Item #CA-4
February 3, 2004

THE ILLINOIS ARTICULATION INITIATIVE: ENDORSEMENT OF PHYSICS ARTICULATION

Submitted for: Action.

Summary: The Illinois Articulation Initiative (IAI) was launched in January 1993 to ease the transfer of students among Illinois public and independent, associate and baccalaureate degree-granting institutions with the objective of increasing baccalaureate degree completion. To date, five general education panels and 28 major panels have developed and implemented statewide recommendations of courses that will be accepted in transfer at participating institutions. The most recent panel to complete its recommendation is physics. The IAI Steering Panel endorsed the recommendation at its November 7, 2003 meeting.

Action Requested: That the Board of Higher Education endorse the recommendations of the physics major panel.

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STATE OF ILLINOIS
BOARD OF HIGHER EDUCATION

THE ILLINOIS ARTICULATION INITIATIVE: ENDORSEMENT OF PHYSICS ARTICULATION

The Illinois Articulation Initiative (IAI) was launched in January 1993 to ease the transfer of students among Illinois public and independent, associate and baccalaureate degree-granting institutions with the objective of increasing baccalaureate degree completion. Two key concepts provided the basic foundation of IAI policy: that "associate and baccalaureate degree-granting institutions are equal partners" in educating freshman and sophomore students, and that "faculties should take primary responsibility for developing and maintaining program and course articulation." To date, five general education panels and 28 major panels have developed and implemented recommendations of courses that will be accepted in transfer statewide at participating institutions.

Major panel recommendations were designed to help students complete appropriate prerequisites, support courses in other disciplines, and other lower division coursework to prepare them for advanced work in the major discipline. The most recent panel to complete its recommendation is physics. The IAI Steering Panel endorsed the recommendation at its November 7, 2003 meeting. The Steering Panel requests that the Board of Higher Education endorse the work of the physics major panel.

Resolution

The staff recommends adoption of the following resolution:

The Board of Higher Education hereby endorses the recommendation of the physics panel and requests staff and institutions begin the steps necessary to implement the articulation plan.

PHYSICS

Bachelor's programs in physics are based on an in-depth foundation of sequential coursework in science and math, while upper-division coursework provides the preparation necessary for graduate studies and/or work in industry. Multiple tracks are often available. For example, some institutions offer a specialty in applied physics or certification for high school teaching. To transfer as a junior into a bachelor's physics program students must complete a minimum of 60 semester credits. Students should be aware that because of differences among schools in the number of credits for which various courses are offered and the possible need for prerequisite courses, it may be difficult to complete an Associate in Science degree without taking more credits than will be accepted in a transfer. Students planning on a physics major should select courses in consultation with an advisor.

	Associate in Science
General Education Core Courses[1]	**38-41 semester credits**
Communication	9 semester credits
Mathematics	
(select Calculus I: M1 900)	4-5 semester credits
Physical Science	
(select General Chemistry I with lab: CHM 911)	4-5 semester credits
Life Sciences	3-4 semester credits
Humanities and Fine Arts	9 semester credits
Social and Behavioral Science	9 semester credits

[1] General education courses are described in the Illinois General Education Core Curriculum.

Required Courses

Supporting Courses	**10-15 semester credits**
Calculus II	3-5 semester credits
Calculus III	3-5 semester credits
General Chemistry II (with lab)	4-5 semester credits
Physics Core Courses[2]	**12-18 semester credits**
Calculus-based Physics I - Mechanics (with lab)	4-5 semester credits
Calculus-based Physics II - Electricity and Magnetism (with lab)	4-5 semester credits
either Introductory Quantum Physics and Other Topics	2-4 semester credits
and Introductory Thermal Physics and Other Topics	2-4 semester credits
or Calculus-based Physics III - Thermal and Quantum Physics (with lab)	4-5 semester credits

[2] Some schools will accept General Physics I and II instead of Calculus-based Physics I and II, but require the student to take a special course to bridge the gap in material that would be covered in Calculus-based Physics I and II. Students should consult the requirements for the specific school and an academic advisor.

