Utah System of Higher Education
New Academic Program Proposal
Cover/Signature Page - Abbreviated Template

Institution Submitting Request:	University of Utah
Proposed Program Title:	BA/BS in Physics with emphases in Applied Physics and Biom
Sponsoring School, College, or Division:	College of Science
Sponsoring Academic Department(s) or Unit(s):	Department of Physics & Astronomy
Classification of Instructional Program Code[1] :	14.1201, 40.0899, respectively
Min/Max Credit Hours Required of Full Program:	70 / 92
Proposed Beginning Term[2]:	Fall 2017
Institutional Board of Trustees' Approval Date:	

Program Type:

☐	Certificate of Proficiency	☐ Entry-level CTE CP	☐ Mid-level CP
☐	Certificate of Completion		
☐	Minor		
☐	Graduate Certificate		
☐	K-12 Endorsement Program		
☒	NEW Emphasis for Regent-Approved Program		
	Credit Hours for NEW Emphasis Only:	70 / 92	
	Current Major CIP:	40.0801	
	Current Program Title:		Physics
	Current Program BOR Approval Date:		
☐	Out of Service Area Delivery Program		

Chief Academic Officer (or Designee) Signature:
I, the Chief Academic Officer or Designee, certify that all required institutional approvals have been obtained prior to submitting this request to the Office of the Commissioner.

Please type your first and last name _____ Date:

☐ I understand that checking this box constitutes my legal signature.

[1] For CIP code classifications, please see http://nces.ed.gov/ipeds/cipcode/Default.aspx?y=55.
[2] "Proposed Beginning Term" refers to first term after Regent approval that students may declare this program.

Utah System of Higher Education
Program Description - Abbreviated Template

Section I: The Request

University of Utah requests approval to offer the following Emphasis: BA/BS in Physics with emphases in Applied Physics and Biomedical Physics effective Fall 2017. This program was approved by the institional Board of Trustees on .

Section II: Program Proposal/Needs Assessment

Program Description/Rationale

Present a brief program description. Describe the institutional procedures used to arrive at a decision to offer the program. Briefly indicate why such a program should be initiated. State how the institution and the USHE benefit by offering the proposed program. Provide evidence of student interest and demand that supports potential program enrollment.

Prior to this year, a student wishing to major in Physics at the University of Utah had one degree option, a BA or BS in Physics. However, within this single degree, the student was required to select one of three substantively different tracks. This last year, as the Department of Physics & Astronomy worked through the process of adding an Astronomy and Astrophysics emphasis to our degree program, the Department decided the time had come to make these different tracks into transcriptable emphases. The motivation for this was to better serve the students. By making the tracks into transcriptable emphases, students are better able to highlight their background and skills to potential employers and graduate schools.

The three tracks that currently exist within the degree "Physics" are Preprofessional Physics, Applied Physics and Biomedical Physics.

The Preprofessional Physics track is the most mathematically and theoretically rigorous program designed for students intending to pursue a graduate degree in physics or a closely related discipline, or for students who are looking for the strongest challenge in their academic program. This program is set apart from the other degree programs in that students are required to complete the three semester sequence of courses PHYS 4410, PHYS 4420 and PHYS 5450, which are a very rigorous set of courses delving into post-Newtonian Mechanics, Electrodynamics and Quantum Mechanics. Nearly half of the students currently in the Department of Physics & Astronomy are working towards this degree program. The department graduates approximately 18 students each year with this track.

The Applied Physics track is designed to provide broad foundational exposure to physics principles in the context of technological applications. This track replaces some of the theory classes for application coursework, such as PHYS 3410, PHYS 3610 and PHYS 3620. This track also represents about half the student body within the Department of Physics & Astronomy. The department graduates approximately 18 students each year with this degree track.

The Biomedical Physics track is primarily designed to prepare students for medical, dental, optometric or pharmaceutical post bachelor's schools. Students with this degree are also well prepared to pursue graduate studies in medical physics, biophysics, or similar. It is based on the Applied Physics track, but with additional requirements in biology and chemistry. There are fewer students in the department who are working on this degree track. It is a highly prescribed program, and many students select alternate routes. However, the department graduates approximately 4 students each year with this degree, 2-3 of whom go on to prestigious medical schools. It is a very strong degree for students who are successful in the program.

The proposal to convert the existing physics tracks into transcriptable emphases was approved in a meeting of the full Departmental faculty (both tenure-line and career-line) on May 3, 2016. The proposal was initiated by the Departmental Undergraduate Development Committee, with feedback from the Department Chair. The initial proposal asked for minor modifications to the existing Preprofessional and Applied tracks, and called for a task force to examine the Biomedical track. After discussion, the faculty voted positively, 25 in favor, 0 opposed and 2 abstentions, to approve the motion. The Biomedical task force met informally during the summer, and submitted a proposal for the Biomedical Emphasis to the faculty via e-mail. The faculty voted positively, 19 in favor, 0 opposed and 2 abstentions, to approve the motion. At the request of the

Undergraduate Counsel, the committee proposed to the faculty to change the name of the Preprofessional Physics track to just "Physics" and remove the request for this track to become a transcriptable emphasis. This proposal was submitted to the faculty via e-mail. The faculty voted positively, 16 in favor, 0 opposed, 2 abstentions and 1 technical abstention on Sept 30, 2016 to approve the motion.

