UNIVERSITY of MARYLAND BALTIMORE

DR. ROGER J. WARD, JD, MSL, MPA
Interim Provost and Executive Vice President

Academic Affairs/Graduate School
220 Arch Street, 14th Floor
Baltimore, MD 21201
410 706 2477
rward@umaryland.edu

www.umaryland.edu

July 22, 2021

James D. Fielder, PhD
Secretary
Maryland Higher Education Commission
6 North Liberty Street
Baltimore, MD 21201

Dear Secretary Fielder:

The University of Maryland, Baltimore is seeking authorization to offer a Post-Baccalaureate Certificate (PBC) in Medical Physics. The PBC in Medical Physics will be innovative in the state of Maryland, interdisciplinary in its delivery, and will prepare students from physics and engineering professional backgrounds for careers in the radiological physics. The proposed PBC program will require the completion of six courses totaling 18 core credits. Courses in the programs will be taught in predominately hybrid formats. We plan on offering this program beginning with the Fall 2022 term.

The PBC in Medical Physics is designed for students and professionals with related work experience and course work in physics and engineering who are delving into a field of medical physics. The proposed program emphasizes concepts, practices and skills that professionals need to be effective in a wide range of medical physics concepts and who are positioned to apply for further clinical training named Medical Physics Residency.

Every year, about 400 new residents are recruited to the 128 accredited Medical Physics Residency Programs in North America and five new residents are enrolled at the two major academic institutions (with Radiation Oncology departments) in the state of Maryland; University of Maryland Medical Center and Johns Hopkins University. Given this demand, it is desirable to initiate and maintain a certificate program for Maryland applicants who have graduated with a PhD degree in the physical or biomedical sciences and who wish to pursue a career in medical physics. Such a program would especially help candidates who are working professionals and prefer to pursue the certification as part-time students.

Thank you for your time and consideration of this request. Please contact me if you need additional information.

Regards,

Dr. Roger J. Ward, JD, MSL, MPA
Interim Provost and Executive Vice President
Dean, Graduate School

Office Use Only: PP#

Cover Sheet for In-State Institutions
New Program or Substantial Modification to Existing Program

Institution Submitting Proposal	University of Maryland, Baltimore

Each action below requires a separate proposal and cover sheet.

- ○ New Academic Program
- ○ New Area of Concentration
- ○ New Degree Level Approval
- ◉ New Stand-Alone Certificate
- ○ Off Campus Program
- ○ Substantial Change to a Degree Program
- ○ Substantial Change to an Area of Concentration
- ○ Substantial Change to a Certificate Program
- ○ Cooperative Degree Program
- ○ Offer Program at Regional Higher Education Center

Payment Submitted: ◉ Yes ○ No Payment Type: ◉ R*STARS # ○ Check # Payment Amount: $850 Date Submitted: 7/15/21

Department Proposing Program	University of Maryland Graduate School	
Degree Level and Degree Type	Post-Baccalaureate Certificate	
Title of Proposed Program	Medical Physics	
Total Number of Credits	18	
Suggested Codes	HEGIS:	CIP: 51.2205
Program Modality	◉ On-campus ○ Distance Education (*fully online*)	
Program Resources	◉ Using Existing Resources ○ Requiring New Resources	
Projected Implementation Date	◉ Fall ○ Spring ○ Summer	Year: 2022
Provide Link to Most Recent Academic Catalog	URL: https://iq3prod1.smartcatalogiq.com/Catalogs/University-of-Maryland-Baltimore-Graduate-School/2020-2021/Graduate-Catalog	
Preferred Contact for this Proposal	Name: Dr. Courtney Resnick	
	Title: Director, Academic Administration	
	Phone: (410) 706-1527	
	Email: cresnick@umaryland.edu	
President/Chief Executive	Type Name: Dr. Roger Ward, Interim Provost and Executive V.P.	
	Signature:	Date: 07/16/2021
	Date of Approval/Endorsement by Governing Board:	

Revised 1/2021

UNIVERSITY OF MARYLAND, BALTIMORE (UMB) GRADUATE SCHOOL
Proposal for a New Program
Post-Baccalaureate Certificate in Medical Physics

Table of Contents

A. Centrality to institutional mission statement and planning priorities

1. Program description and alignment with mission

The University of Maryland, Baltimore (UMB) Graduate School is pleased to submit a proposal to establish a new Post-Baccalaureate Certificate (PBC) in Medical Physics.

The Post-Baccalaureate Certificate in Medical Physics will be innovative in the state of Maryland, interdisciplinary in its delivery, and will prepare students from physics and engineering professional backgrounds for careers in the radiological physics. Medical Physics is an applied branch of physics that is focused on the application of the concepts and methods of physics to the diagnosis and treatment of human disease. American Association of Medical Physicists (AAPM – the parent professional society of Medical Physicists) defines a medical physicist as a person who focuses on three distinct areas of activities- (i) clinical service and consultation, (ii) research and development, and (iii) teaching. Within this scope, medical physicists contribute to the effectiveness of radiological imaging procedures by assuring radiation safety and helping to develop improved imaging techniques (e.g., mammography CT, MR, ultrasound). They also contribute to the development of therapeutic techniques (e.g., prostate implants, stereotactic radiosurgery etc.), collaborate with radiation oncologists to design radiotherapy treatment plans, and monitor equipment and procedures to ensure the accurate delivery of treatment plans to cancer patients. Despite such important roles in the medical field, this profession has not been well-recognized. In the state of Maryland, there is only one new program at the master's level that offers didactic training and a degree in Medical Physics. The majority of the medical physics residency programs in the US seek PhD graduates. The residency programs at the University of Maryland and the Johns Hopkins University require graduates with PhD in medical physics or graduates with a PhD degree in the physical sciences with a Commission on Accreditation of Medical Physics Education Programs, Inc. (CAMPEP) certificate degree in medical physics. To date, there is no graduate certificate program in the state of Maryland. Establishing such a program at the UMB will be beneficial to the University of Maryland and the Johns Hopkins University, since both institutions will be able to prioritize candidates from the certificate program for their respective medical physics residency spots. The letter of support for our initiative from Dr. John Wong, Chief of Division of Medical Physics, at the Johns Hopkins University's Department of Radiation Oncology highlights the importance of this endeavor.

