FAIRMONT STATE UNIVERSITY

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Approved by the Curriculum Committee on January 21, 2020

MEMORANDUM

TO: Faculty Senate

FROM: Susan Ross

DATE: February 4, 2020

SUBJECT: Curriculum Proposal #19-20-06 Physics Aviation

The Physics Program proposes to add a new elective course to the course catalog that has previously been offered and taught as Special Topics courses numbered 1099-002, Introduction to Physics for Aviation. This new course meets the requirements of the FAA's Advisory Circular AC 61-139, Section 9. Academic Areas, part (2) Aerodynamics and Aircraft Performance, whereas PHYS 1101 and 1105 do not. Laboratory experiments, homework problems and lectures apply the concepts and quantitative principles of kinematics and dynamics to aerodynamic flight (including rotary flight), rocket propulsion and buoyant (lighter-than-air) flight.

cc: Richard Harvey
Cheri Gonzalez
Laura Ransom
Lori Schoonmaker
Siegfried Bleher

CURRICULUM PROPOSAL (Submit one hard copy and an electronic copy to the Associate Provost by the second Tuesday of the month.)

Proposal Number:	#19-20-06
School/Department/Program:	College of Science and Technology/Natural Sciences Department/Physics Program
Preparer/Contact Person:	Siegfried Bleher
Telephone Extension:	X4582
Date Originally Submitted:	October 4, 2019
Revision (Indicate date and label it Revision #1, #2, etc.):	Revision #1 January 13, 2020
Implementation Date Requested:	Fall 2020

I. **PROPOSAL.** Write a brief abstract, not exceeding 100 words, which describes the overall content of the proposal.

The Physics Program proposes to add a new elective course to the course catalog that has previously been offered and taught as Special Topics courses numbered 1099-002, Introduction to Physics for Aviation. This new course meets the requirements of the FAA's Advisory Circular AC 61-139, Section 9. Academic Areas, part (2) Aerodynamics and Aircraft Performance, whereas PHYS 1101 and 1105 do not. Laboratory experiments, homework problems and lectures apply the concepts and quantitative principles of kinematics and dynamics to aerodynamic flight (including rotary flight), rocket propulsion and buoyant (lighter-than-air) flight.

II. **DESCRIPTION OF THE PROPOSAL.** Provide a response for each letter, A-H, and for each Roman Numeral II–V. If any section does not apply to your proposal, reply N/A.

A. Deletion of course(s) or credit(s) from program(s)

N/A

Total hours deleted. _____

B. Addition of course(s) or credit(s) from program(s)

N/A

Total hours added. _____

C. Provision for interchangeable use of course(s) with program(s)

N/A

D. Revision of course content. Include, as an appendix, a revised course description, written in complete sentences, suitable for use in the university catalog.

N/A

E. Other changes to existing courses such as changes to title, course number, and elective or required status.

N/A

F. Creation of new course(s). For each new course

1. Designate the course number, title, units of credit, prerequisites (if any), ownership (FSU or shared) and specify its status as an elective or required course. If you are creating a shared course, attach a memo from the Deans of the affected Schools explaining the rationale for the course being shared.

Course Number	Title	Credit	Prerequisites	Ownership	Status
PHYS 1104	Introduction to Physics for Aviation	4	MATH 1540 or MATH 1585 or MATH 2501 or MATH ACT 24 or old MATH SAT 560 or new MATH SAT 580 or College Level Math of ACCUPLACER 65	FSU	Elective

2. Include, as an appendix, a course description, written in complete sentences, suitable for use in the college catalog.

Please see Appendix A

3. Include, as an appendix, a detailed course outline consisting of at least two levels.

Please see Appendix A

4. In order to meet the requirements as outlined in Goal One of the Strategic Plan, please include Outcome Competencies and Methods of Assessment as an appendix. Examples are available upon request from the Chair of the Curriculum Committee.

Please see Appendix A

G. Attach an itemized summary of the present program(s) affected, if any, and of the proposed change(s).

Describe how this proposal affects the hours needed to complete this program. Specifically, what is the net gain or loss in hours? Use the format for Current and Proposed Programs in Appendix A.

III. **RATIONALE FOR THE PROPOSAL**.

A. **Quantitative Assessment**: This course has been taught three times at FSU from 2017 – 2019, with number of registered students 13, 10, 17, respectively.

B. **Qualitative Assessment**: Student learning outcomes for PHYS 1104 are aligned with the requirements for academic courses described in the FAA's Advisory Circular AC 61-139 as follows:

(a) Courses listed within this academic area should be designed for a pilot to understand the principles of airplane aerodynamics and aircraft performance.
(b) *General courses such as physics may satisfy this academic area requirement provided the course description clearly indicates that aerodynamics and/or aircraft performance are the primary focus of the course*.
(c) General areas that should be discussed for aerodynamics and aircraft performance include but are not limited to the following:
• Aerodynamics and terminology with emphasis on lift, weight, thrust, and drag forces acting upon an airplane in flight; calculation of stall speed; W&B; stability and control; operating data; low speed aerodynamics, fundamentals associated with transonic and supersonic flight.
• Aircraft performance requirements; performance of aircraft powered by reciprocating, turboprop, or jet turbine engines; special flight conditions often experienced by commercial pilots of fixed-wing aircraft; configuration changes.