Labor Market Demand

Provide local, state, and/or national labor market data that speak to the need for this program. Occupational demand, wage, and number of annual openings information may be found at sources such as Utah DWS Occupation Information Data Viewer (jobs.utah.gov/jsp/wi/utalmis/gotoOccinfo.do) and the Occupation Outlook Handbook (www.bls.gov/oco).

The American Institute of Physics reports that the majority of students with a Bachelor's degree in Physics will go on to graduate school in Physics or a related field. 43% will enter the workforce with a Bachelor's degree. Bachelor's degree recipients in the workforce are primarily in the private sector (61%), with College and University, High School, National Labs, and Active Military making up most of the remaining workforce. Individuals employed in the private sector are most likely to be in a STEM related position, such as Engineering or Computer or Information Systems. Employees in these fields reported high levels of satisfaction with their employment. Individuals in non-STEM related private sector work were less satisfied with their employment. Individuals working in education, at a national lab, or in the military also reported high levels of satisfaction with their employment. Reported salaries were greatest for private sector STEM positions, with a median starting salary of $51,000. Private sector non-STEM employment had the widest range of starting salaries, from the low $20,000's to the mid $50,000. (This data was collected from the classes of 2011 and 2012.)

According to the Bureau of Labor Statistics, employment in life, physical and social science occupations is expected to grow 7%, which is about as fast as average. The median wage in these fields was $62,160 in May 2015, which was higher than the median wage for all occupations of $36,200. Since individuals with Bachelor's degrees in physics are most likely to enter the private sector in engineering or computer and information systems, it is worth considering the Bureau of Labor Statistics information in these areas. Certain types of engineering positions are growing, while other types are declining, with an overall growth rate of 3%, which is lower than average. However, in computer and information technology occupations, the overall growth is 12%, which is higher than average.

The National Association of Colleges and Employers Spring 2016 Salary Survey reports that individuals with a Bachelor's degree in Physics have a median staring salary of $54,720. As many undergraduate students attend graduate school after graduation it is also useful to note the National Association of Colleges and Employers report that individuals with a PhD in Physics have a median starting salary of $66,500.

Consistency with Institutional Mission/Impact on Other USHE Institutions

Explain how the program is consistent with the institution's Regents-approved mission, roles, and goals. Institutional mission and roles may be found at higheredutah.org/policies/policyr312/ . Indicate if the program will be delivered outside of designated service area; provide justification. Service areas are defined in higheredutah.org/policies/policyr315/ .

Currently, students seeking a degree in Physics from the University of Utah Department of Physics & Astronomy are required to select a degree track. Each of these tracks has a set of foundation courses that are similar to foundational classes required at peer institutions across the United States. The breadth and depth courses for these three tracks are distinctly different from each other; they are consistent with requirements for similar degree emphases at peer institutions. By converting these tracks into a transcriptable emphasis, students seeking a degree in Physics will be able to highlight their unique skill set to potential graduate schools and employers. In addition, by offering transcriptable emphases in the Department of Physics & Astronomy, we will be creating more consistency within the college, and across the university, as this is something that has already been done by all the other departments in the College of Science, and many of the departments at the University of Utah.

Finances

What costs or savings are anticipated in implementing the proposed program? If new funds are required, indicate expected sources of funds. Describe any budgetary impact on other programs or units within the institution.

As these three tracks are already in existence, the conversion of the tracks to emphases will have no impact on the finances of

the institution.

Section III: Curriculum

Program Curriculum

List all courses, including new courses, to be offered in the proposed program by prefix, number, title, and credit hours (or credit equivalences). Indicate new courses with an X in the appropriate columns. The total number of credit hours should reflect the number of credits required to receive the award. For NEW Emphases, skip to emphases tables below.
For variable credits, please enter the minimum value in the table below for credit hours. To explain variable credit in detail as well as any additional information, use the narrative box below.

