative Examination and observation of lab performance
<u>D/A Conversion:</u> Identify the purpose of D/A conversion circuits. Recognize binary weighted D/A converter circuits. Recognize R/2R ladder D/A converter circuits and describe resolution. Predict the outputs of an R/2R ladder D/A converter.	Class Discussion/Activity Summative Examination and observation of lab performance

Measure the outputs of an R/2R ladder D/A converter. Recognize normal operation of an R/2R ladder D/A converter.	
Data Selector Circuits: Identify the purpose of data selector circuits. Recognize data selector circuits. Recognize normal operation of a data selector circuit.	Class Discussion/Activity Summative Examination and observation of lab performance
Data Distributor Circuits: Identify the purpose of data distributor circuits. Recognize data distributor circuits. Recognize normal operation of a data distributor circuit	Class Discussion/Activity Summative Examination and observation of lab performance
DC Series Field: Describe basic DC motor action. Describe the DC Series Field motor. Identify the principles of circular force and torque. Describe the characteristics of a DC Series Field motor. Identify the loaded characteristics of a DC Series Field motor.	Class Discussion/Activity Written Project/Paper Summative Examination
Brushless DC Motors: Identify the physical characteristics of BLDC motors. Describe the advantages of BLDC over other types. Understand basic BLDC types, applications, and configurations. Describe motor drive, position sensing, and other controller functions.	Class Discussion/Activity Written Project/Paper Summative Examination
Troubleshooting AC Motors: Describe safety issues related to motor troubleshooting. Describe routine maintenance on motors. Describe a visual check of a motor. Describe an operational check and a performance test.	Class Discussion/Activity Written Project/Paper Summative Examination
Pulse Width Modulation and Amplification: Identify the principles of pulse width modulation. Describe the operation of PWM motor control. Describe the operation of a PWM amplifier/driver. Measure signals at various points throughout a PWM circuit. Measure and compare pulse width vs. current output of a PWM amplifier. Recognize normal operation of a PWM motor driver.	Class Discussion/Activity Written Project/Paper Summative Examination
Error Detection and Feedback: Describe a closed loop feedback controlled motor system. Identify simple block diagrams of closed loop systems. List the functions that a closed loop feedback system performs. Measure the error and feedback signals in a closed loop DC motor system.	Class Discussion/Activity Written Project/Paper Summative Examination
Troubleshooting Closed Loop Systems: Describe the four-step process of basic troubleshooting. Describe component isolation, signal tracing, and signal injection.	Class Discussion/Activity Written Project/Paper Summative Examination

Stepper Motors: Describe the operation of stepper motors. Observe the normal operation of stepper motors. Troubleshoot stepper motors.	Class Discussion/Activity Summative Examination and observation of lab performance
Transducers and Control: Understand the principles of basic heat sensors and temperature transducers. Analyze the operation of a solid-state (IC) temperature transducer and control system.	Class Discussion/Activity Written Project/Paper Summative Examination
Display and Warning: Describe the process of an audio/visual temperature warning system. Analyze the operation of a temperature-activated warning system.	Class Discussion/Activity Written Project/Paper Summative Examination
Light Transducer Operation: Observe the operation of typical light transmitters. Measure voltage characteristics of typical light transmitters. Observe the operation of typical light receivers. Measure the resistance/current/voltage characteristics of typical light receivers.	Class Discussion/Activity Summative Examination and observation of lab performance
Motion Transducers: Describe photointerrupter motion sensors. Describe photoreflector motion sensors. Describe magnetic pickup motion sensors. Describe velocity circuits. Describe acceleration circuits. Describe rpm circuits.	Class Discussion/Activity Summative Examination and observation of lab performance
Motion Transducer Operation: Observe the operation of typical motion sensors. Measure the rpm and velocity output of typical motion. Measure acceleration/deceleration using an oscilloscope.	Class Discussion/Activity Summative Examination and observation of lab performance
Position Transducers: Describe analog angular position sensors. Describe analog linear position sensors. Describe digital angular position sensors Describe digital linear position sensors.	Class Discussion/Activity Summative Examination and observation of lab performance
Position Transducer Operation: Observe the operation of an encoder position sensor. Measure the output signals in an encoder position sensor. Observe the operation of an increment position sensor.	Class Discussion/Activity Summative Examination and observation of lab performance
Introduction to Pulse Modulation and Demodulation: Discuss the theory of Pulse Amplitude Modulation (PAM) in serial data signals. Describe the Pulse Width Modulation (PWM) method of serial data processing. Recognize Pulse Position Modulation (PPM) as a method of serial data transfer.	Class Discussion/Activity Summative Examination and observation of lab performance

Programmable Logic Devices: Identify and describe the basic programmable logic device array structure. Describe the architecture of programmable logic devices. Understand the minimizing processes.	Class Discussion/Activity Written Project/Paper Summative Examination
Programming PLDs: Describe the PLD programming and verification process. Program a generic array logic (GAL) device. Verify the operation of a GAL device.	Class Discussion/Activity Summative Examination
Introduction to Hydraulic Systems: Describe a basic hydraulic system and its components. Describe different system components and their schematic symbols.	Class Discussion/Activity Written Project/Paper Summative Examination
Introduction to Pneumatic Systems: Describe a basic pneumatic system and its components. Describe different system components and their schematic symbols.	Class Discussion/Activity Summative Examination and observation of lab performance
Fluid System Valve: Demonstrate the knowledge of the theory and applications of valves used in hydraulics and pneumatics.	Class Discussion/Activity Summative Examination and observation of lab performance
Hydraulic and Pneumatic Pumps: Recognize the types of pumps used in hydraulic and Pneumatic systems. Describe the basic repairs needed to restore pump operation. Understand the causes of common pump failures.	Class Discussion/Activity Summative Examination and observation of lab performance
Troubleshooting Hydraulic and Pneumatic Systems: Recognize the symptoms of common hydraulic and pneumatic component failures. Demonstrate component troubleshooting procedures.	Class Discussion/Activity Summative Examination and observation of lab performance
Locate various resources for Electronic Control Technology professional development, including, but not limited to, IEEE Control Systems Magazine Archive, publications by IEEE, the Internet web site of IEEE.	Class Discussion/Activity Written Project/Paper