The proposed new Post-Baccalaureate Certificate is consistent with the mission of the University of Maryland, Baltimore (UMB). UMB is the state's public academic health and law university devoted to excellence in professional and graduate education, research, public service and patient care. It educates leaders in health care delivery, biomedical science, social services and the law, and carries out internationally recognized research to cure disease and to improve the

health, social functioning and treatment of the people it serves. UMB is committed to ensuring that the knowledge it generates provides maximum benefit to society.

The Post-Baccalaureate Certificate in Medical Physics is designed for students and professionals with related work experience and course work in physics and engineering who are delving into a field of medical physics. The proposed program emphasizes concepts, practices and skills that professionals need to be effective in a wide range of medical physics concepts and who are positioned to apply for further clinical training named Medical Physics Residency. The certificate program course work also fulfills the necessary requirements for American Board of Radiology (ABR) or ABR examinations for medical physics candidates. The ABR is the body that certifies the diplomates of the field of Diagnostic Radiology, Radiation Oncology and Medical Physics.

The proposed Post-Baccalaureate Certificate program will require the completion of 6 courses totaling 18 core credits. Students enrolled continuously will enroll in fall (2 courses) spring (2 courses) and winter (2 courses-alternate) and will be able to complete the program in 21 months. Courses in the programs will be taught in predominately hybrid formats.

The proposed Post-Baccalaureate Certificate will commence beginning in Fall semester 2022 per the following schedule:

	Year 1	Year 2
Fall A	MP605: Radiological Physics and Dosimetry	MP606: Radiation Protection and Radiation Safety
Fall B	MP603: Anatomy and Physiology	MP604: Radiobiology
Spring	MP601: Radiation Therapy Physics	MP602: Fundamentals of Imaging in Medicine

2. Alignment with institutional strategic goals

The proposed Post-Baccalaureate Certificate advances UMB's mission "to improve the human condition and serve the public good of Maryland and society at-large through education, research, clinical care, and service." Additionally, the Post-Baccalaureate Certificate in Medical Physics contributes to the fulfillment of related strategic goals for UMB, in a number of significant ways:

- One of the university's key strategic themes is to "excel at interdisciplinary interprofessional education, clinical care and practice, and public service. The Post-Baccalaureate Certificate in Medical Physics directly responds to this theme by building an area of concentration that is focused on clinical care and practice (Medical Physics).

- The university has recognized the important role the Graduate School plays in creating accessible education for individuals already engaged in their professions. The Post-

Baccalaureate Certificate in Medical Physics is a professional degree which may be completed by a working professional in as few as 21 months in a hybrid environment.

3. Provide a brief narrative of how the proposed program will be adequately funded for at least the first five years of program implementation

The program is resourced sufficiently; there is an already existing faculty in the School of Medicine who will develop coursework and provide instruction. The UMB Graduate School has the capacity to offer the proposed Post-Baccalaureate Certificate within existing resources, and can ensure continued funding to support the program into the foreseeable future. Given the focused nature of the proposed program, enrollment will be approximately five students per cohort.

4. Provide a description of the institution's commitment to ongoing administrative, financial, and technical support of the proposed program and continuation of the program for a period sufficient to allow enrolled students to complete the program.

The UMB Graduate School has an ongoing commitment to sustaining new degree programs that it has developed. The Graduate School has committed significant resources in the realm of administrative support including a Vice Dean and Assistant Dean who will provide leadership for the quality and sustainability of the Post-Baccalaureate Certificate in Medical Physics. This is done in partnership with the University of Maryland School of Medicine, which will provide faculty support and program direction. Additionally, the Graduate School plans sufficiently to ensure the financial viability of all new degree programs including the provision of faculty instruction and advisement to ensure a quality learning experience for students. The Graduate School has also invested in technical assistance through our centralized Center for Information Technology Services (CITS) and the Faculty Center for Teaching and Learning (FCTL), which both assist our faculty and students in their success as teachers and learners, respectively. If for some unforeseeable reason the Graduate School discontinues the Post-Baccalaureate Certificate in Medical Physics, then we are committed to a teach-out plan for all enrolled students, so they may complete the program and earn their degree.

B. Critical and Compelling Regional or Statewide Need as Identified in the State Plan

Alignment with Maryland State Plan

There is a compelling regional and statewide need for board certified medical physicists to care for the health and well-being of Maryland's citizens. The Maryland State Plan for Post-Secondary Education 2017 – 2022 outlines several goals for institutions of higher education. This Post-Baccalaureate Certificate in Medical Physics addresses each area.

Goal 1: Success: The Post-Baccalaureate Certificate in Medical Physics is designed to prepared individuals to contribute to the clinical care of Marylanders. The curriculum has been designed to ensure student success and at the same time ensure learning outcomes of the highest standards. The degree has been designed to advance best practices in teaching, learning and assessment for graduate-level health professionals.

Goal 2: Access, Affordability, and Completion: The Post-Baccalaureate Certificate in Medical Physics is affordably priced, consistent with the mission of public higher education, and can be completed within 21 months. The design and academic commitment will encourage program completion resulting in a qualified and competent clinical workforce.

Goal 3: Innovation: The Post-Baccalaureate Certificate in Medical Physics has direct alignment with the state-plan goal of innovation by applying the science of teaching and learning to curricular design and assessment in the medical physics curriculum.

Critical Need

In the clinic of the Radiation Oncology, the Diagnostic Radiology and the Nuclear Medicine, Medical Physicists play key roles. It is impossible to imagine any clinical activities without a physicist's contribution. A qualified or a board-certified physicist is a physicist deemed and certified by the ABR as a qualified clinical physicist who can perform the above-mentioned tasks independently. In order to be eligible to take the ABR certification examinations (Parts I through III), the candidate needs to be trained under a Medical Physics Residency Program (MPRP). Admission to an MPRP requires either (i) a graduate degree (MS or PhD) in Medical Physics or (ii) a graduate certificate (post-PhD) in medical physics. In both cases the programs have to be approved by the Commission on Accreditation of Medical Physics Educations Programs (CAMPEP).

As of March 17, 2020, there are 21 CAMPEP accredited medical physics graduate certificate programs in the United States. Every year, about 400 new residents are recruited to the 128 CAMPEP accredited Medical Physics Residency Programs in North America and five new residents are enrolled at the two major academic institutions (with Radiation Oncology departments) in the state of Maryland; University of Maryland Medical Center and Johns Hopkins University. Given this demand, it is desirable to initiate and maintain a certificate program for Maryland applicants who have graduated with a PhD degree in the physical or biomedical sciences and who wish to pursue a career in medical physics. Such a program would especially help candidates who are working professionals and prefer to pursue the certification as part-time students. Also, with the Post-Baccalaureate Certificate in place, the medical physics residency programs at both the University of Maryland and the Johns Hopkins University will benefit, since both institutions will be able to prioritize candidates from the certificate programs for the residency spots. The certificate program's curriculum is derived with ABR examinations as a guide and will adhere to CAMPEP requirements to standardize the program to all students.