Course Number	NEW Course	Course Title	Credit Hours
General Education Courses (list specific courses if recommended for this program on Degree Map)			
		General Education Credit Hour Sub-Total	
Required Courses			
MATH 1210		Calculus I	4
MATH 1220		Calculus II	4
MATH 2210		Calculus III	3
MATH 2250		Differential Equations and Linear Algebra	4
CHEM 1210		General Chemistry I	4
CHEM 1215		General Chemistry Laboratory I	1
CHEM 1220		General Chemistry II	4
CHEM 1225		General Chemistry Laboratory II	1
PHYS 1970		Undergraduate Seminar I	1
PHYS 1980		Undergraduate Seminar II	1
PHYS 3210/2210		Physics for Scientists I/Physics for Scientists and Engineers I	4
PHYS 2215		Physics Laboratory for Scientists and Engineers I	1
PHYS 3220/2220		Physics for Scientists II/Physics for Scientists and Engineers II	4
PHYS 2225		Physics Laboratory for Scientists and Engineers II	1
PHYS 3719/3729		Physics Undergraduate Laboratory/Honors Physics Undergraduate Lab	4
PHYS 3740		Introduction to Quantum Theory and Relativity	3
PHYS 3760		Principles of Thermodynamics and Statistical Mechanics	3
PHYS 5010		Theoretical Classical Mechanics and Quantum Mechanics	3
PHYS 5020		Theoretical Electricity and Magnetism and Statistical Physics	3
Add Another Required Course			
		Required Course Credit Hour Sub-Total	53
Elective Courses			

Course Number	NEW Course	Course Title	Credit Hours
Add Another Elective Course			
		Elective Credit Hour Sub-Total	
		Core Curriculum Credit Hour Sub-Total	53

Are students required to choose an emphasis for the already-existing degree? *Yes or* X *No*

Course Number	NEW Course	Course Title	Credit Hours
Name of Emphasis:		Applied Physics	
MATH 3150		Partial Differential Equations for Engineering Students	2
MATH 3160		Applied Complex Variables	2
PHYS 3730		Introduction to Computing in Physics	4
PHYS Lab		Select from PHYS 3410, PHYS 3610, PHYS 3620, PHYS/ASTR 4060	3
PHYS Lab		Select from PHYS 3410, PHYS 3610, PHYS 3620, PHYS/ASTR 4060	3
PHYS 5***		Select from PHYS 5110, PHYS 5510	3
Add Another Emphasis Course			
		Emphasis Credit Hour Sub-Total	17
		Total Number of Credits to Complete Program	70

Course Number	NEW Course	Course Title	Credit Hours
Name of Emphasis:		Biomedical Physics	
MATH 4600		Mathematics in Physiology and Medicine	4
CHEM 2310		Organic Chemistry I	4
CHEM 2315		Organic Chemistry Laboratory I	2
CHEM Adv		At least 5 cr from CHEM 2320 & CHEM 2325, CHEM 3000, CHEM 3130	5
PHYS Lab		Select from PHYS 3410, PHYS 3610, PHYS 3620, PHYS 3730	3
PHYS Adv		Select from PHYS 4210, PHYS 4230, PHYS 4310, PHYS 5110, PHYS 5	3
BIOL Elec		Select from BIOL 1210, BIOL 2020, BIOL 2030, BIOL 2420, BIOL 3510	3
BIOL Elec		Select from BIOL 1210, BIOL 2020, BIOL 2030, BIOL 2420, BIOL 3510	3
BIOL Elec		Select from BIOL 1210, BIOL 2020, BIOL 2030, BIOL 2420, BIOL 3510	3
BIOL Lab		Select from BIOL 3215, BIOL 3515	2
Add Another Emphasis Course			

Course Number	NEW Course	Course Title	Credit Hours
		Emphasis Credit Hour Sub-Total	32
		Total Number of Credits to Complete Program	85

Propose a NEW Emphasis to an existing Regent approved program

Program Curriculum Narrative

Describe any variable credits. You may also include additional curriculum information, as needed.

The electives for PHYS Lab for the Applied Physics emphasis are: PHYS 3410 - Foundations of Modern Optics, PHYS 3610 - Electronics for Scientific Instrumentation, PHYS 3620 - Data Acquisition for Scientific Instrumentation, PHYS/ASTR 4060 - Observational Astronomy for Scientists.

The electives for PHYS 5*** for the Applied Physics emphasis are: PHYS 5110 - Introduction to Nuclear and Particle Physics, PHYS 5510 - Solid-State Physics I.

The electives for the CHEM Adv for the Biomedical Physics emphasis are: at least 5 credits from CHEM 2320 - Organic Chemistry II (4) & CHEM 2325 - Organic Chemistry Laboratory II (2), CHEM 3000 - Quantitative Analysis (4), CHEM 3100 - Inorganic Chemistry (5), CHEM 3130 - Solid-State Chemistry (2), CHEM 3200 - Radiochemistry with Laboratory I (3), CHEM 5810 - Nanoscience: Where Biology, Chemistry and Physics Intersect (3).

The electives for PHYS Lab for the Biomedical Physics emphasis are: PHYS 3410 - Foundations of Modern Optics, PHYS 3610 - Electronics for Scientific Instrumentation, PHYS 3620 - Data Acquisition for Scientific Instrumentation, PHYS 3730 - Introduction to Computing in Physics.