Other Prerequisite Courses[3]

Differential Equations	3-4 semester credits
Introduction to Linear Algebra	3-4 semester credits
Computer Programming for Science and Engineering	3-4 semester credits

[3] Some schools require completion of one or more of these courses before students may begin junior-year required courses. Students entering college with Advanced Placement (AP) or proficiency credit are advised to consider taking these courses as electives. Students entering without advanced credit who know they will transfer to a school that requires any of these courses before beginning junior-year courses may consider taking these courses and not completing all of the General Education Core Curriculum (and the Associate in Science degree). This decision should be made in close consultation with an academic advisor to understand the implications it has on the transfer of coursework.

Supporting Course Descriptions

MTH 901, 902, 903 Calculus I, II, III (10-15 semester credits): Topics include (but are not limited to) the following: limits and continuity; definition of derivative: rate of change, slope; derivatives of polynomial and rational functions; the chain rule; implicit differentials; approximation by differentials; higher order derivatives; Rolle's theorem: mean value theorem; applications of the derivative; anti-derivative; the definite integral; the fundamental theorem of calculus; area, volume, other applications of the integral; the calculus of the trigometric functions; logarithmic and exponential functions; techniques of integration, including numerical methods; indeterminate forms: L'Hopital's rule; improper integrals; sequences and series, convergence tests, Taylor series; functions of more than one variable, partial derivatives; the differential, directional derivatives, gradients; double and triple integrals: evaluation and applications. Prerequisite for Calculus I: College Algebra and Trigonometry with a grade of C or better.

MTH 911 Introduction to Linear Algebra (3-4 semester credits): A first course in vectors, matrices, vector spaces, and linear transfromations. The ideas in this course serve not only as an introduction to more abstract mathematics courses at the junior-senior level, but also have many useful applications outside mathematics. The course is not intended to replace a more complete linear algebra course at the junior-senior level. The course should be taken concurrently with, but not replace, the last course in the calculus sequence. It should cover the following topics: vectors, operations on matrices; matrices; inverse of a matrix; solution of systems of linear equations; rank of a matrix; vector spaces and subspaces; linear dependence and independence; basis and dimension; linear transformations; sums, composites, inverses of linear transformations; range and kernel of a linear transformation. Further topics could include: determinants; eigenvalues and eigenvectors; orthogonality and inner product spaces; and quadratic forms. Prerequisite: MTH 902, Calculus II.

MTH 912 Differential Equations (3-4 semester credits): The course must cover linear equations of the first order; linear equations with constant coefficients; the general linear equation; variation of parameters; undetermined coeficients; linear independence; the Wronskian; exact equations; separation of variables; and applications. In addition, the course must cover at least two or three of the following topics: systems of linear differential equations; boundary value equations; numerical methods; and stability of solutions. Prerequisite: MTH 902 Calculus II.

MTH 922 Computer Programming for Science and Engineering (3-4 semester credits): A computer programming course (in a structured higher-level language) with a Calculus I prerequisite. The course should emphasize the use of programming in problem analysis and problem solving and will include applications in mathematics. The course should include topics identified in the Illinois Mathematics and Computer Science Articulation Guide prepared by IMACC-ISMAA Joint Task Force, as follows: syntax of language; control structures; numerical methods (Newton root finder, average slope, arc length, Riemann, trapezoidal, Simpson sums); use of arrays (single dimensional as linear regression; two dimensional as matrix sum, product or inverse); subroutines and functions; simulation; curve fit (least squares criteria and estimation of models); and data types (complex, double precision, logical). Prerequisite: MTH 901, Calculus I.

CHM 911, 912 General Chemistry I and II (8-10 semester credits): Topics include the periodic table of the elements, atomic structure, basic concepts of quantum theory, bonding, stochiometry of compounds and reactions, thermochemistry, the gaseous state, basic concepts of the liquid and solid states, solutions, acids and bases, equilibrium, acid-base equilibria, solubility equilibria, kinetics, thermodynamics, electrochemistry, coordination compounds, nuclear chemistry and descriptive topics in inorganic chemistry. Laboratory required. Prerequisite: One year of high

school chemistry. Students should complete CHM 911 and 912 at the same school, since topics are covered in different order by different schools.