C. Quantifiable and reliable evidence and documentation of market supply and demand in the region and the state

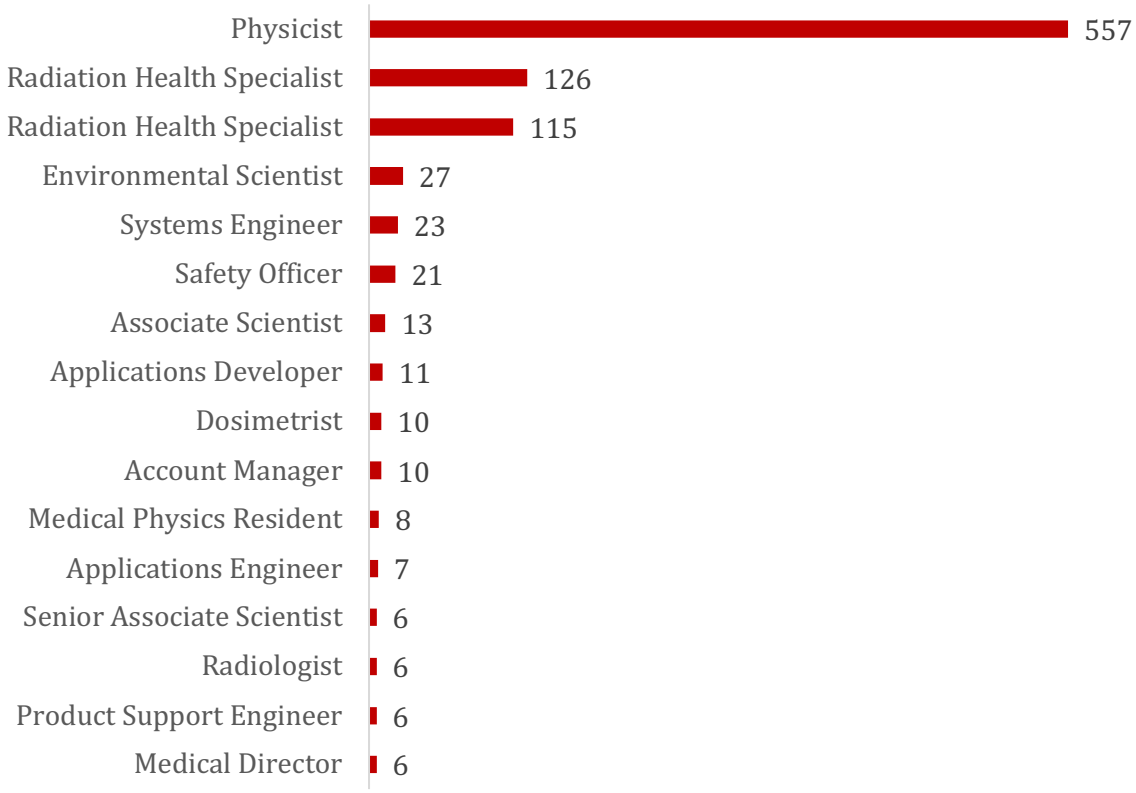
UMB approached the Washington DC based Educational Advisory Board (EAB) to conduct an employer demand study for medical physicists with graduate training. Through the analysis of employer demand data, the EAB sought to assess the market viability of graduate training in medical physics. EAB's market research function provides insights which guide strategic programmatic decisions by combining qualitative and quantitative data to help identify opportunities and align curriculum with employer and student demand. EAB reports rely primarily on labor market data to explore occupation and job trends.

EAB's findings indicate adequate market demand, and also that marketing messages should focus on the opportunity to enter or advance in a medical physics career in the local area. U.S. Naval sailors on active-duty service who work or seek to work in the medical physics field would also benefit from a hybrid program.

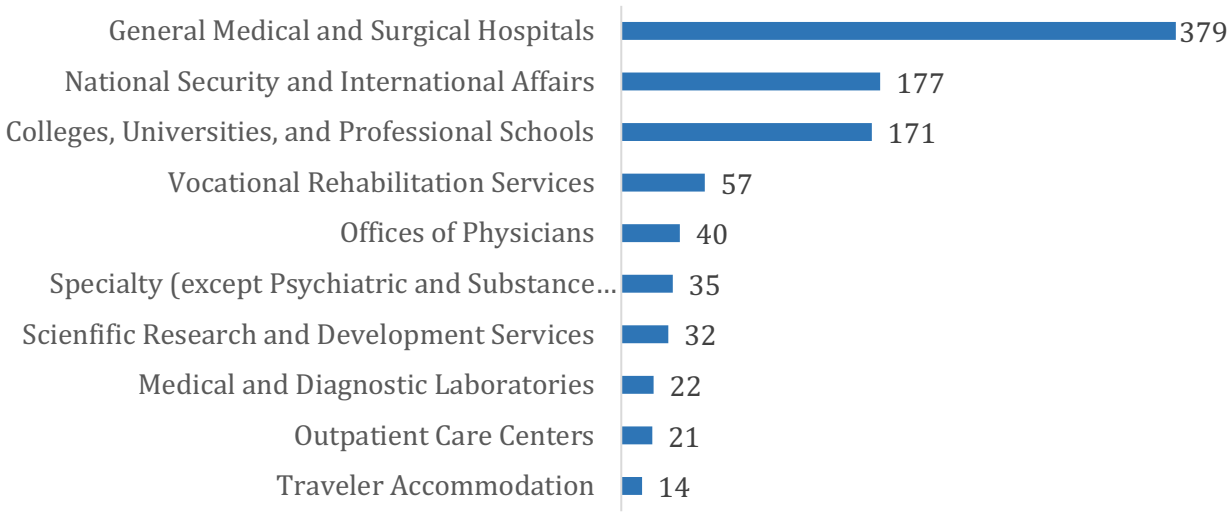
Additionally, the EAB report indicates a high number of job postings for graduate-level medical physics professionals. Thirty-nine percent of all job opportunities for medical physics professionals require applicants to possess graduate-level credentials. It is recommended to develop coursework that confers 'radiation oncology,' 'radiology,' and 'treatment planning' skills to improve graduate outcomes. In addition to 'physics' and 'medical physics' skills, employers seek medical physics graduates with 'radiation oncology,' 'radiology,' and 'treatment planning' skills most often. Employers also seek graduates with other diagnostic and therapeutic skills, such as 'dosimetry' skills, and with skills related to radiation protection and training in the workplace. The core courses taught in graduate certificate program inclusively teaches radiation dosimetry, radiation treatment planning, diagnostic imaging and radiation protection either through the course or clinical practicum.

