UNIVERSITY OF DELAWARE

ONLINE
GRADUATE CERTIFICATE
IN
APPLIED BIOINFORMATICS

ACADEMIC PROGRAM APPLICATION

FEBRUARY 15, 2017

UNIVERSITY
FACULTY SENATE FORM

ONLINE GRADUATE CERTIFICATE IN APPLIED BIOINFORMATICS

Academic Program Approval

This form is a routing document for the approval of new and revised academic programs. Proposing department should complete this form. Detailed instructions for the proposal should be followed. A checklist is available to assist in the preparation of a proposal. For more information, call the Faculty Senate Office at 831-2921.

Submitted by: __Cathy Wu, PhD_____ phone number ___831-8869_____

Department: ___Computer & Information Sciences__ email address ____wuc@udel.edu___

Date: __2/15/2017_____

Action: Request for New Online Graduate Certificate in Applied Bioinformatics (ABNF-CERT)

(Example: add major/minor/concentration, delete major/minor/concentration, revise major/minor/concentration, academic unit name change, request for permanent status, policy change, etc.)

Effective term___17F _____

(use format 04F, 05W)

Current degree__N/A _____

(Example: BA, BACH, BACJ, HBA, EDD, MA, MBA, etc.)

Proposed change leads to the degree of: ___Graduate Certificate_____

(Example: BA, BACH, BACJ, HBA, EDD, MA, MBA, etc.)

Proposed name:__Online Graduate Certificate in Applied Bioinformatics (ABNF-CERT)_

Proposed new name for revised or new major / minor / concentration / academic unit

(if applicable)

Revising or Deleting:

    Undergraduate major / Concentration:_____

        (Example: Applied Music – Instrumental degree BMAS)

    Undergraduate minor:_____

        (Example: African Studies, Business Administration, English, Leadership, etc.)

    Graduate Program Policy statement change:_____

        (**Must attach** your Graduate Program Policy Statement)

    Graduate Program of Study:_____

        (Example: Animal Science: MS Animal Science: PHD Economics: MA Economics: PHD)

    Graduate minor / concentration:_____

Note: all graduate studies proposals must include an electronic copy of the Graduate

Program Policy Document, either describing the new program or highlighting the changes made to the original policy document.

List new courses required for the new or revised curriculum. How do they support the overall program objectives of the major/minor/concentrations)?
(Be aware that approval of the curriculum is dependent upon these courses successfully passing through the **Course Challenge** list. If there are no new courses enter "None")

BINF690 Programming for Bioinformatics
* new course being developed and has been submitted to the course inventory process.

Supply support letter from the Library, Dean, and/or Department Chair if needed
(all new majors/minors will need a support letter from the appropriate administrator.)

Explain, when appropriate, how this new/revised curriculum supports the 5 goals of undergraduate education: http://www.ugs.udel.edu/gened/

N/A

Identify other units affected by the proposed changes:
(This would include other departments/units whose courses are a required part of the proposed curriculum. Attach permission from the affected units. If no other unit is affected, enter "None")

None

Describe the rationale for the proposed program change(s):
(Explain your reasons for creating, revising, or deleting the curriculum or program.)

The Online Graduate Certificate in Applied Bioinformatics (ABNF-CERT) will provide a fully online graduate level program in bioinformatics, an area of signature UD strength. It will be of interest to working professionals regionally, nationally, and globally who wish to gain knowledge and practical experience in bioinformatics, a rapidly expanding field of study with an explosion of career opportunities.

Building on the core curriculum of UD's MS, PSM and PhD bioinformatics degree programs, the Online Graduate Certificate will allow students to gain core competency in bioinformatics for real-world applications ranging from pharmaceutical, health care to agriculture and energy and meet industry's demand for professionals who have the ability to interpret complex biological data. A fully online Graduate Certificate Program will allow us to better serve the needs of working professionals, addressing the main barrier in their ability to attend classes during normal working hours, while increasing enrollment to these classes and to our program.

Program Requirements:
(Show the new or revised curriculum as it should appear in the Course Catalog. If this is a revision, be sure to indicate the changes being made to the current curriculum and **include a side-by-side comparison** of the credit distribution before and after the proposed change.) **See example of side by side.**

Online ABNF-CERT: Degree Requirement	
12 Credit Hours Total	
Bioinformatics Core	12 Credits

Online ABNF-CERT: Course Curriculum	
Bioinformatics (3)	BINF644: Bioinformatics (3)
Systems Biology (3)	BINF694: Systems Biology I (3)
Database (3)	BINF640: Databases for Bioinformatics (3)
Programming (3)	BINF690: Programming for Bioinformatics (3)

ROUTING AND AUTHORIZATION: (Please do not remove supporting documentation.)

