AUTHORIZATION TO PLAN (ATP) A NEW ACADEMIC PROGRAM

1. Prior to completion of the ATP, consultation has been made with the Vice Chancellor for Academic Affairs (VCAA) regarding the interest in proposing a new Engineering program.

2. **Campus/College/Department:** UHH/College of Arts and Science

3. **Chair of Planning Committee:** Kenneth Morris

   Planning Committee Members: Christian Andersen, Dan Brown, Robert Chi, Jie Cheng, Tep Dobry, Linda Golian-Lui, Bill Heacox, Randy Hirokama, Raina Ivanova, Ernest Kho, Bruce Liebert , Bill Mautz, Gerald Mello, Bruce Mathews, Jene Michaud, Ken Morris, Kenith Simmons, William Steiner, Marcel Tsang

4. **Degree/Certificate Proposed:** B.S. in Engineering Science

5. **Describe the Need for Program:**
   a. Program Description

   1) Program Learning Outcomes

   In order to ensure the provision of adequate engineering education designed to meet the science and technology-oriented economic development opportunities and needs of Neighbor Island communities, we propose to offer an accreditable undergraduate degree at UH Hilo (UHH) in Engineering Science.

   Learning objectives for program:

   1. Strong analytical thinking
   2. Strong quantitative skills
   3. Qualified to enter a wide variety of jobs
   4. One of the following
      a. Broad knowledge of instrument systems, including
         i. optical/photonics systems
         ii. electro-mechanical systems
         iii. computer interfaces and controls
      b. Broad knowledge of sustainable energy technology, including
         i. design principles
         ii. underlying physical, chemical, and biological science
         iii. equipment and associated technology

   2) Program Justification

   The Undergraduate Engineering Science degree program addresses the UH Hilo Strategic Plan goal of "maintaining a well-rounded mix of liberal arts and professional programs." This program will complement bachelor's programs in Agricultural Science, Astronomy and Physics, Mathematics, Computer Science, Biological Sciences and other degrees requiring engineering support of data acquisition, analysis and presentation systems, communication systems, and related components.

In order for the UH System to be better positioned to meet the State's science and technology goals, UHH requires essential support to excel in applied and basic STEM (science, technology, engineering and mathematics) research fields that provide the hands-on experiences essential for our graduates to be competitive in the global discovery and innovation enterprise. The proposed Undergraduate Engineering Science Program will serve as a nice addition to the existing STEM related research programs, and offer solid faculty-guided research experiences that can benefit student groups and community. The Engineering Science program at UH Hilo will make an active and measurable contribution to the State's economy and provide a solid return on its investment both through the production of new knowledge and methodologies that help Hawaii's business and citizens, and through the enhanced educational experience of its students.

The uniqueness of the proposed program at UHH is that it focuses on ***General Engineering Skills***. This degree starts by developing general engineering skills (aligned with the UHM/UHCCs pre-engineering curriculum) and provides upper division ***concentrations*** in collaboration with UHM to produce graduates in areas critical to the State.

3) Program Rationale Based on Workforce Needs
Nationally, according to Occupational Outlook Handbook (2010-11 Edition) published by Bureau of Labor Statistics, "*Overall engineering employment is expected to grow by 11 percent over the 2008–18 decade.*"

The need in Hawaii is reflected in the following assessment done to identify the demand and need of engineers (Innovation and Technology in Hawaii: An Economic and Workforce Profile. October 2008; prepared for The Hawaii Science & Technology Institute):

- Engineer demand: Each year, in addition to the current workforce, the State of Hawaii needs approximately 100 electrical engineers and 35-50 engineers specializing in a wide range of other areas to fill projected existing and newly created jobs in government and companies.
- Engineer supply: Each year, the University of Hawaii Manoa graduates approximately 100 engineers from its baccalaureate and advanced degree programs in electrical, mechanical, and civil engineering. Approximately half leave Hawaii and therefore, between approximately 85-100 engineers must be imported, which represents the range of the annual in-state gap between supply and demand.