The EAB identified the top job titles for graduates of medical physics program displayed in the table below. Key observation from EAB's market analysis shows that 39% of all job opportunities for medical physics professionals require applicants to possess a graduate degree.

Top Titles for Graduate-Level Medical Physics



EAB has also identified the top industries in which an employer of medical physicists operates are ranked in the following table.



D. Reasonableness of Program Duplication

Johns Hopkins University recently started offering graduate level master's program in Medical physics. This program is intended for undergraduate degree holders who are seeking to go into the field of medical physics. This program is also being offered as a full-time course work. However, there are currently no Post-Baccalaureate Certificate programs in Medical Physics in the state of Maryland. The program that the University of Maryland Baltimore is offering is a part-time coursework for students who already have a graduate degree and are entering the field of medical physics. Therefore, there is no concern regarding program duplication.

E. Relevance to High-demand Programs at Historically Black Institutions (HBIs)

The proposed Post-Baccalaureate Certificate in Medical Physics does not have relevance to the uniqueness and/or institutional identities and missions of HBIs. Currently, there are no academic programs offered through Bowie State University, Coppin State University, Morgan State University, and the University of Maryland Eastern Shore that resemble the proposed PBC in Medical Physics. Based on the current offerings of the Maryland HBIs, we do not expect any impact on the implementation or maintenance of high-demand programs at HBIs. Within the vicinity "Howard University" in the District of Columbia has recently launched a full time Master's degree program in Medical Physics.

F. Relevance to the Identity of Historically Black Institutions

HBIs have a unique history and identity related to the education of racial minorities in the United States. HBIs are dedicated to educating graduates who can interact with other racial and ethnic groups upon graduation. Predominately White Institutions (PWI) also must educate students to interact with diverse individuals upon graduation. Consequently, we do not believe that offering this proposed program in Medical Physics impacts the mission and identity of HBIs.

Additionally, any student who has attended a regionally accredited institution and completed appropriate qualifications for admission to the Post-Baccalaureate Certificate in Medical Physics, including credentials earned at HBIs, is eligible to apply to the program. Graduates of HBIs could improve their competitiveness in the marketplace and reach their professional goals by enrolling in and completing the proposed degree program.

G. Adequacy of curriculum design and delivery to related learning outcomes

1. Provide a list of courses with title, semester credit hours and course descriptions

Certificate Program in Medical Physics (18 Credits) Below are the core courses that will be offered in certificate program. All of these courses are new courses.

MP601: *Radiation Therapy Physics* (3 Credits)
This course is designed to provide graduate learners the opportunity to develop an understanding of the systemic use of radiation in the treatment of cancer. This course provides learners with the detailed review of X-ray production and fundamentals of nuclear physics and radioactivity. Also included in the course will be the analysis of radiation absorption and interactions of radiation in biological materials. Further materials in this course includes ion chamber dosimetry, cavity theories, external beam therapy that includes both low and high energy therapy, proton and electron therapy, brachytherapy, dosimetry protocols, clinical process of treatment planning, monitor unit calculations, intensity-modulated radiation therapy detectors used in radiation therapy.

MP602: *Fundamentals of Imaging in Medicine* (3 Credits).
This course provides the foundations and covers the mathematics, physics and instrumentation of several modern imaging modalities including X-ray imaging, computerized tomography, nuclear medicine physics (PET/SPECT), magnetic resonance imaging, ultrasound etc. The course also dives into the topics of image contrast, image resolution, SNR, MTF and other relevant imaging principles applied in medical imaging applications.

MP603: *Anatomy and Physiology For Medical Physicists* (3 Credits)
Students learn about anatomic structures in various cross sections, and their underlying physiology pertaining to radiation therapy. The course covers topics on medical terminology, basic anatomy and physiology, nomenclatures of human anatomy. The major learning objective of this course is for the learners to be able to identify major organs in radiological images and understand their physiological functions.

MP604 *Radiobiology for Medical Physicists (*3 Credits)
This course will provide basics of the biology and overview of radiation interactions and effects with cells. Topics such as cell biology, DNA damage and repair, cell survival curves, carcinogenesis, radiation genetic effects, radiation protection, tumor and normal tissue control probabilities and various other biological topics pertaining to radiation therapy and cancer treatment will be instructed.

MP605: *Radiological Physics and Dosimetry* (3 Credits)
This course is designed to give students the basic information regarding basic radiation physics: radioactive decay, radiation producing devices, characteristics of the different types of radiation (photons, charged and uncharged particles) and mechanisms of their interactions with materials.

MP606: *Radiation Protection and Radiation Safety* (3 Credits)

This course is designed to provide learners with the knowledge and technical background to understand the calculation methodology, compliance with the safety standards, and use of quantitative risk assessment for radiation protection & safety. This course also covers the topics on the fundamental principles and objectives of health physics (radiation protection), dose quantities used to evaluate human radiation risks, effects of radiation exposure and fetal risks, elementary shielding calculations and protection measures for clinical environments, the characterization and proper use of health physics instrumentation, and the regulatory and administrative requirements of health physics programs in general and clinical activities.

2. Describe the educational objectives and intended student learning outcomes

The Graduate School recognizes that each Post-Baccalaureate Certificate student must have achieved certain learning. The following objectives as directly mentioned by CAMPEP should be achieved by the end of the program.

i. an understanding of the role of patient safety in the clinical practice of medical physics;
ii. an understanding of how research and inquiry lead to the creation of new knowledge;
iii. the ability to critically evaluate research and scholarship in medical physics;
iv. the competent use of research to pose new questions and to solve problems in research and clinical settings;
v. the communication and interpersonal skills that are necessary to function in a collaborative, multidisciplinary environment;
vi. the professional attributes and the ethical conduct and actions that are required of medical physicists; and
vii. a valuing of career-long continuing education to keep scientific knowledge and skills current

UMB is committed to providing the best teaching and learning possible and excellence in all of its courses. Every effort is made to ensure that coherence, cohesiveness, and academic rigor is applied in the curriculum design. Courses are designed to result in learning outcomes appropriate to the rigor and breadth of the course and all courses assess student achievement of defined learning outcomes through regular and formal assessment planning.