Department Chairperson ____ *Kathleen J. Mc____* ____ Date____ 02/13/2017 ____

Dean of College____ *tunde ogunmaiwo* ____ Date 2/17/2017 ____

(By signing above, the Dean confirms that their college policies and bylaws have been followed correctly during consideration of the request described in this form.

The approval actions that were taken at the college level were (check all that apply) :

_____college faculty vote; __✓_____college curriculum approval _____college senate approval

Chairperson, College Curriculum Committee_____ Date 2/15/2017

Chairperson, Senate Com. on UG or GR Studies_____Date_____

Chairperson, Senate Coordinating Com._____Date_____

Secretary, Faculty Senate_____Date_____

Date of Senate Resolution_____Date to be Effective_____

Registrar _____Program Code_____Date_____

Vice Provost for Academic Affairs & International Programs_____Date_____

Board of Trustee Notification _____Date_____

Revised 9/22/2015/khs

PROGRAM POLICY STATEMENT

I. PROGRAM HISTORY

A. RATIONALE

The completion of the human genome sequence marked the beginning of a new era of biological research. Scientists have begun to systematically tackle gene functions and other complex regulatory processes by studying organisms at the global scales. Advances in high-throughput biotechnologies and large-scale bioscience have further enabled modeling and simulation over a multitude of length, time and biological scales from biomolecules, cells, tissues and organs to organisms and population. With the enormous volume of data being produced, biology has become a quantitative science. Computational approaches, in combination with experimental methods, have become essential for generating novel hypotheses, deriving new scientific knowledge, and driving discovery and innovation.

Fundamental to the modern day biological studies and key to the basic understanding of complex biological systems, Bioinformatics is impacting the science and technology of fields ranging from agricultural and environmental sciences to pharmaceutical and medical sciences. The research requires close collaboration among multi-disciplinary teams of researchers in quantitative sciences, life sciences, and their interfaces.

According to many accredited scientific and industry reviews, bioinformatics may well be the single fastest-growing specialty in the life sciences. The bioinformatics market is expected to grow to $12.86 billion by 2020. Indeed, there has been an explosion of bioinformatics careers (*Science Careers*, June 2014). As Big Data is pouring out of life sciences research, it is creating ample opportunities for scientists with expertise in bioinformatics, computer science, and related skill sets. Big pharma, biotech, and software companies are clamoring to hire professionals with experience in bioinformatics and the management, analysis, and visualization of huge amounts of biological and health care information.

The University of Delaware currently does not offer an online Graduate Certificate in bioinformatics. The proposed Online ABNF-CERT in the bioinformatics discipline is essential for UD to meet industry's demand for professionals who have the ability to interpret complex biological data through their knowledge of bioinformatics methods, tools and/or databases. The primary target audience for this new program is regional, national and international professionals working in fields such as molecular and cellular biology, genetics and genomics, biomedical engineering, medical sciences, animal or plant sciences, or scientific programming. A fully online Graduate Certificate program will allow us to better serve the needs of working professionals who often cite their inability to attend classes during normal working hours as the main barrier to graduate school enrollment. As such, we receive frequent inquiries for distance learning options from prospective students.

The Online Graduate Certificate program in Applied Bioinformatics (ABNF-CERT) is administered through its academic home, the Department of Computer & Information Sciences, and is coordinated by the Center for Bioinformatics & Computational Biology. The team of course instructors are well recognized researchers and practitioners in the fields of bioinformatics, computational biology, systems biology, genomics, translational bioinformatics, and big data. The active participation of the instructional team in national and international initiatives and their

direct involvement in the development of major bioinformatics tools and resources ensures that the team's knowledge and experience at the forefront of technological advances will translate to a rigorous course curriculum to maximize the academic and career opportunities for students.