III. COURSE OUTLINE

A. Digital Electronic:
1. Number System and Codes
2. Boolean algebra
3. Logic Gates
4. Memory devices
5. Microprocessor architecture

B. Industrial Electronics:
1. Linear integrated circuits
2. A/D and D/A conversion
3. DC motors and generators
4. Control devices and circuits

5. Power control devices and circuits
6. Optical control devices
7. Sensors and transducers
8. Pulse modulation techniques, Data acquisition, and Data communication

C. Programmable Controllers:
1. I/O modules, memory organizations
2. Instruction sets of several different programmable controllers
3. Ladder logic and control applications
4. Introduction to Hydraulic Systems
5. Introduction to Pneumatic Systems
6. Fluid System Valve Operation
7. Hydraulic and Pneumatic Pumps
8. Troubleshooting Hydraulic and Pneumatic Systems

IV. METHOD(S) OF INSTRUCTION

A. NIDA Electronics Training Software, Labs, Lecture
B. Readings from textbook
C. Supplemental handouts/industry journals and websites
D. Peer interactive activities/discussions in classroom

V. REQUIRED TEXTBOOK:

A. NIDA Corp., Unit IV. *Digital Circuits Lab/Text Manual*, 2001, NIDA Corporation
B. Floyd, T. L. (2009). *Digital Fundamentals, 10/E.* Prentice Hall.

VI. REQUIRED MATERIALS

A. Textbook
B. A computer with internet access (available through the Jefferson College Labs)
C. Paper, notebooks, pens, pencils with erasers, jump drive electronic storage

VII. SUPPLEMENTAL REFERENCES

A. Class handouts
B. Current internet resources
C. On-line reference materials

VIII. METHOD OF EVALUATION

A. Distribution of the Final Grade:

1. Unit Tests – 100 points each
2. Lab Exercises – 10 points each

3. Lesson Quizzes – 10 points each
4. Instructor evaluation of observed traits and characteristics – 50 points

B. Assignment of Final Letter Grade:

A = 90-100%
B = 80-89.9%
C = 70-79.9%
D = 60-69.9%
F = 0-59.9%

IX. ADA AA STATEMENT

Any student requiring special accommodations should inform the instructor and the Coordinator of Disability Support Services (Library; phone 636-481-3169).

X. ACADEMIC HONESTY STATEMENT

All students are responsible for complying with campus policies as stated in the Student Handbook. (see College website, http://www.jeffco.edu/jeffco/index.php?option=com_weblinks&catid=26&Itemid=84)

JEFFERSON COLLEGE

COURSE SYLLABUS

(BET2xx)

Lasers and Optics

4 Credit Hours

Prepared by: Scott Sebaugh
Date: 3/20/2012

Mary Beth Ottinger, Division Chair
Elizabeth Check, Dean, Career & Technical Education

BET2xx Lasers and Optics

I. CATALOGUE DESCRIPTION

A. Prerequisite: reading proficiency and a grade of "C" or better in ETC133.

B. Credit hour award: 4

C. Description: This course introduces the fundamentals of lasers and optics. It provides an introduction to the nature and properties of light, optical handling and positioning, light sources, laser safety, basic geometric optics, basic physical optics, principles of laser operation and the relevant aspects of a communications system. Other topics include signals and their spectra, noise, amplitude, frequency, angle and pulse modulation, transmission and reception, digital-to-analog and analog-to-digital conversions associated with communications techniques of laser and fiber optic theory. They will be introduced to optoelectronic components for triggering and sensing circuits, fiber optics for data transfer and optical alignments and will have a basic knowledge of laser to computer communication. (S)

II. EXPECTED LEARNING OUTCOMES/CORRESPONDING ASSESSMENT

Expected Learning Outcomes	Assessment Measures
Introduction To Lasers: Describe the basic particle theory of light. Describe the basic wave theory of light. Describe the principles behind the quantum theory of light. Define the term Laser. Describe the quantum theory of radiation. Describe the characteristics of laser light. Describe the fundamental elements of a laser. Describe the various uses of lasers.	Class Discussion/Activity Summative Examination
Introduction To Fiber Optics: Demonstrate how fiber optic technology evolved. Define fiber optic light propagation using a block diagram. Describe fiber optic cable construction. Describe the theory of light propagation. List some of the key advantages of using fiber optic technology.	Class Discussion/Activity Summative Examination
Photonic Devices: Describe the current-voltage equation for photodiodes. Describe the operation of the photocurrent mode and the photovoltage mode.	Class Discussion/Activity Summative Examination
Electrical Response Time of Diodes: Describe the response time of photodiodes, diffusion time, drift, The resistance-capacitance response time,	Class Discussion/Activity Summative Examination
Photoconductivity: Describe conductivity and mobility, gain and bandwidth, sensitization.	Class Discussion/Activity Summative Examination