The electives for PHYS Adv for the Biomedical Physics emphasis are: PHYS 4210 - Optics in Biology, PHYS 4230 - Properties and Functions of Processive Molecular Motors, PHYS 4310 - Physics in Biology, PHYS 5110 - Introduction to Nuclear and Particle Physics, PHYS 5510 - Solid-State Physics I.

The electives for BIOL Elec for the Biomedical Physics emphasis are: BIOL1210 - Principles of Biology, BIOL 2020 - Principles of Cell Biology, BIOL 2030 - Genetics, BIOL 2420 - Human Physiology, BIOL 3510 - Biological Chemistry I.

The electives for BIOL Lab for the Biomedical Physics emphasis are: BIOL 3215 - Cell Biology Laboratory, BIOL 3515 - Biological Chemistry Laboratory.

There is some variation in the total number of credits within each emphasis.

For the Preprofessional Physics emphasis, the PHYS 5*** electives, PHYS 5110, PHYS 5510, and PHYS 5520 are 3 credit hour courses, while PHYS 5460 is a 4 credit hour course.

For the Applied Physics emphasis, the PHYS Lab electives, PHYS 3410 is a 4 credit hour course while PHYS 3610, PHYS 3620, and PHYS/ASTR 4060 are 3 credit hour courses.

For the Biomedical Physics emphasis, the CHEM Adv electives have a range from 2 credit hours to 5 credit hours. Therefore, it is possible to create combinations of as few as 5 credits, or as many as 8 credits.

For the Biomedical Physics emphasis, the PHYS Lab electives, PHYS 3410 and PHYS 3730 are 4 credit hour courses while PHYS 3610 and PHYS 3620 are 3 credit hour courses.

For the Biomedical Physics emphasis, the BIOL Elec electives, BIOL 1210 and BIOL 2420 are 4 credit hour courses while BIOL 2020, BIOL 2030, and BIOL 3510 are 3 credit hour courses.

For the Biomedical Physics emphasis, the BIOL Lab electives, BIOL 3215 is a 2 credit hour course, and BIOL 3515 is a 3 credit hour course.

Otherwise, the elective courses all have the same number of credit hours shown in the table.

Degree Map

Degree maps pertain to undergraduate programs ONLY. Provide a degree map for proposed program. Degree Maps were approved by the State Board of Regents on July 17, 2014 as a degree completion measure. Degree maps or graduation plans are a suggested semester-by-semester class schedule that includes prefix, number, title, and semester hours. For more details see http://higheredutah.org/pdf/agendas/201407/TAB%20A%202014-7-18.pdf (Item #3).

Please cut-and-paste the degree map or manually enter the degree map in the table below

Applied Physics Emphasis
First Year Fall Cr. Hr. First Year Spring Cr. Hr.
PHYS 1970 1 PHYS 1980 1
MATH 1210 4 MATH 1220 4
CHEM 1210 4 CHEM 1220 4
CHEM 1215 1 CHEM 1225 1
Gen Ed (FF) 3 Gen Ed (HF) 3
General Elective 3 General Elective 3
Total 16 Total 16
Second Year Fall Cr. Hr. Second Year Spring Cr. Hr.
MATH 2210 3 MATH 2250 4
PHYS 3210 4 PHYS 3220 4
PHYS 2215 1 PHYS 2225 1
Gen Ed (WR2) 3 Gen Ed (AI) 3
General Elective 3 General Elective 3
Total 14 Total 15
Third Year Fall Cr. Hr. Third Year Spring Cr. Hr.
MATH 3150 2 MATH 3160 2
PHYS 3740 3 PHYS 3760 3
PHYS Lab 3 PHYS 3730 4
Gen Ed (BF) 3 Gen Ed (FF) 3
Gen Ed (IR) 3 General Elective 3
Total 14 Total 15
Fourth Year Fall Cr. Hr. Fourth Year Spring Cr. Hr.
PHYS 5010 3 PHYS 5020 3
PHYS 5*** 3 PHYS 3719 4
PHYS Lab 3 Gen Ed (BF) 3
Gen Ed (HF) 3 Gen Ed (DV) 3
Gen Ed (CW) 3 General Elective 3
Total 15 Total 16

Biomedical Physics Emphasis
First Year Fall Cr. Hr. First Year Spring Cr. Hr.
PHYS 1970 1 PHYS 1980 1
MATH 1210 4 MATH 1220 4
CHEM 1210 4 CHEM 1220 4
CHEM 1215 1 CHEM 1225 1
Gen Ed (FF) 3 Gen Ed (HF) 3
Gen Ed (WR2) 3 General Elective 3
Total 16 Total 16
Second Year Fall Cr. Hr. Second Year Spring Cr. Hr.
MATH 2210 3 MATH 2250 4
PHYS 3210 4 PHYS 3220 4