PHYS 1104 (Introduction to Physics for Aviation) teaches students the principles of kinematics and dynamics that underlie flight and aerodynamics. Homework, demonstrations and many of the labs are specific to aviation. Please see Appendix B for a detailed course description.

IV. Should this proposal affect any course or program in another school, a memo must be sent to the Dean of each school impacted and a copy of the memo(s) must be included with this proposal. In addition, the Deans of the affected schools must sign below to indicate their notification of this proposal.

By signing here, you are indicating your college's/school's notification of this proposal.

College/School	Dean	Signature
School of Business & Aviation	Timothy R. Dixley	
College of Science	Steven Root	

V. Should this proposal affect any course to be added or deleted from the general studies requirements, a memo from the chair of the General Studies Committee indicating approval of the change must be included with this proposal.

VI. ADDITIONAL COMMENTS.

General education approval is being submitted by the Aviation program (that is, the new Application for Course Acceptance as a Core Curriculum Course under Category 8 Natural Science with Critical Thinking).

APPENDIX A – PHYS 1104

Course Description

This course introduces students to principles of mechanics and fluid mechanics (linear and rotational motion, force and torque, work and energy, buoyancy) and their application to flight (including fixed-wing aircraft, rotary-wing aircraft and lighter-than-air flight). The prerequisites are MATH 1540 or MATH 1585 or MATH 2501 or MATH ACT 24 or old MATH SAT 560 or new MATH SAT 580 or College Level Math of ACCUPLACER 65. This course is offered in the spring semester only.

Course Outline

This algebra-based course covers the following topics:

- **Mechanics**:
  - kinematics in 1D
  - kinematics in 2D
  - relative velocity
  - Newton's 3 laws
  - work-energy theorem
  - rotational kinematics and dynamics
  - impulse and momentum
- **Fluid Dynamics**: pressure
  - Pascal's principle
  - Archimedes' principle
  - Bernoulli's equation
  - Reynolds number
- **Flight Kinematics**
  - Navigation in 3D: Euler angles, Aircraft Body frame, North-East-Down frame
  - pitch, yaw, roll
  - aircraft control surfaces
- **Flight Dynamics**
  - Forces involved in flight (thrust, lift, drag, weight)
  - Planes, helicopters and drones, balloons, spaceflight.
- **Thermodynamics**
  - Temperature, pressure, volume, equation of state
  - 3 laws of thermodynamics,
  - gas laws (Boyle's law, Charles' law, Gay-Lussac's law, General Gas Law – equation of state, Avogadro's law, humidity, partial pressure)

Outcome Competencies

1. Students will be able to apply the following mathematical methods to solve problems of motion (linear and rotational) that arise in aviation (aerodynamic flight and lighter-than-air flight) through:
   a. converting word problem statements to appropriate representations including pictures/graphs and the appropriate mathematical variables and relationships,
   b. graphical and algebraic methods of adding vectors,
   c. right triangle trigonometry,
   d. algebraic manipulations to solve one degree of freedom equations,
   e. algebraic manipulations (substitution, elimination) to solve two degree of freedom equations.

   Assessment: Word Problem Homework, Word Problem Exam Questions

2. Students will be able to apply the correct principles and equations of motion to problems of motion that arise in aviation. (This is assessed via conceptual questions.) Students will be able to correctly identify the following principles of motion:
    a. principles of linear kinematics (i.e. relationships between displacement, velocity and acceleration)
    b. Newton's laws of motion applied to linear dynamics,
    c. kinetic energy,
    d. potential energy,
    e. linear momentum,
    f. rotational kinematics (i.e. angular displacement, angular velocity and angular acceleration),
    g. Newton's laws of motion applied to rotational dynamics.

    Assessment: conceptual Questions Homework, Conceptual Exam Questions, Daily use of personal response devices

3. Students will be able to solve problems of motion that arise in aviation. (This is assessed via word problems.) Principles of motion included in the problems of motion students will be able to solve:
    a. principles of linear kinematics (i.e. relationships between displacement, velocity and acceleration)
    b. Newton's laws of motion applied to linear dynamics,
    c. kinetic energy,
    d. potential energy,
    e. linear momentum,
    f. rotational kinematics (i.e. angular displacement, angular velocity and angular acceleration),
    g. Newton's laws of motion applied to rotational dynamics.

    Assessment: Word Problem Homework, Word Problem Exam Questions

4. Students will be able to use laboratory equipment to explore the behavior of physical systems. Specifically, students will be able to
    a. Perform experiments that investigate the qualitative behavior of systems and experiments that collect numerical data.
    b. Quantitatively analyze the data to demonstrate physical principles, extract physical parameters, test models, and refine models.
    c. Assess and measure the role of experimental error.
    d. Demonstrate and discuss the links between physical principles and empirical data in the form of laboratory reports.

    Assessment: Preparation and submission of lab reports

Methods of Assessment

1. Daily homework that develop quantitative skills and conceptual understanding of material presented in lectures.
2. 3 – 4 tests during semester, plus comprehensive final test.
3. Daily use of personal response devices ("clickers").
4. Preparation and submission of lab reports.