Light-Emitting Diodes: Describe the process of recombination of excess carriers. Describe quantum efficiency, response time, steady-state input electrical current and output LED optical power.	Class Discussion/Activity Summative Examination
Organic Light-Emitting Diodes: Describe how a organic light-emitting diode operates. Describe the energy band structure of organic semiconductors Compare and contrast optoelectric organic materials. Describe the current-voltage characteristics of zero bias and flat band condition.	Class Discussion/Activity Summative Examination
Lasers: Describe amplifiers and feedback, spontaneous and stimulated emissions, optical gain, optical feedback.	Class Discussion/Activity Summative Examination
Introduction to Direct Modulation of Laser Diodes: Describe time-dependent behavior of laser diodes during current modulation before the laser reaches threshold $0<t<\tau d$ and after the laser reaches threshold: $\tau d<t<T0$ where T0 is the bit period.	Class Discussion/Activity Summative Examination
Optical Fibers and Optical Fiber Amplifiers: Describe waveguiding in optical fibers, capacity and optical amplifiers.	Class Discussion/Activity Summative Examination
Apply complex, linear and matrix algebra to the propagation of optical electromagnetic waves. a. Determination of reflection and transmission coefficients. b. Formulation and analysis of their propagation characteristics in linear media. c. Formulation and analysis of interference and diffraction patterns.	Class Discussion/Activity Summative Examination
Characterizing Photonic Devices in the Laboratory: Describe the use of the lock-in amplifier, chopping wheel or chopper, photon detectors and curve tracer.	Class Discussion/Activity Summative Examination
Identify operations and basic properties of the most common laser types, He-Ne, Argon-ion, and carbon-dioxide, ruby, titanium sapphire, neodymium YAG and glass, knowledge of other main laser types	Class Discussion/Activity Written Project/Paper Summative Examination
In addition each student will undertake a review article on a particular laser application and present their findings in a short oral presentation.	Class Discussion/Activity Summative Examination
Locate various resources for Laser and Optic Technology professional development, including, but not limited to, the Journal of OSA, publications of OSA, the Internet web site of OSA, other related web sites..	Class Discussion/Activity Written Project/Paper
Medical Electronics Safety : Define electrical safety. List the names of major organizations which publish electrical safety codes and standards. List responsibilities of hospital staff regarding safety. Relate how preventive maintenance reduces electrical hazards.	Class Discussion/Activity Written Project/Paper Summative Examination

Define corrective maintenance. Define preventive maintenance. Explain the insurance and legal requirements regarding electrical safety. Develop an electrical safety program for a typical hospital. Define leakage current. Explain the usefulness of A.C. line isolation systems. List the dangers associated with poor grounding. Describe required grounding of electronics equipment. Explain how hazards through ground faults can be reduced. Administer electrical safety tests on equipment. List precautions for working with/on ladders. List extra precautions biomed personnel must take to maintain. -- Cleanliness standards in medical facilities. Describe the following safety code standards: NFPA 99 NFPA 70 NFPA 102 CFR 21 Describe microshock (also called cardiac shock). Describe macroshock. State the ground resistance limit for *existing* portable medical equipment in patient care areas. State the ground resistance limit for *new* portable medical equipment in patient care. State the chassis leakage current limit for portable medical equipment in patient care areas. State the lead leakage current limit for portable medical equipment in patient care areas. Describe the current rules for radiation safety required in medical equipment maintenance and use. Describe the current rules for safety in the maintenance and use of medical laser equipment. Describe fire safety rules commonly required for medical equipment maintenance personnel. Describe chemical rules commonly required for medical equipment maintenance personnel.	

III. COURSE OUTLINE

A. Part I: Introductory Concepts
   1. Introduction
   2. Electrons and Photons

B. Part II: Photonic Devices
   1. Photodiodes
   2. Electrical Response Time of Diodes
   3. Photoconductivity

4. Light-Emitting Diodes
5. Organic Light-Emitting Diodes
6. Lasers

C. Part III: Advanced Topics
1. Direct Modulation of Laser Diodes
2. Optical Fibers and Optical Fiber Amplifiers

D. Part IV: Characterizing Photonic Devices in the Laboratory
1. Measurements in Photonics
2. Experimental Photonics

E. Part V: Electrical Safety
1. Physiological Effect of Electricity
2. Important Susceptibility Parameter
3. Distribution of Electric Power
4. Macro shock Hazards
5. Micro shock Hazard
6. Electrical-Safety Codes and Standards
7. Basic Approaches to Protection against Shock
8. Protection: Power Distribution
9. Protection: Equipment Design
10. Electrical-Safety Analyzers
11. Testing the Electrical System
12. Tests of Electric Appliances

IV. METHOD(S) OF INSTRUCTION

A. Lecture/Labs/instructional video from industry manufacturers
B. Readings from textbook
C. Supplemental handouts/industry journals and websites
D. Peer interactive activities/discussions in classroom

V. REQUIRED TEXTBOOK:

Pearsall, T. P. (2010). *Photonics Essentials,(2nd ed).* McGraw-Hill.

VI. REQUIRED MATERIALS

A. Textbook
B. A computer with internet access (available through the Jefferson College Labs)
C. Paper, notebooks, pens, pencils with erasers, jump drive electronic storage

VII. SUPPLEMENTAL REFERENCES

A. J. G. Webster (February 2009). *Medical Instrumentation Application and Design, 4th Edition.* Madison, Wisconsin: John Wiley and Sons Inc.
B. Eugene Hecht. *(1974). Schaum's Outline of Optics, 1st Edition. Adelphi Uni*versity: McGraw-Hill.
C. Class hand outs
D. Current internet resources.
E. On-line reference materials.

VIII. METHOD OF EVALUATION

A. Written Projects or Papers will equal 30% of total course grade. This will consist of 1-3 assignments focused on Lasers and Optics technology theory and principles. Six (6) laboratory experiments related to the course material are performed throughout the semester.
B. Summative Written Examinations: 4 examinations worth up to 60%
C. Attendance/participation grade will equal 10% of total course grade
D. Grading Scale:
A = 90-100%
B = 80-89.9%
C = 70-79.9%
D = 60-69.9%
F = 0-59.9%

IX. ADA AA STATEMENT

Any student requiring special accommodations should inform the instructor and the Coordinator of Disability Support Services (Library; phone 636-481-3169).