PHYS 2215 1 PHYS 2225 1
BIOL Elec 3 BIOL Elec 3
Gen Ed (BF) 3 Gen Ed (AI) 3
Total 14 Total 15
Third Year Fall Cr. Hr. Third Year Spring Cr. Hr.
PHYS 3740 3 MATH 4600 4
PHYS Lab 3 PHYS 3760 3
CHEM 2310 4 PHYS 3719 4
CHEM 2315 2 CHEM Adv 5
Gen Ed (FF) 3
Total 15 Total 16
Fourth Year Fall Cr. Hr. Fourth Year Spring Cr. Hr.
PHYS 5010 3 PHYS 5020 3
PHYS Adv 3 BIOL Lab 2
BIOL Elect 3 Gen Ed (BF) 3
Gen Ed (HF) 3 Gen Ed (DV) 3
Gen Ed (CW) 3 Gen Ed (IR) 3
Total 15 Total 14

NWCCU MINOR CHANGE

Institution: University of Utah
Proposal Name: Physics Bachelor's Degree programs with Emphases in Applied Physics and Biomedical Physics

a. Mission and Core Themes:

Prior to this year, a student wishing to major in Physics at the University of Utah had one degree option, a BA or BS in Physics. However, within this single degree, the student was required to select one of three substantively different tracks. Each of these tracks has a set of foundation courses that are similar to foundational classes required at peer institutions across the United States. The breadth and depth courses for these three tracks are distinctly different from each other. However, they are consistent with requirements for similar degree emphases at peer institutions.

By converting the Applied Physics track and Biomedical Physics tracks into transcriptable emphases, students seeking a degree in these areas of Physics will be able to highlight their unique skill set to potential graduate schools and employers. In addition, by offering transcriptable emphases in the Department of Physics & Astronomy, we will be creating more consistency within the college, and across the university; all the other departments in the College of Science, and many of the departments at the University of Utah already offer transcriptable emphases.

b. Authorization:

1. *evidence of formal approval by the governing board and by the appropriate governmental agency to offer the proposed existing and/or new program(s) at the proposed site(s). If the institution is located in, or operates in, a state that has only minimal requirements for chartering, but also a higher level of authorization to grant degrees, approval at the higher level is required;*

c. Educational Offerings:

In the following tables, we list the required and elective courses for each of the proposed degree emphases, including the total number of credits, and expected student learning outcome (by number) that is met by the course. (This does not include additional credits required to meet general education, Bachelor's degree requirements, and University of Utah degree requirements.)

Applied Physics Emphasis				
	Course Number	Course Name	ESLO	Cr Hrs
Required	MATH 1210	Calculus I	3	4
	MATH 1220	Calculus II	3	4
	MATH 2210	Calculus III	3	3
	MATH 2250	Differential Equations and Linear Algebra	3	4
	MATH 3150	Partial Differential Equations for Engineering Students	3	2
	MATH 3160	Applied Complex Variables	3	2
	CHEM 1210	General Chemistry I	1,3	4
	CHEM 1215	General Chemistry Laboratory I	1,3,4	1
	CHEM 1220	General Chemistry II	1,3	4
	CHEM 1225	General Chemistry Laboratory II	1,3,4	1
	PHYS 1970	Undergraduate Seminar I	1,2,5	1
	PHYS 1980	Undergraduate Seminar II	1,2,5	1
	PHYS 3210/2210	Physics for Scientists I/Physics for Scientists and Engineers I	1,3	4
	PHYS 2215	Physics Laboratory for Scientists and Engineers I	1,3,4,5	1
	PHYS 3220/2220	Physics for Scientists II/Physics for Scientists and Engineers II	1,3	4
	PHYS 2225	Physics Laboratory for Scientists and Engineers II	1,3,4,5	1
	PHYS 3719	Physics Undergraduate Laboratory	1,3,4,5	4
	PHYS 3730	Introduction to Computing in Physics	1,3,5,6	4
	PHYS 3740	Introduction to Quantum Theory and Relativity	1,3	3
	PHYS 3760	Principles of Thermodynamics and Statistical Mechanics	1,3	3
	PHYS 5010	Theoretical Mechanics and Quantum Mechanics	1,3	3

	PHYS 5020	Theoretical Electricity and Magnetism and Statistical Physics	1,3	3
Select 2	PHYS 3410	Foundations of Modern Optics	1,3,4,5	4
	PHYS 3610	Electronics for Scientific Instrumentation	1,3,4	3
	PHYS 3620	Data Acquisition for Scientific Instrumentation	1,3,4	3
	PHYS/ASTR 4060	Observational Astronomy for Scientists	1,3,4	3
Select 1	PHYS 5110	Introduction to Nuclear and Particle Physics	1,2,3,5	3
	PHYS 5510	Solid-State Physics I	1,2,3,5	3
		Total Credit Hours		70-71