There are currently thirteen working telescopes near the summit of Mauna Kea. Along with attracting more investments, recruiting locally has long been recognized by observatories as key development targets. *A 2007 University of Hawai`i survey showed that only 18% of the astronomy observatories' technical and administrative staff based on the island of Hawai`i were born on the island. Despite significant costs, a full 40% of the observatories' technical and administrative staff had to be recruited and relocated from overseas locations, primarily because the pool of qualified applicants on Hawai`i Island was insufficient to fill the observatories' needs. It would be very beneficial to both the local island community, and the*

observatories, if there was an adequate local pool of qualified candidates to fill these positions as they become available. Based on the requirements of the current observatories and creation of new positions planned for the Thirty Meter Telescope, together with ordinary job turnover, projections show that approximately 352 technical jobs will come open from 2010 through 2023 (Hawaii Island Astronomy Workforce Opportunities 2010-2023), for which our graduates in Instrumentation focus will be qualified

b. Existing UH program(s)

The University of Hawaii Manoa (UHM) currently offers a bachelor's degree in Computer Engineering, baccalaureate and graduate programs in electrical, mechanical, and civil engineering; Maui College has started an undergraduate program in engineering technology. The undergraduate degree in Engineering Science that UH Hilo is planning is unique, and distinct from the existing programs at UH Manoa and Maui College. This program will be broad in scope, with two identified areas of concentration, ***Alternative Energy*** and ***Instrumentation*** respectively. The proposed program will allow training opportunities in telescope engineering, sustainable energy, data manipulation and analysis and engineering design, and will seek to address state needs for a workforce trained for high priority science and technology fields in the State. The program will have linkages to current and next generation observatories on Mauna Kea and other enterprises (especially in alternative energies) on the Big Island. Part of the plan is to recognize technologies that will help recruit students, especially of island societies, and train them in the modern aspects of engineering science.

During the initial planning stage, consultations have been made with UHM College of Engineering. It is in agreement that the proposed engineering program with focuses on instrumentation and alternative energy would be a useful addition to the existing programs in UH Manoa, and unarguably this is going to be the right program for the Big Island Community.

To work within the constraints of resources and goals, a closer association with UHM Engineering at upper division level and Kapiolani Community College (KCC) at lower division level is also in everyone's interest. This will leverage our faculty, expand our possible areas of concentration, reconcile us with the UH Community College programs, and facilitate accreditation. The idea would be to create a "Faculty of Engineering Science" composed of faculty from various campuses (largely by distance). A shared faculty position at Manoa is included in the planning and budget to facilitate the participation of needed faculty willing to be included in the program.

6. Planning the New Program

a. Planning Period

i. The planning period will be from January 1st 2012 through December 31st 2012.

ii. An advisory committee of faculties selected from CAFNRM, COBE, CAS, COP and interested outside professionals from UH Manoa and other

institutions will be invited to meet to discuss the legislative and planning milestones set out in the legislation.

iii. The committee will develop the degree requirements including core and elective courses. Once the degree program is developed, it will be submitted to the UHH Curriculum Review Process formal approval.

iv. The committee will create demonstration platforms and projects to engage faculty/students across involved departments and other stakeholders.

v. The committee will coordinate with private/public community engineering stakeholders for shadowing, internship, and job opportunities.

vi. The committee will set up budget analysis and manage the existing fund.

vii. Assuming that all approvals are received within schedule, the program will be implemented as following:

- Recruitment of students launched Q1 2013
- Interim facilities completed Q1 2013
- Faculty hired – Q2 2013
- Inaugural class enrolled Fall 2014

b. Description of resources required

In order to provide the above degrees, the following resources should be allocated to the UHH undergraduate Engineering Science program:

i. Faculty – it is estimated that at full implementation the program would require approximately four new faculty members: two engineering faculty and two non-engineering faculty (e.g. Math). Engineering faculty is budgeted at $110,000 (associate rank) and $85,000 (assistant rank) per year per person without fringe (Two engineering position are legislatively appropriated general funded, so no fringe is included in this budget.). Non-engineering faculty at assistant professor level is budgeted at $84,150 per year (60,000 plus 40.25% fringe) per person (including fringe benefits). Additional support of lecturers for 12 prerequisite and GE classes is required. Lecturers are budgeted at $5,000 per course.

ii. Facilities – at full implementation it has been assumed renovation of existing facilities would be required. The cost is estimated at approximately $200,000.

