Audrey Van Nuland has submitted a request for a major curricular change. His/her email address is: aud.vannuland@wsu.edu.

Requested change: Revise or Drop Graduate Certificate

Title: Graduate Certificate in Bioinformatics

Requested Effective Date: Fall 2020

Revise certificate requirement: Yes

Dean: Gloss, Lisa - Dean - Graduate School - MSE Graduate, Swindell, Samantha - CAS

Chair: Carter, Pat,

Catalog Subcommittee
Approval Date

AAC, PHSC, or GSC
Approval Date

Faculty Senate
Approval Date

1. I approve this proposal in its current form.

Sincerely,

Lisa Gloss

Dr. Lisa M. Gloss
Dean, Graduate School
Associate professor, School of Molecular Biosciences
Washington State University
Pullman, WA   99164-1030
TEL (509) 335-5859

From: "curriculum.submit@wsu.edu" <curriculum.submit@wsu.edu>
Date: Friday, September 27, 2019 at 10:40 AM
To: "Carter, Patrick Andrew" <pacarter@wsu.edu>, Lisa Gloss <lmgloss@wsu.edu>
Subject: 528867 Biological Sciences Requirements Revise - Revise or Drop Graduate Certificate

Carter, Pat,

Gloss, Lisa - Dean - Graduate School - MSE Graduate,

Audrey Van Nuland has submitted a request for a major curricular change.

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Both Chair and Dean approval is required to complete the submission process. Please indicate that you have reviewed the proposal by highlighting one of the statements below and **reply all** to this email. (curriculum.submit@wsu.edu.) [Details of major change requested can be found in the attached supplemental documentation]

1. I approve this proposal in its current form.

2. I approve this proposal with revisions. Revisions are attached.

3. I do not approve this proposal. Please return to submitter.

If you do not respond within one week, you will be sent a reminder email. If no response is received within three weeks of the submission date, the proposal will be returned to the submitter.

Thank you for your assistance as we embark on this new process. If you have any questions or concerns, please let us know wsu.curriculum@wsu.edu.

Blaine Golden, Assistant Registrar

Graduations, Curriculum, and Athletic Compliance

Washington State University

Registrar's Office

PO Box 641035

Pullman WA 99164-1035

509-335-7905

bgolden@wsu.edu

Note: Please use the attachments to this email rather than the link below to view the supporting documentation.

1. I approve this proposal in its current form.

Pat Carter

From: curriculum.submit@wsu.edu <curriculum.submit@wsu.edu>
Sent: Friday, September 27, 2019 10:40 AM
To: Carter, Patrick Andrew <pacarter@wsu.edu>; Gloss, Lisa M <lmgloss@wsu.edu>
Subject: 528867 Biological Sciences Requirements Revise - Revise or Drop Graduate Certificate

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Gloss, Lisa - Dean - Graduate School - MSE Graduate,

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==**1. I approve this proposal in its current form.**==

From: curriculum.submit@wsu.edu [mailto:curriculum.submit@wsu.edu]
Sent: Friday, September 27, 2019 10:40 AM
To: Swindell, Samantha <sswindell@wsu.edu>
Subject: 528867 Biological Sciences Requirements Revise - Revise or Drop Graduate Certificate

,

Swindell, Samantha - CAS,

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Blaine Golden, Assistant Registrar

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Rationale Statement

The rationale for adding additional courses as electives to the Graduate Certificate in Bioinformatics is that new classes have been approved on campus that are appropriately suited to fulfill the Bioinformatics electives. Below is a more detailed description of the courses which justify why they are an appropriate fit for the certificate.

AFS 505: Topics in Computational and Analytical Methods for Scientists
Applied computational methods for researchers processing, managing, and analyzing data in scientific and engineering fields. Variable-credit (1-6) course with 5-weeks per module and 1 credit per module.
Modules offered: Data Structures in R, Data Visualization in R, Data Wrangling in R, Programming in Python, Data Analysis with Python, Computing for Big Data.

HORT550: Bioinformatics for Research Class
The goal of the class is to provide students with foundational knowledge about advanced bioinformatics analyses of next-generation sequencing data. Not only will students learn how to conduct the analyses, and the principles behind the analyses, but also learn how to critically examine the data produced by the analyses and the implications to the greater study of biological questions.

Graduate Certificate in Bioinformatics

1. *Credit Hours: 12 credit hours total*
   NOTE: Candidates for the certificate must receive a grade of B or higher in each course. Additionally, a candidate must take at least two courses for the certificate outside of their home department.
2. *Required Course*
   - MBIOS 578
3. *Electives: 9 credits minimum*
   - AFS 505/HORT505
   - CPT S 570
   - CPT S 571
   - CPT S 572
   - CROP SCI 545
   - CROP SCI 555
   - BIOLOGY 519
   - BIOLOGY 521
   - BIOLOGY 534
   - BIOLOGY 566 (or MATH 563)
   - BIOLOGY 576
   - HORT 503
   - HORT550
   - MBIOS 503
   - STAT 523
   - STAT 530
   - STAT 536 (or MATH 536)
   - STAT 565
4. *GPA requirement: Cumulative GPA may not fall below a 3.0*

WASHINGTON STATE UNIVERSITY

Office of the
Registrar

MEMORANDUM

TO: Faculty Senate

FROM: Blaine Golden, Assistant Registrar

DATE: November 12th, 2019

SUBJECT: Graduate Certificate in Bioinformatics

This is to clarify the status of the attached Graduate Certificate in Bioinformatics. A revision was originally submitted by the department in 2018, but held over for final Senate vote on 10.3.2019. In the meantime, the department submitted another revision with a Fall 2020 effective date. This second revision is attached for your consideration.