Faculty will assess student achievement and mastery of learning outcomes in their courses using a variety of assessments including meaningful and substantive contributions to classroom discussions, satisfactory completion of assignments, scores on quizzes and examinations, scores on team collaboration, scores on written essays and term papers, and evaluation of medical physics clinical practice.

3. Discuss how general education requirements will be met, if applicable.

Not applicable.

4. Identify any specialized accreditation or graduate certification requirements

The certificate program in medical physics will undergo accreditation process by Commission on Accreditation of Medical Physics Education Programs, Inc. (CAMPEP). CAMPEP accreditation will be sought for first cohort of students.

5. If contracting with another institution, provide a copy of the contract

Not applicable.

H. Adequacy of Articulation

Not applicable

I. Adequacy of Faculty Resources

1. Provide a brief narrative demonstrating the quality of program faculty. Include a summary list of faculty with appointment type, terminal degree title and field, academic title/rank, status (full-time, part-time, adjunct) and the course(s) each faculty member will teach in the proposed program

   UMB is committed to providing the best hybrid teaching and learning possible and to excellence in all of its courses. Every effort is made to ensure that coherence, cohesiveness, and academic rigor between programs offered in traditional instructional formats and those offered online are equivalent. Courses are designed to result in learning outcomes appropriate to the rigor and breadth of the course and all courses assess student achievement of defined learning outcomes through regular and formal assessment planning.

   The hybrid courses within this Post-Baccalaureate Certificate are being designed by faculty members in appropriate disciplines and will be further developed for online learning in collaboration with instructional designers and other experts in the field at UMB. Course learning outcomes and course descriptions are the same for every section of the course. The learning outcomes for each course are the foundation of the course; the learning activities, assessments and content of the course are in alignment with the outcomes and provide a clear pathway for mastery of the outcomes.

Faculty from the Department of Radiation Oncology, School of Medicine have significant experience in instructional technologies that is currently being employed in our residency and fellowship programs. Faculty member below have full time (FT), regular appointments and have required expertise to teach all the proposed courses for the certificate program. Below is a list of faculties in the program, all whom are full-time, and all within the SOM Department of Radiation Oncology

Name	Degree and Field	Title	Other	Courses Taught
Sawant, Amit	PhD in Biomedical Engineering	Associate Professor, Chief of Medical Physics	(***)	MP602:Fundamentals of Imaging In Medicine, MP604:Radiobiology for Medical Physicists
Becker, Stewart	PhD in Medical Physics	Assistant Professor	ABR certified	MP606:Radiation Protection and Radiation Safety
Chen, Shifeng	PhD in Physics	AssociateProfessor, Associate Chief of Clinical Physics	ABR certified	MP601:Radiation Therapy Physics
Gopal, Arun	PhD in Medical Physics	Assistant Professor	BWMC,ABR certified	MP601:Radiation Therapy Physics
Rana, Zaker	MD, Radiation Oncology	Assistant Professor	ABR Eligible	MP603:Anatomy and Physiology for Medical Physicists
Mossahebi, Sina	PhD in Physics	Assistant Professor	MPTC, ABR certified	MP606:Radiation Protection and Radiation Safety
Lasio, Giovanni M.	PhD in Physics	AssociateProfessor	UCH, ABR certified	MP602:Fundamentals of Imaging in Medicine
Yi, Byong Yong	PhD in Physics	Professor, Director of Proton Physics	MPTC, ABR certified	MP605:Radiological Physics and Dosimetry
Mohindra, Pranshu	MD, Radiation Oncology	Associate Professor	ABR Certified	MP603:Anatomy and Physiology for Medical Physicists
Lamichhane, Narottam	PhD in Medical Physics	Assistant Professor	ABR certified	MP602:Fundamentals of Imaging in Medicine, MP601: Radiation Therapy Physics

Kalavagunta, Chaitanya	PhD in Medical Physics	Assistant Professor	ABR certified	MP602:Fundamentals of Imaging in Medicine (MRI)
Cammin, Jochen	PhD in Physics	Assistant Professor	ABR certified	MP605:Radiological Physics and Dosimetry
Shukla, Hem	PhD in Biochemistry	Assistant Professor	(***)	MP604:Radiobiology for Medical Physicists
Zhang, Baoshe	PhD in Physics	Assistant Professor	ABR Certified	MP602:Fundamentals of Imaging in Medicine
Guerrero, Mariana	PhD in Physics	Associate Professor	ABR Certified	MP604:Radiobiology for Medical Physicists

BWMC = Baltimore Washington Medical Center; MPTC= Maryland Proton Treatment Center UCH = Upper Chesapeake Health.
(***) Research Faculty, not certified

2. Demonstrate how the insitution will provide ongoing pedagogy training for faculty in evidenced-based best practices:

   UMB, through its Facultty Center for Teaching and Learning, has a robust process for training faculty and ensuring effective instruction. Based on Quality Matters standards, at UMB we have developed a rubric that outlines best practices for distance education – this rubric helps faculty and instructional designers develop the courses, assess the readiness of the course and ensure that the online courses are instructionally and peagogically sound. The best practices are grounded in research, a proven synthesis of strategies, activities, design techniques, and organizational items that have proven successful in higher education. The specific domains of this checklist are as follows:

   - Course overview and introduction to the students
   - Course organization and design
   - Learning objectives (competencies)
   - Instructional materials
   - Learner communication, interaction, and collaboration
   - Assessment and evaluation (measurement)
   - Course technology
   - Learner support

   The learning managment platform UMB utilizes and provides IT support for is the Blackboard Learning Management System for online course delivery. Within Blackboard, is the Collaborate conferencing software that we will use for our synchronous live activities, i.e., orientation, face-to-face class sessions, and recurring webinars. Additionally the FCTL team has availabe to them the use of a video recorder to record lectures, webcams, and interactive smart board. We will also use video and Camtasia software for scree lecture capture.

J. Adequacy of Library Resources

The University of Maryland, Baltimore's Health Sciences and Humans Services Library (HS/HSL) collection contain more than 30,000 electronic journals, 162 current print journals, approximately 170,000 books, and 6,000 electronic books. Students can access the electronic resources offered on the library website by logging in with their University ID number. The library serves as the regional medical library for ten southeastern states as part of the National Library of Medicines National Network of Libraries of Medicine. In addition to the library services and collections, the building also houses computing services. Faculty librarians are dedicated to providing direct service to students. They use subject expertise to develop online resources and provide in-person consultations.