iii. Library and librarian support – The program draws in partly on existing courses, but new books, archived databases and case files will need to be purchased by the library. Additional support on expanding collections at the library would require approximately $25,000/year and this number would increase to $30,000K/year when the program is in full implementation. A full time *science* librarian would be needed after the program is in full implementation at a cost of approximately $60K/year. The science librarian will fill a gap that UHH now has and will provide additional support to the UHH system for its STEM initiatives. Half of the cost of full time *science* librarian will be absorbed by proposed Engineering Science Program.

iv. Lab support staff and Administrative staff – at full implementation, engineering science program would require a full time lab support staff that would coordinate and manage teaching labs as well as practical labs. A full time administrative staff would be necessary for this program as his/her main

job responsibility would be working with observatories and other enterprises on students' internships, potential jobs, collaborative projects, etc.

v. B Budget - $12,500 and $50,000 are budgeted for FY2012/13 and FY2013/14 respectively, and $75,000 a year is budgeted from FY2014/15.

c. Five-Year Business Plan. Attachment 1 shows the projected budget for the program.

Initial funding was approved in HB346 in support of SR 105 which called for the comprehensive planning of undergraduate engineering program in UH Hilo. HB346 provided UHH funding of $500K for planning (FY 2009/10 and FY 2010/11) and $300K a year for implementation starting from FY2011/12.

7. Impact on current courses or programs

Engineering-related education and training programs are a high priority for the State's Innovation Initiative. UH Hilo already has a small pre-engineering program in place that, if properly restructured, could form the foundation for a full undergraduate program. The new program will give these students an option to finish their undergraduate degree in Engineering at UH Hilo rather than transfer to a mainland university or to UH Manoa. Graduates of this program will have the opportunity to apply to the UH Manoa graduate program in Engineering and specialize in biological, civil, electrical, mechanical, or ocean resources engineering.

This program will complement the UH Manoa programs in engineering by providing an alternative to UH Manoa's emphasis on traditional engineering disciplines, allowing instead a highly flexible, interdisciplinary education appropriate to the job opportunities in rural areas such as the Big Island. Additional engineering curriculum offerings would allow the University of Hawaii System to excel in applied and basic science, technology, engineering, and mathematics research fields that provide the hands-on experiences essential for its graduates to be competitive in the global discovery and innovation enterprise.

Ripple effect has been taken into consideration on the current courses and programs. Affected departments were consulted regarding availability of instructional resources for existing and planned courses for this proposed Engineering Program. A draft curriculum was sent out to affected departments. A business plan for the proposed program has taken collective input regarding additional instructional resources needed into consideration. Original feedback from affected departments is attached as attachment 2.

The ATP has completed the campus approval process prior to review by the Council of Chief Academic Officers

Reviewed by:

Campus Chief Academic Officer:
_____Recommend
Comments :

Signature Print Name Date

Chancellor: ___ Approved ___ Disapproved
Comments:

Signature Print Name Date

Council of Chief Academic Officers (Systemwide Consultation):
Comments :

Signature Print Name Date

(A copy of the signed document is provided to the Office of the Executive Vice President of Academic Affairs/Provost)

Attachment 1. Undergraduate Engineering Science Program Business Plan

Year	FY2012/13	FY2013/14	FY2014/15	FY2015/16	FY2016/17	FY2017/18
Program Costs						
Faculty/Shared Faculty w Fringe (see note 2.)	110,000	113,300	206,876	305,035	408,897	421,164
Lab Support Staff w Fringe			50,000	50,000	50,000	50,000
Administrative Staff w Fringe			40,000	40,000	40,000	40,000
Prerequisite GE Cost (see note 3.)			50,000	60,000	60,000	60,000
Library	25,000	25,000	25,000	30,000	30,000	30,000
Librarian (see note 4.)		15,000	30,000	30,000	30,000	30,000
Facility Renovation	100,000	100,000				
B Budget (see note 5.)	25,000	40,000	50,000	50,000	50,000	50,000
Total Expense	**260,000**	**293,300**	**451,876**	**565,035**	**668,897**	**681,164**
Revenue						
Projected Enrollment (see note 6.)			20	35	45	55
No. of Courses			10	10	10	10
No. of Credits			30	30	30	30
SSH			600	1,050	1,350	1,650
Tuition Rate/Credit			277	297	319	319
Professional Fee (per student/per year) (see note 7.)				800	800	800
Total Revenue from Tuition			166,200	323,850	450,650	554,350
Existing Support from Legislature	300,000	300,000	300,000	300,000	300,000	300,000
Total Revenue	**300,000**	**300,000**	**466,200**	**623,850**	**750,650**	**854,350**
Balance	**40,000**	**6,700**	**14,325**	**58,815**	**81,753**	**173,186**

materials and postage

Attachment 1. Undergraduate Engineering Science Program Business Plan

Budget Assumptions:

1. Inaugural Class will enroll in Fall 2014 (FY2014/15)

2. Two Engineering Faculties with proposed salary of 110K and 85K respectively are budgeted(BOR already approved two additional engieering positions for UHH, fringe will be coming out of special account, so no fringe is budgeted here. Two non-Engineering faculties (e.g. Math) with average salary with fringe 84150 per faculty are budgeted. First Engineering Faculty will be on board fall 2012 (FY2012/13) The rest of the faculties hiring schedule is as follows: second engineering faculty on board fall 2014 (FY2014/15), the first Non-Engineering faculty on board fall 2015 (FY2015/16), and the second Non-Engineering faculty on board fall 2016(FY2016/17). An annual increase rate of 3% has been included in the budget.

3. Prerequisite GE costs are calculated by filling in with lecturers, and lecturer rate is budgeted as $5000 per course.

4. A full time librarian will be hired from FY2014/15. This librarian will fill in the gap that UHH doesn't have a science librarian. This librarian will support the UHH system for its STEM initiatives.Half of the costs are recognized here, the other half will be covered by other programs.

5. $25000/year B budget for FY2012/13, $40000/year for FY2013/14 and $50000/year from FY2014/15 and on.

6. 20 students per freshman class, on average 5 students drop out the program after freshman, and another 5 students drop out the program after Sophomore.

7. A $400/semester professional fee charged to undergraduate engineering students of sophomore, junior, or senior standing only.

Attachment 2. Proposed UHH Undergraduate Engineering Science Program Curriculum

				CREDITS							
new course?	alpha	number	Title	Engr credits	GE credits	All students take in Freshamn-Sophomore sequence	All students take in Junior-Senior Sequence	Junior-Senior courses: instrumentation track only	Junior-Sernior Courses: energy track only	Prerequisites, if notable	comment
Engineering courses, Freshman-sophmore											
Y			Freshman seminar	1		1					
	CE	270	Applied Mechanics I	3		3				PHYS 170 and MATH 206	
	Phys	211	Electronics	4		4				PHYS 171 and PHYS 171L	Equivalent to Manoas EE 211 (Circuits I)
Non-Engineering courses, Freshman-sophmore											
	Eng	100	Freshman composition		3	3					
	Comm	251	Public Speaking			3					Part of Manoas fresh-soph sequence
	Ag	230	Sustainable Agriculture (WC)		3	3					GE: WC and GCC
	Econ	100 or 130	Economics (SS)		3	3					GE SS, part of Manoas fresh-soph sequence
Y			Society and Alternative Energy (SS)		3	3					GE: SS and WI
			Hum GE		3	3					
?	Kap EE 160 or CS 150 or new CS 160		Programming for engineers	?		4				MATH 104 or MATH 205	CS 150 possible uhh course; EE160 is currently offered at Kapiolani and Manoa; possibly Kapiolani will offer as distance in the future. CS 150 is 3 credits, EE 160 is 4 credits. Kap EE 160 has ICS 101 and pre-calculus as preregs. We have an engineer on our CS faculty; she could develop 4 cr engr course
	Math	205	Calculus I			4					
	Math	206	Calculus II			4					
	Math	231	Calculus III			3					
	Math	232	Calculus IV			3					
	Math	300	Ordinary diff equations			3				C in MATH 206.	
	Chem	124	General Chemistry I			3				Placement exam	
	Chem	125	General Chem II			3				at least "C" (not "C-") in CHEM 124.	
	Chem	124L	Gen Chemistry I Lab			1					
	Phys	170	Gen Phys I: Mechanics			4				MATH 205 (may take concurrently)	
	Phys	171	Gen Phys II: Elec & Magnetism			4				PHYS 170; Math 206 (concurrent OK)	
	Phys	170L	Gen Phys I Lab			1					
	Phys	171L	Gen Phys II Lab			1					
Non-Engineering courses taken by all students, Junior-Senior (12 GE, 3 math)											
			Hum GE		3		3				
			HAP GE		3		3				
			Language Arts GE		3		3				
			WC GE		3		3				
Y	Math		Intro Discrete Math / Linear Algebra				3				Prereq to control systems. A new course is needed to because engr students do not have time to take both 310 (discrete math) and 311 (linear algebra). .