The proposed Online ABNF-CERT thus offers several benefits to students:
- Earn credential from a highly reputable bioinformatics graduate program to advance career
- Earn graduate level college credits that can be applied towards a Master's or PhD degree program
- Gain core competency for rapidly growing bioinformatics job opportunities in fields from genomics, pharmaceuticals and health care to big data analytics
- Gain knowledge and experience in bioinformatics and systems biology methods and tools and practical programming and database skills for real-world applications
- Learn cutting-edge state-of-the-art course contents from nationally and internationally recognized researchers and practitioners in the field
- Learn in an interactive, experiential and multidisciplinary team environment that couples lecture-based instructions with hands-on exercises and term projects

B. DEGREE OFFERED

The program will offer the *Online Graduate Certificate in Applied Bioinformatics (ABNF-CERT)*.

II. ADMISSION

A. ADMISSION REQUIREMENTS

Admission to the graduate certificate program is competitive. Those who meet stated requirements are not guaranteed admission, nor are those who fail to meet all of those requirements necessarily precluded from admission if they offer other appropriate strengths.

The following are the admission requirements to the Online Graduate Certificate program in Applied Bioinformatics:
- A bachelor's degree at an accredited four-year college or university with a minimum grade average of 3.0 on a 4.0 system;
- Applicants must be in the last semester of undergraduate study or hold an undergraduate degree in biological, computational, or other disciplines. However, applicants are expected to have scholarly competence in mathematics, computer science and/or biology;
- GRE scores are recommended but may be waived upon application review;
- International student applicants must demonstrate a satisfactory level of proficiency in the English language if English is not the first language. The University requires an official paper-based TOEFL score of at least 550, or at least 79 on the Internet-based TOEFL. TOEFL scores more than two years old cannot be considered official;
- Two letters of recommendation are required. Ideally at least one letter is from professors, the other letter can be from employers or others who have had a supervisory relationship with the applicant and are able to assess the applicant's potential for success in graduate studies;

- Applications must also include a resume outlining work and academic experience, as well as an application essay consisting of the answers to the following questions:
  1. What educational background and scientific research or employment experience prepare you for this bioinformatics graduate certificate program?
  2. What are your long-term professional objectives?
  3. What specific attributes of the program make you feel that this certificate is appropriate to help you achieve your professional objectives?

B. APPLICATION

Application to the Online Graduate Certificate program in Applied Bioinformatics (ABNF-CERT) will be submitted using the on-line graduate admission application that includes transcripts from all previous college or university study, letters of recommendation, resume, application essay, and official GRE scores and TOEFL scores (if applicable). If any part of an application is missing, evaluation of the application cannot begin. The applicant will apply to the Center for Bioinformatics and Computational Biology.

B.1. APPLICATION DEADLINES

Admission decisions are made on a rolling basis as and when applications are complete. The central graduate admissions office continues to process applications and transcripts throughout the year and follows the stated two (2) week processing timeline for all materials received in the office.

The application deadlines are:
- Fall Semester: July 1st
- Spring Semester: December 1st

B.2. CHANGE OF CLASSIFICATION

Students currently matriculated in other graduate degree programs on campus at University of Delaware who are interested in a bioinformatics graduate certificate program will be encouraged to consider the existing on-campus Graduate Certificate in Bioinformatics (BINF-CERT). They will be permitted to seek approval to enter the Online Graduate Certificate program in Applied Bioinformatics (ABNF-CERT) only in exceptional cases and will require a case-by-case review. Students matriculated in other online graduate degree programs at University of Delaware may apply to the online ABNF-CERT program.

C. ADMISSION STATUS

Students may be admitted into the Online Graduate Certificate program in Applied Bioinformatics (ABNF-CERT) with regular status or provisional status.

Regular. Regular status is offered to students who meet all of the established entrance requirements, who have a record of high scholarship in their fields of specialization, and who have the ability, interest, and maturity necessary for successful study at this graduate level program.

Provisional. Provisional status is offered to students who are seeking admission to the program but lack one or more of the specified prerequisites. All provisional requirements must be met within the deadline given before regular status can be granted. Students who file an application during the final year of undergraduate work and are unable to supply complete official transcripts showing the conferral of the degree will be admitted pending conferral of the degree if their records are otherwise satisfactory and complete.

III. ACADEMIC

A. DEGREE REQUIREMENTS

Online ABNF-CERT: Degree Requirement	
12 Credit Hours Total	
Bioinformatics Core	12 Credits

B. COURSE CURRICULUM

The tables below list the course curriculum of the Online Graduate Certificate program in Applied Bioinformatics.