The HS/HSL is one of the largest health sciences libraries in the United States with a track-record of user-centered innovative services and programs. The library consists of 57 employees including 27 faculty librarians. The attractive and vibrant facility, which opened in 1998, serves as a hub for collaboration and learning with resources, programs, and tools that promote discovery, creativity, and innovation. With wireless connectivity throughout the building, the HS/HSL has 45 group study rooms, three computer classrooms, an Innovation Space which includes 3D printers; a presentation and practice studio, art gallery, and multiple technology enhanced meeting spaces. Through the HS/HSL's website (www.hshsl.umaryland.edu,) the UMB community has access to a full range of resources and services.

The HS/HSL supports the University's students, faculty, and staff members in the schools of dentistry, law, medicine, nursing, pharmacy, and social work; the Graduate School; the University of Maryland Medical Center; and other affiliated institutions. Research Connection, the library's suite of research services, is available for all programs on campus and includes individual research consultations, a systematic review service, research impact assessment, reference assistance, and more. For over 30 years, the HS/HSL has provided liaison services, in which faculty librarians are assigned to work with specific user communities. Faculty librarians have many years of instructional experience in the classroom, in the community, and the online environment. In FY16, faculty librarians reached 4,131 faculty, staff and students through online and in-person instructional sessions offered through the curriculum and in library-sponsored workshops.

In FY16, the HS/HSL licensed 116 databases, 4,524 journals, 18,018 e-books, and maintained a print collection of 360,104 volumes. One hundred percent of the current journal subscriptions are available electronically. Through its interlibrary loan and document delivery service, library staff can acquire articles and other resources not available through the library's collections. These are secured through local, regional, and national networks including the University System of Maryland and Affiliated Institutions, the National Library of Medicine's DOCLINE service, and OCLC, among others. The HS/HSL is also home to the National Network of Libraries of Medicine/Southeastern Atlantic Region (NNLM/SEA), whose mission is to advance the progress of medicine and improve the public health by providing all U.S. health professionals with equal access to biomedical information and improve the public's access to information to enable them to make informed decisions about their health. With only eight regions in the U.S. designated as regional medical libraries under contract to the National Library of Medicine at the National Institutes of Health, the Southeastern/Atlantic Region serves ten southeastern states, Puerto Rico, the U.S. Virgin 18 Islands, and the District of Columbia. The HS/HSL has held this competitive and prestigious designation for over 30 years.

K. Adequacy of physical facilities, infrastructure, and instructional equipment

UMB's 71-acre research and technology complex encompasses 67 buildings in West Baltimore near the Inner Harbor. Faculty have offices provided within their respective departments and the

The faculty has offices provided within their respective departments, and the Graduate School has identified space to house instructional technology and design personnel. UMB has adequate facilities, infrastructure and equipment to support the distance learning needs of the Post-Baccalaureate Certificate in Medical Physics. Students will have full access to the computing facilities at UMB. In addition, students will be provided with UMB e-mail and library accounts and will have complete journal searching ability via PubMed. UMB possesses computing facilities that includes a networked computing environment for support of a broad range of information technology functions, including basic research, clinical research, patient information and general office management. The physical facilities used for the implantation of the program is going to the Department of Radiation Oncology at the University of Maryland Medical Center and its affiliated community practices as needed.

L. Adequacy of financial resources with documentation

No new general funds will be required for implementation of the proposed certification program. The certificate program will be coordinated and administered fully through the Graduate School, and instruction will be managed by faculty in the SOM. Tuition will be administered through the Graduate School and student tuition payment is in addition to that required of any individual professional school at UMB. The Graduate School will collect tuition revenue.

Note: The certificate program is going to be implemented in the Division of Medical Physics at the Department of Radiation Oncology at the University of Maryland, Baltimore. The faculty and the staff members supporting the program are going to be the full-time faculty physicists and administrative staffs who are currently working at the department of radiation oncology. Therefore, the program expenditures including the salary and benefits of the faculty and administrative staffs are not going to be incurred and is already being accounted for. The program is not anticipating expenditure on the equipment, library, or renovated spaces, as the program will be utilizing the existing facility to implement the program

M. Adequacy of Provision of Evaluation of Program

Students will have the opportunity to evaluate courses and faculty through a standard evaluation of every course. Formal assessment planning is already in place throughout UMB Schools including the Graduate School. Our approach includes ensuring that student learning is in alignment with course learning outcomes, alignment of mission at institutional and program levels, alignment of mission with learning outcomes, then program outcomes with curriculum, flowing down to course outcomes and assignments. Assessment activities emphasize analysis of results and feedback loops for continuous improvement. Additional evaluation includes tracking of student retention, grade distributions, and cost-effectiveness, and regular academic program

reviews consider these factors. The program will be evaluated through periodic program review every 7 years or by accreditation site visits whichever is more frequent.

N. Consistency with the State's Minority Student Achievement Goals

A key feature of UMB's mission and strategic planning involves respecting, valuing and achieving equity and diversity. The Strategic Plan states: diversity represents a core value, which is defined as being "committed to a culture that is enriched by diversity, in the broadest sense, in its thoughts, actions, and leadership" (University of Maryland, Baltimore, n.d.). The state of Maryland also has a goal of expanding educational opportunities for minority and educationally disadvantaged students.

The proposed Post-Baccalaureate Certificate in Medical Physics aims to address both UMB's and the State's cultural diversity goals. First, the delivery of the majority of the courses in the program with distance learning technology will enhance student access, as it expands access and success for learners from diverse communities. Essentially, distance learning is quickly becoming the educational opportunity for students who may not or would not be able to participate in a traditional in-person college education. For rural and isolated communities, distance learning can be the vehicle that conquers geography and space between teachers and students. The emergence of so-called "virtual universities" has had more success in attracting diverse populations compared to traditional colleges. Ibarra (1999) asserts that historically underrepresented groups are highly attracted to internet-based degrees that embrace the core values of social change and community engagement.

The second manner in which the proposed Post-Baccalaureate Certificate in Medical Physics addresses diversity goals is that distance learning not only achieves "access," but can also help ensure "success," as the technology of distance learning meets the needs of various learners and allows for differentiated instruction. Essentially, with the proper use of its varied technology, distance learning can address the needs of all populations, creating an environment where students can thrive. In contrast with many universities that have a predominance of a particular and preferred learning environment grounded in outmoded ideas about one-size fits all educational pipelines, the varied types of interactions common in distance education embrace a shift from passive to active learning and from competition to collaboration. Furthermore, different learning styles and cultures can be accommodated more easily because useful collaborative learning values diversity (Palloff & Pratt, 2005).