Biomedical Physics Emphasis				
	Course Number	Course Name	ESLO	Cr Hrs
Required	MATH 1210	Calculus I	3	4
	MATH 1220	Calculus II	3	4
	MATH 2210	Calculus III	3	3
	MATH 2250	Differential Equations and Linear Algebra	3	4
	MATH 4600	Mathematics in Physiology and Medicine	1,2,3	4
	CHEM 1210	General Chemistry I	1,3	4
	CHEM 1215	General Chemistry Laboratory I	1,3,4	1
	CHEM 1220	General Chemistry II	1,3	4
	CHEM 1225	General Chemistry Laboratory II	1,3,4	1
	CHEM 2310	Organic Chemistry I	1,3	4
	CHEM 2315	Organic Chemistry Laboratory I	1,3,4	2
	PHYS 1970	Undergraduate Seminar I	1,2,5	1
	PHYS 1980	Undergraduate Seminar II	1,2,5	1
	PHYS 3210/2210	Physics for Scientists I/Physics for Scientists and Engineers I	1,3	4
	PHYS 2215	Physics Laboratory for Scientists and Engineers I	1,3,4,5	1
	PHYS 3220/2220	Physics for Scientists II/Physics for Scientists and Engineers II	1,3	4
	PHYS 2225	Physics Laboratory for Scientists and Engineers II	1,3,4,5	1
	PHYS 3719	Physics Undergraduate Laboratory	1,3,4,5	4
	PHYS 3740	Introduction to Quantum Theory and Relativity	1,3	3
	PHYS 3760	Principles of Thermodynamics and Statistical Mechanics	1,3	3
	PHYS 5010	Theoretical Mechanics and Quantum Mechanics	1,3	3
	PHYS 5020	Theoretical Electricity and Magnetism and Statistical Physics	1,3	3
Select at	CHEM 2320 &	Organic Chemistry II	1,3	4
least 5 cr	CHEM 2325	Organic Chemistry Laboratory II	1,3,4	2
	CHEM 3000	Quantitative Analysis	1,3,4,5	4
	CHEM 3100	Inorganic Chemistry	1,3	5
	CHEM 3130	Solid-State Chemistry	1,3	2
	CHEM 3200	Radiochemistry with Laboratory I	1,3,4	3
	CHEM 5810	Nanoscience: Where Biology, Chemistry and Physics Intersect	1,3	3
Select 1	PHYS 3410	Foundations of Modern Optics	1,3,4,5	4
	PHYS 3610	Electronics for Scientific Instrumentation	1,3,4	3
	PHYS 3620	Data Acquisition for Scientific Instrumentation	1,3,4	3
	PHYS 3730	Introduction to Computing in Physics	1,3,4,6	4
Select 1	PHYS 4210	Optics in Biology	1,2,3,5	3
	PHYS 4230	Properties and Functions of Processive Molecular Motors	1,2,3,5	3
	PHYS 4310	Physics in Biology	1,2,3,5	3
	PHYS 5110	Introduction to Nuclear and Particle Physics	1,2,3,5	3
	PHYS 5510	Solid-State Physics I	1,2,3,5	3
Select 3	BIOL 1210	Principles of Biology	1,3	4
	BIOL 2020	Principles of Cell Biology	1,3	3

	BIOL 2030	Genetics	1,3	3
	BIOL 2420	Human Physiology	1,3	4
	BIOL 3510	Biological Chemistry	1,3	3
Select 1	BIOL 3215	Cell Biology Laboratory	1,3,4	2
	BIOL 3515	Biological Chemistry Laboratory	1,3,4	3
		Total Credit Hours		85-92

The expected student learning outcomes for these emphases are:

1. The nature of physics and its concepts
    a. Understanding the role of observation and the interplay between experiments and theory in scientific progress.
    b. Understanding the self-correcting nature of science.
    c. Familiarity with the major historical threads and key players in the development of physics.
    d. Basic understanding of the major threads of physics concepts: conservation laws, forces (gravity, E&M), fields, Newton's laws, work and energy, optics, thermodynamics, relativity, quantum mechanics, condensed matter physics, particle physics, cosmology.
    e. Ability to integrate physics concepts with concepts from other branches of science.
    f. Understanding the place of humans in the Universe.
2. The role of physics and science in society
    a. Understanding scientific ethics.
    b. Understanding political issues in the relationship between science and society. Public perceptions of scientists. Ethical uses of scientific results.
    c. Understanding the physical basis of some major contemporary societal problems, such as energy production, nuclear power, and human impacts on the global climate.
3. Mathematical skills, modeling skills, and problem solving skills
    a. Ability to organize problems by identifying physical principles, identifying relevant vs. irrelevant quantities, and making appropriate diagrams.
    b. Ability to use the language of mathematics to solve physical problems.
    c. Ability to build physical models by abstracting the most important concepts.
    d. Ability to use and interpret graphical representations of data.
    e. Ability to estimate results.
4. Fundamental laboratory skills
    a. Understanding how to collect, organize, and present data and connect it to physical principles.
    b. Ability to carry out error analysis, understanding what errors mean.
    c. Estimating and understanding the statistical significance of experimental results using concepts such as confidence levels and chance probabilities.
    d. Understanding the basics of experimental design, and the tradeoffs between statistical and systematic uncertainties.
    e. Understanding of and commitment to laboratory safety.
5. Scientific communication
    a. Basic writing ability: Ability to use correct grammar, punctuation, clear sentence structure, and coherent paragraph construction.
    b. Scientific writing ability: Ability to use technical terms correctly, introduce notation properly, and use displayed equations, tables, figures, and citations properly.
    c. Presentation skills: Ability to give effective, persuasive presentations to peers, both formal and informal.
    d. Teamwork: Ability to work in groups to solve scientific problems.
    e. Proper attribution of sources. Honesty in reporting results.
6. Computational literacy (required for Preprofessional and Applied Physics Emphases, optional for Biomedical Emphasis)
    a. Ability to write simple code in a modern, high-level computing language.
    b. Ability to use scientific subroutine packages.
    c. Ability to solve problems using symbolic math systems.
    d. Knowledge of basic numerical analysis, such as the solution of linear systems, the determination of eigenvalues, Fourier analysis, and the numerical integration of differential equations.

e. Understanding of computer modeling of physical systems.

7. Research experience (required for students in the honors program, optional for other students)
    a. Ability to apply physics competencies semi-independently in a research context.
    b. Ability to synthesize physics principles and applications.
    c. Ability to present research motivations, findings, and significance.

The expected student learning outcomes (ESLOs) that each course addresses are included in the above tables. For many of the courses, the expected learning outcomes are the ones involving mathematical skills and subject knowledge. We expect that students who are successful in the program will become competent in these areas. Physics is a rigorous subject, and students who are not competent mathematically and in physics content knowledge will not be successful in the major. In addition, each of the emphases required students to complete many laboratory based courses. Again, students cannot be successful in these courses if they do not develop fundamental laboratory skills.

Other ESLOs are not addressed by as many courses: the role of science in society, scientific communication, and computational literacy. For this reason, the Undergraduate Development Committee has been very conscientious in determining that the courses that meet these objectives adequately evaluate these skills. For the role of science in society, the Undergraduate Development Committee verified that this topic was addressed in both introductory and advanced classes. For scientific communication, all students in these emphases are required to take PHYS 3719 – Physics Undergraduate Laboratory. While other classes do include written papers, and therefore contribute to the students' scientific communication skills, PHYS 3719 is expected to meet all of the outcomes in this category. The students are required to work in small groups to conduct their experiments, write papers on two of the experiments, and give one oral presentation. The written papers and oral presentation make up the bulk of the grade for the course. Students who are successful in PHYS 3719 will have demonstrated competence in scientific communication. Similar arguments can be made for PHYS 3730, which is the only required course that meets the computational literacy objective.

4. *evidence of approval by the appropriate academic policy body of the institution;*

d. Planning:

As stated in section a, prior to this year, a student wishing to major in Physics at the University of Utah had one degree option, a BA or BS in Physics. However, within this single degree, the student was required to select one of three substantively different tracks. This last year, as the Department of Physics & Astronomy worked through the process of adding an Astronomy and Astrophysics emphasis to our degree program, the Department decided the time had come to make these different tracks into transcriptable emphases.

The purpose of this change is primarily to benefit current and future undergraduate students in the Department of Physics & Astronomy. By converting these tracks into transcriptable emphases, students seeking a degree in Physics will be able to highlight their unique skill set to potential graduate schools and employers. In addition, by offering transcriptable emphases in the Department of Physics & Astronomy, we will be creating more consistency within the college, and across the university, as this is something that has already been done by all the other departments in the College of Science, and many of the departments at the University of Utah.

The Undergraduate Development Committee began working towards the goal of creating transcriptable emphases during the 2014 – 2015 academic year. The first step was to begin the process of creating an Astronomy and Astrophysics emphasis. This emphasis received final approval from the NWCCU this June. While the Astronomy and Astrophysics emphasis was being evaluated by all the governing bodies within the University of Utah, the State of Utah and the NWCCU, the Undergradute Development Committee continued working on converting the existing tracks to transcriptable emphases.