X. ACADEMIC HONESTY STATEMENT

All students are responsible for complying with campus policies as stated in the Student Handbook (see College website, http://www.jeffco.edu/jeffco/index.php?option=com_weblinks&catid=26&Itemid=84)

JEFFERSON COLLEGE

COURSE SYLLABUS

BET2xx

Diagnostic Instrumentation Systems

6 Credit Hours

Prepared by: Scott Sebaugh
Date: 3/20/2012

Mary Beth Ottinger, Division Chair
Elizabeth Check, Dean, Career & Technical Education

BET2xxx Diagnostic Instrumentation Systems

I. CATALOGUE DESCRIPTION

A. Prerequisite: reading proficiency and a grade of "C" or better in BET2xx Electronic Control Technology

B. Credit hour award: 6

C. Description: Topics taught in this course are sensors, transducers, and electronic circuits associated with biomedical instrumentation. Operation, maintenance, diagnostics and calibration of various types of biomedical instrumentation will be performed. Origination of biopotentials will be discussed. Electrodes and circuitry used to record electroencephalograms, electromyography, and electrocardiograms will be analyzed. This course includes laboratory work to reinforce topics covered in the lectures. (S)

II. EXPECTED LEARNING OUTCOMES/CORRESPONDING ASSESSMENT MEASURES

Expected Learning Outcomes	Assessment Measures
Explain the following concepts using terminology of Medicine and Medical Devices: Generalized Medical Instrumentation Systems Alternative Operational modes Medical Measurement Constraints Classification of Biomedical Instruments Interfering and Modifying Inputs Compensation Techniques Generalized Dynamic Characteristics Design Criteria Commercial Medical Instrumentation Development Process Regulation of Medical Devices	Class Discussion/Activity Written Project/Paper Summative Examination
Describe the following types of displacement-sensitive measurement methods: Resistive Sensors Bridge Circuits Inductive Sensors Capacitive Sensors Piezoelectric Sensors Temperature Measurements Thermocouples Thermistors Radiation Thermometry	Class Discussion/Activity Written Project/Paper Summative Examination

Fiber-Optic Temperature Sensors Optical Measurements Radiation Sources Geometrical and Fiber Optics Optical Filters Radiation Sensors Optical Combinations	
Describe the functions of the bioelectric amplifier. State the requirements for bioelectric amplifiers. Describe the basic principles of operation of a bioelectric amplifier. Describe the different configurations used in the design of bioelectric amplifiers. State the principles of operation of isolation amplifiers. List the basic properties of the operational amplifier. Sketch the circuit diagram of an op amp. Calculate voltage gain, impedance (input and output) and other characteristics of op amps. Define following terms used in bioelectric amps (e.g.: inverter, offset null, zero suppression, summing junction, common mode rejection and virtual ground). Ideal Op Amps Inverting Amplifiers Noninverting Amplifiers Differential Amplifiers Comparators Rectifiers Logarithmic Amplifiers Integrators Differentiators Active Filters Frequency Response Offset Voltage Bias Current Input and Output Resistance Phase-Sensitive Demodulators Timers Microcomputers in Medical Instrumentation	Class Discussion/Activity Written Project/Paper Summative Examination
Compare and contrast the following bioelectric phenomena at the cellular level and discuss the following bioelectric sources: Electrical Activity of Excitable Cells Volume – Conductor Fields Functional Organization of the Peripheral Nervous System	Class Discussion/Activity Written Project/Paper Summative Examination
Describe how the following Biopotential electrodes, record potentials, interface body and electronic measuring apparatus and how the measurement is made:	Class Discussion/Activity Written Project/Paper Summative Examination

The Electrode-Electrolyte Interface Polarization Polarization and Nonpolarization Electrodes Electrode Behavior and Circuit Models The Electrode – Skin Interface and Motion Artifact Body- Surface Recording Electrodes Internal Electrodes Electrode Arrays Microelectrodes Electrodes for Electric Stimulation of Tissue Practical Hints in Using Electrodes	
Locate various resources for Biomedical Instrumentation Systems professional development, including, but not limited to AAMI publications, the Internet web site of AAMI, other related web sites, and the Biomedical instruction videos	Class Discussion/Activity Written Project/Paper Summative Examination
Describe the functional blocks of the Electrocardiograph. Describe Problems Frequently Encountered. Describe the meaning of Transient Protection. Describe: Common-Mode and Other Interference-Reduction Circuits. List: Amplifiers for Other Biopotential Signals. Give an example of a Biopotential Preamplifier. Describe other Biopotential Signal Processors and their uses: Cardiac Monitors Biotelemetry	Class Discussion/Activity Written Project/Paper Summative Examination
Compare and contrast the following equipment: The Electroneurogram The Electromyogram The Electrocardiogram The Electroretinogram The Electroencephalogram The Magnetoencephalogram	Class Discussion/Activity Written Project/Paper Summative Examination
Describe the following terms as they apply to the direct measurements of the transport of blood, oxygen and nutrients to the tissues of the body: Harmonic Analysis of Blood-Pressure Waveforms Dynamic Properties of Pressure Measurements Systems Measurement of Systems Response Effects of System Parameters on Response Bandwidth requirements for Measuring Blood Pressure Typical Pressure-Waveform Distortion Systems for Measuring Venous Pressure Heart Sounds Phonocardiography Cardiac Catheterization Effects of Potential and Kinetic Energy on Pressure	Class Discussion/Activity Written Project/Paper Summative Examination

Measurements Indirect Measurements of Blood Pressure	
Describe the following methods of measuring concentrations of O2 in the cells: Indicator-Dilution Method That Uses Continuous Infusion Indicator-Dilution Method That Uses Rapid Injection Electromagnetic Flowmeters Ultrasonic Flowmeters Thermal-Convection Velocity Sensors Chamber Plethysmography Electrical –Impedance Plethysmography Photoplethysmography	Class Discussion/Activity Written Project/Paper Summative Examination
<u>Cardiac Support System</u> Describe the principles of defibrillation. Describe the principles and operation of the pacemaker. Describe the principles and operation of the cardioverter. Describe the principles and operation of the intraaortic balloon pump. List three types of cardiac arrhythmias. Describe the events taking place in each part of the ECG waveform. Detail the minimum energy required from an implantable pacemaker. Detail the minimum energy required from an external pacemaker. Troubleshoot problems associated with cardiac support machines. Describe the principles and operation of the cell saver machine. Sketch the main parts of a basic cardiopulmonary bypass circuit. Describe all the available types of blood pumps (roller pump; modified roller pump for pulsatile perfusion, centrifugal pump). Describe proper testing of a defibrillator (general steps).	Class Discussion/Activity Written Project/Paper Summative Examination
Students describe the applicable certification types and requirements.	Class Discussion/Activity Written Project/Paper Summative Examination
Students describe the applicable job positions, duties, and department organizations.	Class Discussion/Activity Summative Examination
Students describe the need for continuing education in the field.	Class Discussion/Activity Written Project/Paper Summative Examination