Additionally, UMB realizes that it must not only embrace and celebrate diversity but also provide opportunities for students to develop faculty who can design curricula to promote cultural competence and intercultural leadership. The Post-Baccalaureate Certificate in Medical Physics uses an interdisciplinary approach to positively influence the climate for diversity, which includes consideration of external (i.e., governmental/political forces and socio-historical forces) and internal (i.e., historical legacy of inclusion or exclusion, compositional diversity, psychological climate, behavioral dimension, organizational/structural diversity) factors deemed necessary to

understand and shape campus environments (Hurtado, Milem, Clayton, Pedersen, & Allen, 1999; Milem, Chang, & Antonio, 2005).

O. Relationship to Low Productivity Programs Identified by the Commission

The proposed Post-Baccalaureate Certificate in Medical Physics program is not directly related to low productivity program identified by the Maryland Higher Education Commission.

P. Adequacy of Distance Education Programs

The Context of Online Education at UMB

As the State's public health, law, and human services university, the mission of UMB is to excel at professional and graduate education, research, patient care, and public service, and to educate leaders in health care delivery, biomedical science, global health, social work, and the law. Also, UMB emphasizes interdisciplinary education in an atmosphere that explicitly values civility, diversity, collaboration, and accountability. UMB expects to achieve its mission in educational excellence and to be competitive; the Graduate School has designed and offered online degree programs that respond to the following changes occurring in higher education (Picciano, Seaman, & Allen, 2010):

- Education Pipeline. The education pipeline is now seeing inputs at every level with a highly diverse prospective student pool. Prospective students are typically working adults who demand part-time and non-residential educational 22 opportunities. Results of the educational experience are becoming ever more outcomes-based.

- Changing Demographics. Data indicate a shift from the traditional-aged student (i.e., 18-22-year old, full-time resident) to older students studying part-time.

- Technology Shift. Online delivery is far outpacing traditional forms of delivery. From 2002 to 2008, online enrollments grew at an annual compound rate of 19% vs. 1.5% for all of higher education. By the fall of 2008, 25% (4.6 million) of all students took at least one online course. There is a growing acceptance that online education is as good as or better than traditional face-to-face delivery models. It is estimated that online learning will grow by 31% from 2020 to 2025.

- The growth of Mobile Technologies. Mobile technologies and miniaturization are changing the computing environment and the educational delivery paradigm. Technologies like netbooks, e-Readers, iPhones, and iPads have the potential to revolutionize the delivery space and to provide anywhere, anytime learning.

- Web 2.0 Revolution. Other technologies that are already figuring widely into the future of education are part of the Web 2.0 revolution. The use of a variety of technologies is disaggregating the educational experience into 'the cloud.' Many of the technologies for the future, like blogs, wikis, podcasts, video, social networking, and social media, virtual worlds, mobile learning, and Personal Learning environments, will have profound effects on the future learning landscape.

Essentially, online education represents a strategy that can address the restrictions of college courses that are delivered onsite. Online learning seeks to expand knowledge beyond the walls of the campus and can reach millions of new learners who could never put their lives on hold to complete a certificate or degree mainly delivered or solely on a college campus. Online programs also can respond to individual student learning needs and styles in ways that cannot be duplicated in the face-to-face classroom. Significant determinants of successful online programs include 1) course design that incorporates best practices, 2) quality faculty who can engage students in the material, and 3) responsible academic oversight. All three of these determinants are present in this proposal.

Instructional Design Team

The following individuals from the Faculty Center of Teaching and Learning will direct the distance education strategy for the PBC in Medical Physics program:

Christina Cestone, PhD | Executive Director, Faculty Center for Teaching and Learning

Dr. Cestone earned a Ph.D. in Educational Psychology from the University of Texas at Austin and a Master's degree in Human and Organizational Learning from The George Washington University. Dr. Cestone research includes faculty learning communities, instructional methods, motivation, and interprofessional education. Most recently, as 23 Associate Dean of Assessment and Evaluation for Drexel University, College of Medicine, Dr. Cestone directed medical student assessment, and course and curriculum evaluation in an integrated medical curriculum for 1,100 medical students. Her interests are in program evaluation, and curriculum and instructional development involving active learning methods. She presents her work nationally and is active in the American Education Research Association (AERA) and the Professional and Organizational Development Network (POD), a national association of directors of Centers for Teaching and Learning.

Kevin Engler, MA | Instructional and Curriculum Designer

Mr. Engler holds a Masters of Arts degree in Instructional Design. Mr. Engler provides instructional design, audio-visual support, and faculty training in the use of instructional technologies. He is responsible for the overall pedagogy, planning and designing of course content and assessments for distance education courses in the program. Mr. Engler is knowledgeable in adult learning theory, distance education pedagogical techniques, course development planning and process management. Mr. Engler is trained and certified in the Quality Matters methodology and the ADDIE approach to course design. He has experience and background in writing instructional objectives that utilize Bloom's Taxonomy.

Erin Hagar, MA/MFA | Instructional and Curriculum Designer

Ms. Hagar taught Spanish at the college level and has worked in instructional and curriculum design for colleges and universities since 2000. She previously worked at Montgomery Community College and Johns Hopkins University, helping faculty incorporate new pedagogical practices and technologies into their face-to-face and online courses. Her areas of expertise include faculty development and training, online course design using the Quality Matters standards, and authentic activities and assessments. She is responsible for the overall pedagogy, planning and designing of course content and assessments for distance education courses in the program.

Sharon Gillooly | Senior Media Production Specialist

Ms. Gillooly leads media production for the AIDE team. Her main focus is to produce videos that support academic instruction. After a long career in documentary television, she completed a Master's Certificate in Online Instructional Development from Florida State University where her work focused on instructional design and emerging technologies. Ms. Gillooly is especially interested in the use of media to enhance learning.

Eric Belt, MS | Senior Academic Innovation Specialist

Mr. Belt holds a Master of Arts degree in distance education and e-Learning. He is an educational technology doctoral student at Boise State University pursuing research in communication, interaction, and engagement in online courses. He was previously the director of learning technology at the College of Southern Maryland and, formerly, the assistant director of e-Learning at Howard Community College. Mr. Belt has served as an instructional designer both virtually and on-campus for various community colleges 24 across the United States. He has a passion for advancing the scholarship of teaching and learning through course design, instructional communication, and faculty professional development.