Graduate Certificate in Bioinformatics

Course Requirements

Students must be simultaneously enrolled in a graduate-degree granting program at Washington State University as either full-time or part-time students, or in the case of post-graduate professional, receive permission from the certificate administrators.

- A total of twelve credits are required for the graduate certificate.
- Three credits are mandatory and the final nine credits will be chosen from a list of electives depending on the background of the student and the cohesion with the research program.
- All courses must be approved by the Bioinformatics Certificate committee, prior to acceptance in the certificate program, and will also need the approval from the students' Masters or PhD committee (on the plan of study).
- Students must achieve a GPA of 3.0 (B) or better in each certificate course. Note, some courses require permission of the instructor and prerequisites; it is the responsibility of each student to meet the specific requirements for each course.
- Students must take 2 courses outside of their home department (cross-listed courses fulfill this requirement).

Courses

Mandatory Course (3 credits):

- MBIOS 578 *Bioinformatics* Computer analysis of protein and nucleic acid sequences, functional genomics and proteomics data; modeling biological networks and pathways. Recommended preparation: Introductory genetics or biochemistry coursework

Elective Courses (9 credits):

Agriculture and Food Systems:

- <u>AFS 505 *Topics in Computational and Analytical Methods for Scientists* Applied computational methods for researchers processing, managing, and analyzing data in scientific and engineering fields</u>

Biology:

- BIOLOGY 519 *Introduction to Population Genetics* Survey of basic population and quantitative genetics

- BIOLOGY 521 *Quantitative Genetics* Fundamentals of quantitative genetics; evolutionary quantitative genetics

- BIOLOGY 534 *Modern Methods in Population Genomics* Problems and prospects of designing a study with genomic data: from raw data to demography and selection inferences.

- BIOLOGY 545 *Statistical Genomics* See CROP SCI 545.

- BIOLOGY 576 *Epigenetics and Systems Biology*. Current literature based course on epigenetics and systems biology with topics in environmental epigenetics, disease etiology, and role epigenetics in evolutionary biology.

- BIOLOGY 566 *Mathematical Genetics* See MATH 563.

Computer science:

- CPT S 570 *Machine Learning* Introduction to building computer systems that learn from their experience; classification and regression problems; unsupervised and reinforcement learning.

- CPT S 571 *Computational Genomics* Fundamental algorithms, techniques and applications.

- CPT S 572 *Numerical Methods in Computational Biology* Prereq cell biology, probability and statistics, graduate standing in computer science, or permission of the instructor. Computational methods for solving scientific problems related to information processing in biological systems at the molecular and cellular levels.

Crop and Soil Sciences:

- CROP SCI 545 *Statistical Genomics* Concepts and applications in modern breeding programs. (Crosslisted course offered as CROP SCI 545, ANIM SCI 545, BIOLOGY 545, HORT 545, PLP 545)

- CROP SCI 555 *Epigenetics in Plants* Understanding principles of epigenetics in plants with a focus on its role in understanding and improving plant genomes and their adaptation to the changing environment. Recommended preparation: General genetics.

Horticulture:

- HORT 503 *Advanced Topics in Horticulture* Current topics and research techniques in horticulture

- HORT 550 *Bioinformatics for Research* Foundational knowledge about advanced bioinformatics analyses of next-generation sequencing data. Recommended preparation: Molecular Biology and/or Genetics.

- HORT 545 *Statistical Genomics* see CROP SCI 545

Mathematics:

- MATH 563 *Mathematical Genetics* Mathematical approaches to population genetics and genome analysis; theories and statistical analyses of genetic parameters. (Crosslisted course offered as MATH 563, BIOLOGY 566).

Molecular Biosciences:

- MBIOS 503 *Advanced Molecular Biology I* DNA replication and recombination in prokaryotes and eukaryotes; recombinant DNA methods and host/vector systems; genome analysis; transgenic organisms. Recommended preparation: Introductory genetics and biochemistry coursework.

Statistics:

- STAT 523 *Statistical Methods for Engineers and Scientists* Hypothesis testing; linear, multilinear, and nonlinear regression; analysis of variance for designed experiments; quality control; statistical computing.

- STAT 530 *Applied Linear Models* The design and analysis of experiments by linear models.

- MATH/STAT 536 *Statistical Computing* Generation of random variables, Monte Carlo simulation, bootstrap and jackknife methods, EM algorithm, Markov chain Monte Carlo methods.

- STAT 565 *Analyzing Microarray and Other Genomic Data* Statistical issues from pre-processing (transforming, normalizing) and analyzing genomic data (differential expression, pattern discovery and predictions).