III. OUTLINE OF TOPICS

A. Basic Concepts of Medical Instrumentation

1. Terminology of Medicine and Medical Devices
2. Generalized Medical Instrumentation Systems
3. Alternative Operational modes

4. Medical Measurement Constraints

B. Basic Sensors and Principles
   1. Displacement Measurements
   2. Temperature Measurements
   3. Optical Measurements

C. Amplifiers and Signal Processing
   1. Ideal Op Amps
   2. Inverting Amplifiers
   3. Noninverting Amplifiers
   4. Differential Amplifiers
   5. Comparators
   6. Rectifiers
   7. Logarithmic Amplifiers
   8. Integrators
   9. Differentiators

D. The Origin of Biopotentials
   1. Electrical Activity of Excitable Cells
   2. Volume – Conductor Fields
   3. Functional Organization of the Peripheral Nervous System

E. Biopotential Electrodes
   1. Electrode Behavior and Circuit Models
   2. The Electrode – Skin Interface and Motion Artifact

F. Biopotential Amplifiers
   1. Basic Requirements
   2. Problems Frequently Encountered
   3. Example of a Biopotential Preamplifier

G. Blood Pressure and Sound
   1. Direct Measurements
   2. Measurement of Systems Response
   3. Bandwidth requirements for Measuring Blood Pressure
   4. Typical Pressure-Waveform Distortion

H. Measurement of Flow and Volume of Blood
   1. Indicator-Dilution Method That Uses Continuous Infusion
   2. Indicator-Dilution Method That Uses Rapid Injection
   3. Electromagnetic Flowmeters

IV. METHOD(S) OF INSTRUCTION
   A. Lecture/instructional videos
   B. Readings from textbook/industry company manufacture website
   C. Supplemental handouts for hand-on exercises
   D. Active Learning in classroom setting

E. Case Studies
F. Hands-on interaction during portions of the course in which the student uses troubleshooting equipment.

V. REQUIRED TEXTBOOK:

J. G. Webster (February 2009). *Medical Instrumentation Application and Design, 4th Edition.* Madison, Wisconsin: John Wiley and Sons Inc.

VI. REQUIRED MATERIALS

A. Textbook
B. A computer with internet access (available through the Jefferson College Labs)
C. Paper, notebooks, pens, pencils with erasers, jump drive electronic storage

VII. SUPPLEMENTAL REFERENCES

A. Class handouts/instructional videos
B. Current internet resources
C. On-line reference materials

VIII. METHOD OF EVALUATION

A. Summative Written Examinations: 20%
B. Oral Presentation(s): 25%
C. Quizzes: 20%
D. Written Assignments: 25%
E. Attendance/Participation: 10%
F. Grading Scale:
A = 90-100%
B = 80-89.9%
C = 70-79.9%
D = 60-69.9%
F = 0-59.9%

IX. ADA AA STATEMENT

Any student requiring special accommodations should inform the instructor and the Coordinator of Disability Support Services (Library; phone 636-481-3169).

X. ACADEMIC HONESTY STATEMENT

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JEFFERSON COLLEGE

COURSE SYLLABUS

BET2xx

Diagnostic Imaging

3 Credit Hours

Prepared by: Scott Sebaugh
Date: 3/20/2012

Mary Beth Ottinger, Division Chair
Elizabeth Check, Dean, Career & Technical Education

BET2xx Diagnostic Imaging

I. CATALOGUE DESCRIPTION

A. Prerequisite: reading proficiency and a grade of "C" or better in BET2xx Electronic Control Technology.

B. Credit hour award: 3

C. Description: This course covers the theory of diagnostic imaging including x-ray, computer aided tomography, nuclear imaging and ultrasound. Components and safety of nuclear imaging systems are included. Safety aspects of x-ray are also taught. (S)

II. EXPECTED LEARNING OUTCOMES/CORRESPONDING ASSESSMENT MEASURES

Expected Learning Outcomes	Assessment Measures
Basic Radiographic Equipment: List the main function of an X-ray machine. Compare the different types of X-ray machines (Fluoroscope, cine, chest, dental). Sketch a circuit diagram of an X-ray tube. Sketch a circuit diagram of an X-ray machine. Describe the "heel effect". Describe the focal spot. Explain the purpose of grids. Explain the purpose of the 'bucky'. Identify dental X-ray machine components. Identify portable X-ray machine components. Identify general 'rad-room' components. Identify 'cath lab' components.	Class Discussion/Activity Written Project/Paper Summative Examination
Radiology: List the main functions of an X-ray machine. Describe the therapeutic applications of X-ray machines. State the diagnostic (measurement) function of an X-ray machine. State the different categories of X-ray machines (e.g.: still picture, continuous picture and motion picture). List the dangers associated with X-rays. Name the units used for measuring radioactivity (e.g.: curie, Roentgen, Dose rate). Explain the terms used in the study of radiology (e.g.: gamma, beta and alpha rays, nuclear radiation, etc.). Sketch the circuit diagram of an X-ray tube.	Class Discussion/Activity Written Project/Paper Summative Examination