Becky Menendez, MA/MEd | Academic Innovation Specialist

Ms. Menendez holds master's degrees in elementary education, teaching English as a Second Language, and educational technology. She has a deep understanding of educational practice and design in higher and postsecondary education, particularly with English language learners, and has supported online course design for the International Baccalaureate, the Community College of Baltimore County, and Penn State University. Ms. Menendez is a trained Quality Matters peer reviewer, providing feedback and guidance to institutions on improving the quality of their online courses.

Collectively, the FCTL team will provide the following services to ensure that best pedagogical practices are used to train and support the most of effective presentation of their course content.

- Guided tutorials on the online course development process, with open questions and answer session.

- Written instructions accompanied by training videos to guide faculty on how to use the learning management system.
- A manual for the faculty regarding principles of good practice and the pedagogy of distance education.
- Provide timely support to the faculty in the use of the technology and trouble shoot any problems that might arise during the course of instruction.
- Work with faculty to design and develop courses, monitor the delivery of the course, and assess and revise the course for future offerings.

Course development and curricular oversight will be accomplished in partnership with a program director, teaching faculty, and the instructional design team, who will ensure course materials follow best practices in online education and adult learning theory. Collectively, they will produce the following materials:

- Course-level outcomes and module level objectives
- Course storyboards that will serve as planning documents for new courses that outline objectives, discussion prompt and learning activities, and resources (e.g., articles, websites, online videos)
- Assignments and assessments that measure student performance and clear instructions for completing them
- Grading Rubrics
- Course syllabus

Supporting Students in Online Learning

All of the courses for the PBC will be a hybrid model with four being offline and two will be online. We realize that the key to the success of the online courses is dependent on a) students knowing upfront the assumptions, requirements, and responsibilities of taking an online course, 2) the ability of students to have the background, knowledge, and technical skills to undertake an online program; and 3) their having access to academic and technical support services to support their online activities. Accordingly, we will provide the following services to support the students in accessing distance learning technology:

- Communicate to students the nature of online learning, including their requirements, roles and responsibilities, and access to support services. We have also prepared a short questionnaire for students that will help them decide whether online learning is right for them. All of our advertising, recruiting, and admissions materials shall clearly and accurately represent the program and the services available.

- Ensure that enrolled students shall have reasonable and adequate access to the range of student services to support their learning.

- Ensure that accepted students will have the background, knowledge, and technical skills needed to undertake the program.

- Make available the library's services to students so that they can have access to research databases, the online catalog of books and media, chat with or e-mail a Librarian, electronic interlibrary loan, and more.

Evaluation and Assessment of Online Courses

We will adhere to a quality improvement model for assuring the continuous quality of the online courses. The process will involve the following steps:

1. Assessment of course readiness as measured by our quality indicators of best practices (including assessment of faculty readiness)
2. Monitoring of course delivery as assessed by the instructional designers with the use of our "course evaluation' rubric."
3. Obtain feedback from the faculty and students and instructional designers.
4. Analysis of feedback as performed by the Distance Learning Committee.
5. Institute course revisions based on comments by the Distance Learning Committee.

Finally, to ensure the sustainability of the distance learning program, the Academic Affairs Office at UMB affirms the following:

- UMB Policies for faculty evaluation includes appropriate consideration of teaching and scholarly activities related to programs offered through distance learning.
- Commitment to ongoing support, both financial and technical, and to a continuation of the program for a period sufficient to enable students to complete a certificate.

Appendix A: Plan of Study

	Year 1	Credits	Year 2	Credits
Fall A	MP605: Radiological Physics and Dosimetry	3	MP606:Radiation Protection and Radiation Safety	3
Fall B	MP603:Anatomy and Physiology	3	MP604: Radiobiology	3
Spring	MP601:Radiation Therapy Physics	3	MP602:Fundamentals of Imaging in Medicine	3

Appendix B: Budget

TABLE 1: PROGRAM RESOURCES					
Resource Categories	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
1. Reallocated Funds	0	0	0	0	0
2. Tuition/Fee Revenue (c +g below)	**$29,311**	**$60,380**	**$69,965**	**$80,071**	**$82,474**
a. Number of F/T Students*	0	0	0	0	0
b. Annual Tuition/Fee Rate	0	0	0	0	0
c. Total F/T Revenue (a x b)	**0**	**0**	**0**	**0**	**0**
d. Number of P/T Students	4	8	9	10	10
e. Credit Hour Rate	$814	$839	$864	$890	$916
f. Annual Credit Hour Rate	9	9	9	9	9
g. Total P/T Revenue (d x e x f)	**$29,311**	**$60,380**	**$69,965**	**$80,071**	**$82,474**
3. Grants, Contracts & Other External Sources	**$ 0** -	**$ 0** -	**$ 0** -	**$ 0** -	**$ 0** -
4. Other Sources	**$39,630**	**$41,999**	**$10,039**	**$61**	**$5,291**
TOTAL (Add 1 – 4)	**$68,941**	**$102,379**	**$80,004**	**$80,132**	**$87,765**

TABLE 2: PROGRAM EXPENDITURES:					
Expenditure Categories	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
1. Faculty (b + c below)	$ 42,403	$ 75,720	$ 75,720	$ 75,720	$ 75,720
a. Number of FTE	0.28	0.50	0.50	0.50	0.50
b. Total Salary	$ 33,600	$ 60,000	$ 60,000	$ 60,000	$ 60,000
c. Total Benefits	$ 8,803	$ 15,720	$ 15,720	$ 15,720	$ 15,720
2. Admin. Staff (b + c below)	$ 4,038	$ 4,159	$ 4,284	$ 4,412	$ 4,545
a. Number of FTE	0.05	0.05	0.05	0.05	0.05
b. Total Salary	$ 3,000	$ 3,090	$ 3,183	$ 3,278	$ 3,377
c. Total Benefits	$ 1,038	$ 1,069	$ 1,101	$ 1,134	$ 1,168
3. Support Staff (b + c below)	0	0	0	0	0
a. Number of FTE	0	0	0	0	0

b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
4. Technical Support and Equipment	$ 22,500	$ 22,500	$ 0 -	$ 0 -	$ 7,500
5. Library	0	0	0	0	0
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	$ 0 -	$ 0 -	$ 0 -	$ 0 -	$ 0 -
TOTAL (Add 1 – 7)	**$ 68,941**	**$ 102,379**	**$ 80,004**	**$ 80,132**	**$ 87,765**