Online ABNF-CERT: Course Curriculum	
Bioinformatics (3)	BINF644: Bioinformatics (3)
Systems Biology (3)	BINF694: Systems Biology I (3)
Database (3)	BINF640: Databases for Bioinformatics (3)
Programming (3)	BINF690: Programming for Bioinformatics (3)

C. COMMITTEE AND DIRECTOR

The development, administration and progress assessment of the Online Graduate Certificate program in Applied Bioinformatics will be guided by the Bioinformatics Graduate Committee and the Director of the Online Graduate Certificate program in Applied Bioinformatics.

The Graduate Committee will be responsible for admission, advising, and progress assessment of the students in the Online Graduate Certificate program. The Director will be responsible for the overall implementation, quality and progress of the degree program. The Assistant Director of the Graduate Education and Outreach at the Center for Bioinformatics and Computational Biology will provide day-to-day program management and assist with student recruitment, admission, advising, progress assessment, and career planning.

D. SATISFACTORY PROGRESS

D.1. ACADEMIC LOAD

The course curriculum of the Online Graduate Certificate in Applied Bioinformatics consists of four graduate level courses that can be taken in any order. Each course will be offered annually during either Fall or Spring semester. Two courses will be offered each semester so that the Certificate program can be completed in as little as one year.

D.2. TRANSFERABILITY

Prior to admission to the Online Graduate Certificate program in Applied Bioinformatics, a prospective student from another institution can be approved by the Bioinformatics Graduate Committee to take up to 6 graduate credits that, if/when admitted to the program, would be applied to the Graduate Certificate. Students who complete graduate credits with the classification of CEND (Continuing Education Non-degree) at the University of Delaware may use a maximum of 6 graduate credits earned with this classification toward their Graduate Certificate.

All requests for transfer credit should be directed to the academic program, Center for Bioinformatics and Computational Biology, using a "Request for Transfer of Graduate Credit" Form. Transfer credits will be accepted provided that such credits: (i) were earned with a grade of no less than B, (ii) are approved by the Bioinformatics Graduate Committee, (iii) are in accord with the Program Policy Statement of the Online Graduate Certificate program in Applied Bioinformatics, (iv) are not older than five years, (v) are graduate level courses, and (vi) were completed at an accredited college or university. Graduate courses counted toward a degree received elsewhere may not be transferred into a degree at UD. Credits from institutions outside of the United States are generally not transferable to UD.

D.3. GRADE REQUIREMENTS

Only graduate courses completed with a grade of B or higher count towards the requirements of Online Graduate Certificate program in Applied Bioinformatics. Students receiving a B- or lower in a required core course are subject to dismissal from the program. However, they may file an appeal to the Bioinformatics Graduate Committee for approval to retake the course and remain in the program if the appeal is approved. Students must obtain at least a 3.0 cumulative grade point average in the courses in the curriculum to receive the Graduate Certificate.

APPENDIX

LETTER OF APPROVAL FROM CONTRIBUTING DEPARTMENT

Department of Computer & Information Sciences

1. Dr. Kathleen McCoy, Professor and Chair, Department of Computer & Information Sciences

UNIVERSITY OF DELAWARE | College of Engineering

DEPARTMENT OF COMPUTER & INFORMATION SCIENCES

101 Smith Hall
Newark, DE 19716
Phone: 302.831.2712
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Email: cis-webmaster@cis.udel.edu

Cathy H. Wu, Ph.D.
Edward G. Jefferson Chair of Bioinformatics & Computational Biology
Director, Center for Bioinformatics & Computational Biology
Director, Master's Programs in Bioinformatics & Computational Biology
Director, PhD Program in Bioinformatics & Systems Biology
Director, Online Graduate Certificate in Applied Bioinformatics
University of Delaware
Newark, DE 19711-5449

Dear Dr. Wu,

The Department of Computer & Information Sciences in the College of Engineering fully supports your efforts to seek academic approval of the following programs:

- Online Graduate Certificate in Applied Bioinformatics

The program leverages the research strength, education resources and bioinformatics infrastructure from participating Departments across the Colleges.

Graduates of the program will gain basic bioinformatics core competencies in the computational techniques to manage data, develop software, and solve problems using database systems and bioinformatics and systems biology approaches. Your Online Graduate Certificate in Applied Bioinformatics will expose students to realistic challenges in analyzing data which will produce students with a competitive advantage.

I look forward to the certificate as an additional tool that will provide the Bioinformatics Graduate Program continued success.

Sincerely,

Kathleen F. McCoy
Professor and Chair
Computer and Information Sciences