Sketch the circuit diagram of a Geiger-Mueller tube. Explain how the X-ray tubes work. Discuss the safety precautions associated with the handling of X-ray tubes. List common problems/faults of X-ray tubes. Sketch the circuit diagram of an X-ray machine.	
<u>Radiation Physics :</u> Define Ionizing radiation. Describe the diagnostic (measurement) function of an X-ray machine. Explain how X-rays are produced. Explain decay rate. Describe hard and soft radiation. <u>Linear Accelerators:</u> Describe a cyclotron. Explain how a cyclotron may be utilized for treatment. Discuss how a neutron beam is generated. Describe the betatron. Discuss the major differences between a cyclotron and betatron. Name the types of isotope treatment units. State the function of a linear accelerator treatment unit. Name the types of beams produced by a linear accelerator and state their uses. List types of linear accelerator designs utilized to accelerate electrons. List the functions of the major block diagram components and auxiliary systems of a medical linear accelerator. Name the common types of external beams utilized in radiotherapy.	Class Discussion/Activity Written Project/Paper Summative Examination
<u>Computed Tomography:</u> Define computed tomography. Identify the components of computed tomography: (gantry, tube/detectors ,generator, couch – computers applications, reconstruction, display) Describe the formation of the image Describe computed tomography dose index (CTDI). Describe multiple scan average dose (MSDA). Describe beam geometry. Describe measuring dose. Describe Protocol selection options (i.e. kvp, mAs, slice thickness, feed, matrix, algorithm).	Class Discussion/Activity Written Project/Paper Summative Examination
<u>Nuclear Medicine:</u> Identify the major components of a scintillation camera and label them correctly on a diagram. List the function of scintillation camera collimators. Identify the material of which scintillation camera collimators are made. Identify the chemical composition of a scintillation crystal and its physical characteristics.	Class Discussion/Activity Written Project/Paper Summative Examination

List the environmental factors that can adversely affect a scintillation crystal. Identify the purpose of a photo multiplier tube in a scintillation detector system. Describe the function of a pulse height analyzer in a scintillation detector system. Differentiate between planar, SPECT, and PET.	
<u>Magnetic Resonance Imaging:</u> Identify Magnet types. Describe Fourier Process. Identify Cryogens. Describe T1 and T2. State purpose of Gradients. Identify Coils. State purpose of auxiliary coils. Identify RF leakage. Identify image produced with metal in bore. Radiation Safety State the importance of exposure time in regard to safety. State the importance of shielding in regard to safety. State the importance of distance from source in regard to radiation safety. Describe the safe handling of Isotopes. Describe the safe handling of Cryogens. Describe the reasons for non-ferrous tools in the MRI suite. Describe the Thomson Effect. Describe the purpose of a film badge. State the inverse square law. State the potential lethal dose of x-radiation for humans.	Class Discussion/Activity Written Project/Paper Summative Examination
<u>Diagnostic Ultrasound Equipment:</u> List the functions of the five basic components of a diagnostic medical ultrasound machine. Identify the unique characteristics for each of the types of transducer scan heads used in real-time ultrasound. Describe current ultrasound image display formats (pie-shaped, rectangular, trapezoidal, circular). Describe the different ultrasound image recording formats (Polaroid film, single emulsion film, thermal paper, magnetic tape, magnetic disks, and optical disks). Describe A-Mode. Describe B-Mode. Describe M-Mode.	Class Discussion/Activity Written Project/Paper Summative Examination
<u>Film Processing:</u> Describe Wet Processing. Identify Chemicals and Functions.	Class Discussion/Activity Written Project/Paper Summative Examination

Describe Dry Processing. Identify and Describe Laser Imaging Process. Describe function and makeup of X-ray Cassettes. Describe and Identify X-ray film types. State dark-room procedures. Describe film duplication process. Demonstrate proper cassette loading technique.	
<u>Picture Archive Communication System:</u> Explain electrical surge potential. List ways of preventing damage from electrical surges. Describe the Internet and its application to imaging modalities. Describe Tele-radiology. Describe Picture Archive Communication system. List major components of Picture Archive Communication system. Describe application used on the internet and imaging modalities.	Class Discussion/Activity Written Project/Paper Summative Examination
Identify key organizations influential to the field of Diagnostic Imaging equipment design.	Class Discussion/Activity Summative Examination

III. OUTLINE OF TOPICS

A. Modern Imaging Systems
   1. X-ray Machines and Digital Radiography
   2. X-ray Computed Tomography
   3. Nuclear Medical Imaging Systems

B. Magnetic Resonance Imaging System
   1. Principles of NMR
   2. MR imaging
   3. MR Imaging
   4. MR pulse programming
   5. MRS & fMRI
   6. Applications of MR

C. Ultrasonic Imaging System
   1. Practice of Ultrasonic Systems
   2. Principles of Ultrasonic Systems

D. Thermal Imaging System
   1. Image Analysis
   2. Image Processing I- image types and linear transforms
   3. Image Processing II – frequency analysis

IV. METHOD(S) OF INSTRUCTION

A. Lecture/instructional videos
B. Readings from textbook/industry company manufacture website
C. Supplemental handouts for exercises

D. Active Learning in the classroom setting
E. Case Studies
F. Hands-on interaction during portions of the course in which the students use diagnostic equipment.

V. REQUIRED TEXTBOOK:
R.S. Khandpur, C. a. (2005). *Biomedical Instrumentation: Technology and Applications (1st Ed.).* McGraw-Hill Professional Publishing.

VI. REQUIRED MATERIALS

A. Textbook
B. A computer with internet access (available through the Jefferson College Labs)
C. Paper, notebooks, pens, pencils with erasers, jump drive electronic storage

VII. SUPPLEMENTAL REFERENCES

A. Class handouts
B. Current internet resources
C. On-line reference materials

VIII. METHOD OF EVALUATION

A. Summative Written Examinations: 20%
B. Oral Presentation(s): 25%
C. Quizzes: 20%
D. Written Assignments: 25%
E. Attendance/Participation: 10%
F. Grading Scale:
A = 90-100%
B = 80-89.9%
C = 70-79.9%
D = 60-69.9%
F = 0-59.9%

IX. ADA AA STATEMENT

Any student requiring special accommodations should inform the instructor and the Coordinator of Disability Support Services (Library; phone 636-481-3169).