Physics Course Descriptions

PHY 901, 902 General Physics I and II (8-10 semester credits): A sequence of courses in physics using algebra and trigonometry. Topics include mechanics (kinematics; Newton's three laws; work and energy; conservation of linear momentum; angular momentum; rotational dynamics; gravitation and Kepler's laws; and harmonic motion), electricity and magnetism (charge; electric field and potential; resistance, capacitance, and inductance; RLC circuits; laws of Gauss, Ampere, and Faraday; magnetic properties; and electromagnetic waves), heat and fluids (laws of thermodynamics; ideal gases and thermal properties; kinetic theory of gases; and fluid mechanics), and modern physics (wave motion and sound; optics; and introduction to modern physics). Laboratory required, but may be a separate course. Students should complete PHY 901 and PHY 902 at the same school before transfer since topics are covered in different order by different schools.

PHY 903, 904, 905 General Physics I, II and III (10-13 semester credits): A sequence of courses in physics using algebra and trigonometry. Topics include mechanics (kinematics; Newton's three laws; work and energy; conservation of linear momentum; angular momentum; rotational dynamics; gravitation and Kepler's laws; and harmonic motion), electricity and magnetism (charge; electric field and potential; resistance, capacitance, and inductance; RLC circuits; laws of Gauss, Ampere, and Faraday; magnetic properties; and electromagnetic waves), heat and fluids (laws of thermodynamics; ideal gases and thermal properties; kinetic theory of gases; and fluid mechanics), and modern physics (wave motion and sound; optics; and introduction to modern physics). Laboratory required, but may be a separate course. Students should complete PHY 903, PHY 904 and PHY 905 at the same school before transfer since topics are covered in different order by different schools.

PHY 911 Calculus-based Physics I - Mechanics (4-5 semester credits): A first course in mechanics using calculus. Topics must include, but are not limited to, kinematics; Newton's laws; work and energy; conservation of linear momentum; angular momentum; rotational dynamics; and harmonic motion. Laboratory required, but may be a separate course.

PHY 912 Calculus-based Physics II - Electricity and Magnetism (4-5 semester credits): A first course in electricity and magnetism using calculus. Topics must include, but are not limited to, charge; electric field and potential; resistance, capacitance, and inductance; dc and ac circuits; magnetic field; laws of Gauss, Ampere, and Faraday; Maxwell's equations and electromagnetic waves. Laboratory required, but may be a separate course. Students should complete PHY 911 and PHY 912 at the same institution.

PHY 913 Introductory Thermal Physics and Other Topics (2-4 semester credits): A first course in thermodynamics and statistical physics using calculus. Topics must include the concept and measurement of temperature; the first and second laws of thermodynamics; entropy; ideal gases and thermal properties; and the kinetic theory of gases. At least two of the following topics must also be included: gravitation; fluid statics and motion; waves; sound; geometrical optics; physical optics; relativity.

PHY 914 Introductory Quantum Physics and Other Topics (2-4 semester credits): A first course in quantum physics using calculus. Topics must include quantization; the atom; solid state physics and conduction; nuclear physics; and elementary particle physics. At least two of the following topics must also be included: gravitation; fluid statics and motion; waves; sound; geometrical optics; physical optics; relativity.

PHY 915 Calculus-based Physics III - Thermal and Quantum Physics (4-5 semester credits): A single course in physics including the topics listed for both PHY 913 and PHY 914. Laboratory required, but may be a separate course.

PHYSICS PANEL MEMBERS 2002-2003

Public Universities:
Sam Bowen, Chicago State University
Douglas Brandt, Eastern Illinois University
Arthur J. Braundmeier, Southern Illinois University Edwardsville
Michael Fortner, Northern Illinois University, *co-chair*
Hal Hart, Western Illinois University
Lew Licht, University of Illinois at Chicago
George Rutherford, Illinois State University

Independent Universities:
James H. Craig, Jr., Bradley University
Paul Robinson, Principia College

Community Colleges:
George Bart, Harry S Truman College, *co-chair*
John Carzoli, Oakton Community College
Deborah Damcott, William Rainey Harper College
Jeffrey Davidson, Highland Community College
Tom Kodogeorgiou, Richard J. Daley College
Rob Mason, Illinois Eastern Community College, Olney Central College
Allan Saaf, Heartland Community College
Tonia Timlin, Lake Land College
Peter K. Vig, Kaskaskia College

Transfer Coordinators:
Three seats currently vacant

Staff:
Neala Schleuning, Illinois Board of Higher Education
Barbara Risse, Illinois Community College Board