The proposal to convert the existing physics tracks into transcriptable emphases was approved in a meeting of the full Departmental faculty (both tenure-line and career-line) on May 3, 2016. The proposal was initiated by the Departmental Undergraduate Development Committee, with feedback from the Department Chair. The initial proposal asked for minor modifications to the existing Preprofessional and Applied tracks, and called for a task force

to examine the Biomedical track. After discussion, the faculty voted positively, 25 in favor, 0 opposed and 2 abstentions, to approve the motion. The Biomedical task force met informally during the summer, and submitted a proposal for the Biomedical Emphasis to the faculty via e-mail. The faculty voted positively, 19 in favor, 0 opposed and 2 abstentions, to approve the motion. At the request of the Undergraduate Counsel, the committee proposed to the faculty to change the name of the Preprofessional Physics track to just "Physics" and remove the request for this track to become a transcriptable emphasis. This proposal was submitted to the faculty via e-mail. The faculty voted positively, 16 in favor, 0 opposed, 2 abstentions and 1 technical abstention on Sept 30, 2016 to approve the motion.

As these are existing tracks within the degree, no changes are needed to the organizational arrangements within the institution. Pending approval, it is expected that these changes will take place beginning Fall 2017.

e. Budget:

As there are no changes to the course offerings, the financial impact is minimal, and there are no expected additional expenditures.

f. Student Services:

The emphasis is not expected to impact student services, or the rest of the student body.

g. Physical Facilities:

There will be no need for additional facilities. The requirements will be met with existing courses.

h. Library and Information Resources:

There will be no need for additional library and information resources.

i. Faculty:

As there are no changes to the course offerings, the current faculty already offering these courses will continue to offer these courses. There will be no impact to faculty.

THE UNIVERSITY OF UTAH
College of Science

August 15, 2016

David B. Kieda
The Graduate School
University of Utah
201 Presidents Circle, Room 302
Salt Lake City, UT 84112-9016

Dear Dean Kieda:

It is my pleasure to join Ben Bromley in his support of the new degree emphases in the Department of Physics & Astronomy. As Ben notes in his letter, the emphases being proposed here serve an immediate and well-attested need for a more focused undergraduate experience that will support students in their long-term career and education goals.

As indicated in their proposal, the three emphases that Department proposes already exist as degree tracks. In this sense, the tracks' conversion into emphases will serve to formalize the preferences that have already evolved organically within the Department. The establishment of these transcriptable emphases can only serve to highlight the rigor and focus of the Physics degree. In this way, the new emphases also serve the important purpose of improving our graduates' competitiveness in today's fast-changing labor market.

In short, because it will serve a need often expressed and shown by our students, and because it will have no adverse impact on the colleges or departments finances, I can find no reason to oppose and many reasons to support the proposal presented by Prof. Bromley and the faculty of the Department of Physics and Astronomy. I hope you will agree with me that such a change is well warranted and will be a significant step toward better serving our student body. Thank you.

Sincerely,

Henry White

Henry S. White
Dean, College of Science, and
Distinguished Professor of Chemistry

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1430 East Presidents Circle, Rm. 220 (JTB), Salt Lake City, UT 84112-0140
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THE UNIVERSITY OF UTAH

Department of Physics and Astronomy
115 South 1400 East #201 Salt Lake City, UT 84112-0830 (801) 581-6901 FAX (801) 581-4801

July 29, 2016

To Whom It May Concern:

The Department of Physics and Astronomy at the University of Utah is seeking to offer transcriptable degree emphases for our Bachelors degree in Physics. The emphases are: Preprofessional Physics, Applied Physics, and Biomedical Physics. As Department Chair, I provide this letter to confirm that the Department has approved these emphases.

Our undergraduate program serves almost 300 students majoring in Physics, with diverse career goals. Many seek employment directly in a variety of fields in industry or on to professional /graduate school. Each proposed emphasis is tuned to help students in their career aspirations. By having the emphases appear on transcripts, our students can highlight the distinct nature of their training to prospective employers or educational institutions.

Details of the emphases are provided in the documentation included in this request. All of the courses described therein are currently offered and the expected learning outcomes are well established. The faculty in the Department of Physics and Astronomy are committed to providing these courses and outcomes to our students. Indeed, faculty votes show unanimous approval for the proposed transcriptable emphases.

In conclusion, the Department of Physics and Astronomy have approved the transcriptable emphases, **Preprofessional Physics**, **Applied Physics**, and **Biomedical Physics**, for the Physics Bachelors degree.

Sincerely,

Benjamin C. Bromley
Professor and Chair

THE UNIVERSITY OF UTAH

Department of Physics and Astronomy
115 South 1400 East #201 Salt Lake City, Utah 84112-0830 (801) 581-6901 FAX (801) 581-4801

October 6, 2016

To Whom It May Concern:

This is an addendum to the previous letter. At the request of the Undergraduate Counsel, the Department of Physics & Astronomy is modifying the original request for three transcriptable emphases. The Department is now requesting that the Preprofessonal program be named “Physics” which will not have an emphasis, and is requesting emphasis designation for the Applied Physics and the Biomedical Physics tracks.

Sincerely,

Ben Bromley
Chair and Professor of Physics & Astronomy

BCB/hlf