X. ACADEMIC HONESTY STATEMENT

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JEFFERSON COLLEGE
COURSE SYLLABUS

BET2xx

Therapeutic Instrumentation

3 Credit Hours

Prepared by: Scott Sebaugh
Date: 3/20/2012

Mary Beth Ottinger, Division Chair
Elizabeth Check, Dean, Career & Technical Education

BET2xx Therapeutic Instrumentation

I. CATALOGUE DESCRIPTION

A. Prerequisite: reading proficiency and a grade of "C" or better in BET2xx Electronic Control Technology.

B. Credit hour award: 3

C. Description: This course is focused on biomedical equipment that is used in the branch of medicine that is concerned with the treatment and care of a patient for the purpose of both preventing and combating disease or alleviating pain or injury. Students are introduced to functional systems of specific medical devices designed to measure, monitor and/or deliver therapeutic applications. (S)

II. EXPECTED LEARNING OUTCOMES/CORRESPONDING ASSESSMENT MEASURES

Expected Learning Outcomes	Assessment Measures
Define the processes in the lungs that are involved in the exchange of gases between the blood and the atmosphere.	Class Lecture Summative Examination
Describe the mechanical behavior of the respiratory system as a combination of pneumatic and mechanical elements.	Class Discussion/Activity Written Project/Paper Summative Examination
Describe the basic principles of a differential pressure sensor.	Class Discussion/Activity Summative Examination
Describe the various elements and functions of a mass-spectrometer system.	Class Discussion/Activity Summative Examination
Name three instruments for monitoring changes in thoracic volume and cite the physical dimension from which each infers volume change.	Class Discussion/Activity Written Project/Paper Summative Examination
Describe some of the existing and emerging roles in the Therapeutic Biomedical Instrumentation Systems profession.	Class Discussion/Activity Written Project/Paper Summative Examination
Locate various resources for Therapeutic Biomedical Instrumentation Systems professional development, including, but not limited to AAMI publications, the Internet web site of AAMI, other related web sites, and the Biomedical instruction videos	Class Discussion/Activity Written Project/Paper
Describe the arrangement of a PCO2 electrode. Explain briefly how it works.	Class Discussion/Activity Summative Examination
Describe what effects the response time of the CO2 electrode. Describe what effects the response time of the O2 electrode.	Class Discussion/Activity Written Project/Paper Summative Examination
Describe the major sections of a hospital department that performs	Class Discussion/Activity

clinical pathology or the department of laboratory medicine.	Written Project/Paper
Identify the basic principles of a spectrophotometer and detail the characteristics of each subsystem.	Class Discussion/Activity Summative Examination
Describe what tests the Beckman-Coulter Synchron LXi 725 can perform. Describe devices based on electrophoretic principles used in a laboratory environment.	Class Discussion/Activity Written Project/Paper Summative Examination
Describe two major classes of electronic devices for measuring blood characteristics.	Class Discussion/Activity Summative Examination
Draw and label a block diagram of an asynchronous cardiac pacemaker	Class Discussion/Activity Summative Examination
Describe why a pacemaker is either of the unipolar or bipolar type.	Class Discussion/Activity Summative Examination
Draw and label a block diagram of an synchronous cardiac pacemaker	Class Discussion/Activity Summative Examination
Describe a transcutaneous RF-powered electric stimulator and its uses.	Class Discussion/Activity Summative Examination
Describe the cochlear prosthesis in a block diagram.	Class Discussion/Activity Summative Examination
Describe how a half-wave rectifier is used in Capacitive-Discharge DC Defibrillators.	Class Discussion/Activity Summative Examination
Describe why in a Cardioverter, the defibrillation pulse must be synchronized with the R wave of the ECG.	Class Discussion/Activity Summative Examination
Describe the two basic units in a Hemodialysis system.	Class Discussion/Activity Summative Examination
Describe the ultrasonic transducer used in kidney stone removal.	Class Discussion/Activity Summative Examination
Discuss high-frequency ventilation principles put into practice.	Class Discussion/Activity Summative Examination
Draw and label a block diagram of a proportional temperature controller used to maintain the temperature of air inside an infant incubator.	Class Discussion/Activity Summative Examination
Draw and label a block diagram of the electronic control system for a fluid or drug delivery pump.	Class Discussion/Activity Summative Examination
Describe the components of an insulin-delivery system.	Class Discussion/Activity Summative Examination
Describe three sections of a typical anesthesia machine.	Class Discussion/Activity Summative Examination
Describe the high-frequency power used to produce an arc in a basic electrosurgical unit.	Class Discussion/Activity Summative Examination
Describe the functions of each block in a diagram of a typical electrosurgical unit.	Class Discussion/Activity Summative Examination
Describe various therapeutic applications of Lasers.	Class Discussion/Activity Summative Examination

III. OUTLINE OF TOPICS

A. Measurements of the Respiratory System
   1. Modeling the Respiratory System
   2. Measurement of Pressure
   3. Measurement of Gas-Flow
   4. Lung Volume
   5. Respiratory Plethysmography
   6. Some Tests of Respiratory Mechanics
   7. Measurements of Gas Concentration
   8. Some Tests of Gas Transport

B. Chemical Biosensors
   1. Blood-Gas and Acid-Base Physiology
   2. Electrochemical Sensors
   3. Chemical Fibrosensors
   4. Ion-Selective Field-Effect Transistor
   5. Immunologically Sensitive Field-Effect Transistor
   6. Noninvasive Blood-Gas Monitoring
   7. Blood-Glucose Sensors
   8. Electronic Noses
   9. Lab-on-a-Chip

C. Clinical Laboratory Instrumentation
   1. Spectrophotemetry
   2. Automated Chemical Analyzers
   3. Chromatology
   4. Electrophoresis
   5. Hemoatology