Attachment 2. Proposed UHH Undergraduate Engineering Science Program Curriculum

				CREDITS							
new course?	alpha	number	Title	Engr credits	GE credits	All students take in Freshamn-Sophomore sequence	All students take in Junior-Senior Sequence	Junior-Senior courses: instrumentation track only	Junior-Sernior Courses: energy track only	Prerequisites, if notable	comment
Engineering courses taken by all students, Junior-Senior (24 credits)											
Y			Computers in engineering (incl process control and CAD)	3			3				
Y			Prob & Statistics for engineers	3			3				
	Phys	341	Thermodynamics	3			3				Bill recommends substituting UHM ME 311
Y			heat/momentum energy transfer	3			3				
Y			Power and Electrical Systems	3			3				
Y			Machinery Design & Control Systems	3			3			Linear algebra?	
Y			Senior capstone	6			6				Internship or design experience or one semester of each. Make WI both semesters
Unique to specialty, Junior-Senior											
Alternative energy											
	Math	301	Partial differential Equations						3	C in MATH 300 and MATH 231.	
	Chem	125L	Gen Chem II Lab						1		
	CE	271	Applied Mechanics II	3					3	CS 270 and Math 231.	needed by some students transferring to Manoa
Y			Fluid Mechanics	3					3		
Y			Renewable Energy Systems (solar, wind, ocean)	3					3		
Y			Geothermal I (Hydrogeology and Geochemistry)	3					3	Math 301	
Y			Geothermal II (Drilling and Operation)	3					3		
Y			Bioprocessing & Biomass Conversions	3					3		*similar to UHM BE 410*
Y			Engineering Properties Biological Mtls	3					3		
Instrumentation											
Y	Phys		Digital electronics (with lab)	4				4			
Y			Technical Instrumentation	3				3			
Y			Instrumentation Internship	3				3			
Y			Photonics & Optics (w/lab)	4				4			
Y			Machine shop and fabrication	3				3			

CREDITS

Freshman-Sophomore credits	63		8	of these are engineering credits
Junior-Senior Credits				
energy	64		45	of these are engineering credits
instrumentation	56		41	of these are engineering credits
TOTAL Credits				
energy	127		53	of these are engineering credits
instrumentation	119		49	of these are engineering credits

Attachment 2. Consultation with Affected Departments
Existing Courses

						How Often Currently Taught? *Check one*					Can your department meet additional demend?				
alpha	**number**	**Title**	**credits**	**GE?**	**Distance Ed?**	Every sem.	Once year	Once every other year	Rarely or never	**Additional demand in students/yr**	Can add this many seats without additional resources	Can add this many seats if dept gets $ for instructor	Can't do, even with $ for instructor $	**Check if adding engineering students will fill under-enrolled sections that are needed by existing students**	**Dept comment**
Ag	230	Sustainable Agriculture	3	Y						20	Y				We will need a room capable of holding 50 students for Ag 230. Norman Arancon has agreed to teach that many without an extra lecturer but needs a larger room than the 30 he currently has.
CE	**270**	**Applied Mechanics I**	**3**							**20**					**new course**
CE	**271**	**Applied Mechanics II**	**3**							**5-10**					**new course**
Chem	124	General Chemistry I	3							20	Y				We can add more to the CHM 124 1nd 125 lecture with minimal impact.
Chem	125	General Chem II	3							20	Y				
Chem	124L	Gen Chemistry I Lab	1							20		Y			The labs will be something else. We have gotten some equipment and could use some upgrading ~$10K. We will need some lecturer funding for 1.5 credits @ Step B ($1651) or B ($1929) per lab, CHEM 124L/125L.
Chem	125L	Gen Chem II Lab	1							5-10		Y			
Comm	251	Public Speaking	3							20					
CS 150		Intro Computer Sci I			?										
Econ	100 or 130	Economics	3	Y						20					
Eng	100	Freshman composition	3	Y						20					
Math	205	Calculus I	4							20		Y			Altogether Math dept will be involved in 26 credits (20 existing courses, 6 new courses) of teaching. 18 credits can be met with a Tenure-Track faculty, the rest (8 crs) can be met with additional instructor support.
Math	206	Calculus II	4							20		Y			
Math	231	Calculus III	3							20		Y			
Math	232	Calculus IV	3							20		Y			
Math	300	Ordinary diff equations	3							20		Y			
Math	301	Partial differential Equations	3							5-10		Y			
Phys	170	Gen Phys I: Mechanics	4							20	Y				
Phys	171	Gen Phys II: Elec & Magnetism	4							20	Y				
Phys	211	Electronics	4							20		Y			currently listed as PHYS 230 (3)
Phys	341	Thermodynamics	3		?					20	Y				
Phys	170L	Gen Phys I Lab	1							20	Y				
Phys	171L	Gen Phys II Lab	1							20	Y				
		Hum GE	6	Y						20					
		HAP GE	3	Y						20					
		Language Arts GE	3	Y						20					
		WC GE	3	Y						20					