D. Therapeutic and Prosthetic Devices
   1. Cardiac Pacemakers and Other Electric Stimulators
   2. Defibrillators and Cardioverters
   3. Mechanical Cardiovascular Orthotic and Prosthetic Devices
   4. Hemodialysis
   5. Lithotripsy
   6. Ventilators
   7. Infant Incubators
   8. Drug Delivery Devices
   9. Surgical Instruments
   10. Therapeutic Applications of the Laser

IV. METHOD(S) OF INSTRUCTION

A. Lecture/instructional videos
B. Readings from textbook/industry company manufacture website
C. Supplemental handouts for hand-on exercises
D. Peer interactive activities/discussions in classroom

V. REQUIRED TEXTBOOK:

R.S. Khandpur, C. a. (2005). *Biomedical Instrumentation: Technology and Applications (1st Ed.).* McGraw-Hill Professional Publishing.

VI. REQUIRED MATERIALS

A. Textbook
B. A computer with internet access (available through the Jefferson College Labs)
C. Paper, notebooks, pens, pencils with erasers, jump drive electronic storage

VII. SUPPLEMENTAL REFERENCES

A. Class handouts
B. Current internet resources
C. On-line reference materials

VIII. METHOD OF EVALUATION

A. Summative Written Examinations: 20%
B. Oral Presentation(s): 25%
C. Quizzes: 20%
D. Written Assignments: 25%
E. Attendance/Participation: 10%
F. Grading Scale:
A = 90-100%
B = 80-89.9%
C = 70-79.9%
D = 60-69.9%
F = 0-59.9%

IX. ADA AA STATEMENT

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X. ACADEMIC HONESTY STATEMENT

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JEFFERSON COLLEGE

COURSE SYLLABUS

(BET2xx)

Biomedical Electronics
Technician Internship

3 Credit Hours

Prepared by: Scott Sebaugh
Date: 3/20/2012

Mary Beth Ottinger, Division Chair
Elizabeth Check, Dean, Career & Technical Education

BET2xx Biomedical Electronics Technician Internship

I. CATALOGUE DESCRIPTION

A. Prerequisite: reading proficiency, student grade point average of 3.0 or instructor approval.

B. Credit hour award: 3

C. Description: The internship is an optional work experience in a biomedical facility under the supervision of an experienced biomedical electronics technician. The student will assist in the performance of safety inspections, preventive maintenance, repairs and calibration of medical equipment. Supervision of the intern is shared by the intern supervisor and the faculty advisor. Topics include: problem solving, use of proper interpersonal skills, interpreting, work authorizations, identifying logistical support requirements, servicing biomedical instruments, and professional development.

II. EXPECTED LEARNING OUTCOMES/CORRESPONDING ASSESSMENT MEASURES

Expected Learning Outcomes	Assessment Measures
PROBLEM SOLVING:	
Identify a biomedical instrumentation operational problem at the intern's hospital.	Supervisor Rating: 1-10
Create a set of alternative solutions for an identified biomedical instrumentation operational problem at the intern's hospital.	Supervisor Rating: 1-10
Solve an identified biomedical instrumentation operational problem at the intern's hospital.	Supervisor Rating: 1-10
USE OF PROPER INTERPERSONAL SKILLS:	
Practice effective interpersonal skills in the assigned hospital setting.	Supervisor Rating: 1-10
Maintain a log of contacts with patients, doctors, and hospital staff and indicate type of interpersonal skill involved with each event.	Supervisor Rating: 1-10 Advisor Rating: 1-10
INTERPRETING WORK AUTHORIZATIONS:	
Review biomedical instrumentation work authorizations policies and procedures to assure current directives are on file.	Supervisor Rating: 1-10 Advisor Rating: 1-10
Maintain a current file of work authorizations for the biomedical instrumentation section at the intern's hospital.	Supervisor Rating: 1-10 Advisor Rating: 1-10
Maintain a log reflecting actions taken to assure biomedical instrumentation work authorizations remain current.	Supervisor Rating: 1-10 Advisor Rating: 1-10
IDENTIFYING LOGISTICAL SUPPORT REQUIREMENTS:	
Maintain a log reflecting actions taken to meet logistical support requirements at the intern's hospital.	Supervisor Rating: 1-10 Advisor Rating: 1-10
SERVICING BIOMEDICAL INSTRUMENTS:	
Maintain a log reflecting actions taken in servicing biomedical	Supervisor Rating: 1-10

instruments at the intern's hospital.	Advisor Rating: 1-10
PROFESSIONAL DEVELOPMENT:	
Discuss biomedical instrument field trends and the expected impact on career advancement.	Advisor Rating: 1-10
Discuss the available certification agencies which evaluate professional skills/performance in the biomedical instrumentation field.	Advisor Rating: 1-10
Outline a schedule for gaining professional certification in the biomedical instrumentation field.	Advisor Rating: 1-10

III. OUTLINE OF TOPICS

A. Problem solving
B. Use of proper interpersonal skills
C. Interpreting work authorizations
D. Identifying logistical support requirements
E. Servicing biomedical instruments
F. Professional development.

IV. METHOD(S) OF INSTRUCTION

On the job peer interactive activities. Intern will be working in the field under the supervision of the intern sponsor and the faculty advisor.

V. REQUIRED TEXTBOOK: N/A

VI. REQUIRED MATERIALS

A. Journal, notebook
B. A computer with internet access
C. Pens, pencils, jump drive

VII. SUPPLEMENTAL REFERENCES

A. Class handouts
B. Current internet resources
C. On-line reference materials

VIII. METHOD OF EVALUATION

A. The student's grade will be evaluated as outlined in assessment measures and will be weighted as 90%.
B. Job attendance will be weighted as 10%.

C. Grading Scale:

A = 90-100%
B = 80-89.9%
C = 70-79.9%
D = 60-69.9%
F = 0-59.9%

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