Attachment 2. Consultation with Affected Departments
(New Courses)

							Does your department have instructor with expertise?		If your department has instructor with expertise, does instructor have time available?				
Title	**Possible Alpha**	**credits**	**Engr credit?**	**GE?**	**Distance Ed?**	**Demand in students/yr**	Tenure-line Faculty	Lecturer	No	Yes	Yes, but only if engineering program supplies replacement instructor	**Dept comment**	**Who takes?**
Society and Alternative Energy (GE SS)	?	3		Y		20	Yes, depending on how it is taught				Possibly but not certain on every other year basis	Cross-listing will deter	both tracks
Bioprocessing & Biomass Conversions	AltEng	3	Y			5-10	N						Alt Energy
Engineering Properties Biological Mtls	AltEng	3	Y			5-10	N						Alt Energy
Geothermal I (Hydrogeology and Geochemistry)	AltEng	3	Y			5-10	Yes for hydrogeology; affiliate faculty has geothermal expertise; would have to team teach		Partly	Partly	Could do on every other year basis	affiliate faculty (the one with real geothermal expertise) is interested, but cannot guarantee availability; teaching as condensed course would help. Offering every other year is more feasible, especially considering class size.	Alt Energy
Geothermal II (Drilling and Operation)	AltEng	3	Y			5-10	Y for affiliate faculty		No?? see comments			affiliate faculty (the one with real geothermal expertise) is interested, but cannot guarantee availability; teaching as condensed course would help. Offering every other year is more feasible, especially considering	Alt Energy
Renewable Energy Systems (solar, wind, ocean)	AltEng	3	Y			5-10	N						Alt Energy
Fluid Mechanics	CE	3	Y			5-10	N					new course, maybe UHM	Alt Energy
Computers in engineering (incl process control and CAD) upper div	CS	3	Y			20	Y				Y		both tracks
Programming for engineers	CS	4			?	20	Y				Y		both tracks
Freshman Engineering Seminar	Engr	1	Y			20							both tracks
heat/momentum energy transfer	Engr	3	Y			20	N						both tracks
Machinery Design & Control Systems	Engr	3	Y			20	N					new course, maybe UHM	both tracks
Power and Electrical Systems	Engr	3	Y			20	N					new course, maybe UHM	both tracks
Senior capstone I-II	Engr	6	Y			20							both tracks

Attachment 2. Consultation with Affected Departments
(New Courses)

							Does your department have instructor with expertise?		If your department has instructor with expertise, does instructor have time available?				
Instrumentation Internship	Instr	3	Y			5-10	N						Instrumentation
Machine shop and fabrication	Instr	3	Y			5-10	N						Instrumentation
Photonics & Optics (w/lab)	Instr	4	Y			5-10	N						Instrumentation
Technical Instrumentation	Instr	3	Y			5-10							Instrumentation
Intro Discrete Math / Linear Algebra	Math	3				20					Y	mix of 310 and 311, need the corresponding course creation/modification support	both tracks
Prob & Statistics for engineers	Math	3	Y			20					Y	need the corresponding course creation/modification support.	both tracks
Digital Electronics	Phys	4	Y			5-10	N	Y			Y	additional equipment resources needed.	Instrumentation