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Appendix I. Additional Program Information

Appendix 1.A. Tabular Data for Program

Table I-1. Basic-Level Curriculum

Table I-1.A. Basic Level Curriculum (Agricultural Engineering -Agricultural and Environmental Engineering Option)

Year, Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics *Check if Contains Significant Design (✓)*	General Education	Other
Fall, Freshman Year	Engl 104: First Year Composition I			3	
	Library 160: Library Instruction			0.5	
	Math 165: Calculus I	4			
	Chem 167: General Chemistry for Engineering Students	4			
	Chem 167L: Laboratory in General Chemistry for Engineering	1			
	Engr 101: Engineering Orientation		0		
	Engr 170: Engineering Graphics and Introductory Design		3 (✓)		
Spring, Freshman Year	Engl 105: First Year Composition II			3	
	Math 166: Calculus II	4			
	Phys 221: Introduction to Classical Physics I	5			
	Engr 160: Engineering Problems with Computer Applications Laboratory		3		
	AE 110: Experiencing Agricultural and Biological Engineering				1
Fall, Sophomore Year	AE 203: Computer Applications and Systems Modeling		3		
	Eng Mech 274: Statics of Engineering		3		

Year, Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics *Check if Contains <u>Significant</u> Design (✓)*	General Education	Other
	Math 266: Differential Equations	3			
	Phys 222: Introduction to Classical Physics II	5			
	Department-approved biological and/or natural resource course	3			
Spring, Sophomore Year	Stat 305: Engineering Statistics	3			
	Social Science / Humanities Course			3	
	AE 201: Sophomore Seminar in Agricultural Engineering				1
	AE 216: Fundamentals of Agricultural and Biological Engineering		3		
	ME 330: Thermodynamics		3		
	Eng Mech 324: Mechanics of Materials		3		
	Eng Mech 327: Mechanics of Materials Laboratory		1		
Fall, Junior Year	Engl 309: Report and Proposal Writing OR Engl 314: Technical Communication OR Sp Cm 212: Fundamentals of Public Speaking OR Ag Eds 311: Presentation and Sales Strategies for Agricultural Audiences			3	
	AE 363: Agri-Industrial Applications of Electric Power and Electronics		4		
	AE 340: Functional Analysis and Design of Agricultural Field Machinery OR AE 478: Design of Agricultural Structures		3 (✓)		
	Eng Mech 378: Mechanics of Fluids		3		

Year, Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics *Check if Contains <u>Significant</u> Design (✓)*	General Education	Other
	CE 332: Structural Analysis I		3		
Spring, Junior Year	AE 301: Junior Seminar in Agricultural Engineering				1
	AE 271: Engineering Applications of Parametric Solid Modeling OR AE 272 Parametric Solid Models, Drawings, and Assemblies using Pro/E		1		
	CE 372: Engineering Hydrology and Hydraulics		4		
	Technical Elective				4
	Department-approved biological and/or natural resource courses	3			
	Social Science / Humanities Course			3	
Fall, Senior Year	AE 401: Senior Seminar				1
	AE 415: Agricultural Engineering Design I		2 (✓)		
	AE 431: Natural Resource Conservation Engineering		3 (✓)		
	AE 404: Instrumentation for Agricultural and Biological Engineering		3 (✓)		
	Technical Elective				3
	U.S. Diversity Course			3	
Spring, Senior Year	Technical Elective				6
	AE 416: Agricultural Engineering Design II		2 (✓)		
	AE 472: Design of Environmental Modification Systems for Animal Housing		4 (✓)		
	International Perspectives Course			3	
TOTALS-ABET REQUIREMENTS		35	54(20)	21.5	17
OVERALL TOTAL	127.5				

Year, Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics *Check if Contains <u>Significant</u> Design (✓)*	General Education	Other
FOR DEGREE					
PERCENT OF TOTAL		27.4	42.3	16.9	13.3
Totals must satisfy one set	Minimum semester credit hours	32 hrs	48 hrs		
	Minimum percentage	25%	37.5 %		

Table I-1.B. Basic Level Curriculum (Agricultural Engineering –Food and Biological Systems Engineering Option)

Year; Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics *Check if Contains <u>Significant</u> Design (✓)*	General Education	Other
Fall, Freshman Year	Engl 104: First Year Composition I			3	
	Library 160: Library Instruction			0.5	
	Math 165: Calculus I	4			
	Chem 167: General Chemistry for Engineering Students	4			
	Chem 167L: Laboratory in General Chemistry for Engineering	1			
	Engr 101: Engineering Orientation		0		
	Engr 170: Engineering Graphics and Introductory Design		3 (✓)		
Spring, Freshman Year	Engl 105: First Year Composition II			3	
	Math 166: Calculus II	4			
	Phys 221: Introduction to Classical Physics I	5			
	Engr 160: Engineering Problems with Computer Applications Laboratory		3		

Year; Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics *Check if Contains <u>Significant</u> Design (✓)*	General Education	Other
	AE 110: Experiencing Agricultural and Biological Engineering				1
Fall, Sophomore Year	AE 203: Computer Applications and Systems Modeling		3		
	Eng Mech 274: Statics of Engineering		3		
	Stat 305: Engineering Statistics	3			
	Biol 211: Principles of Biology I	3			
	Biological Elective	4			
Spring, Sophomore Year	Social Science / Humanities Course			3	
	AE 201: Sophomore Seminar in Agricultural Engineering				1
	AE 216: Fundamentals of Agricultural and Biological Engineering		3		
	Math 266: Differential Equations	3			
	Eng Mech 324: Mechanics of Materials		3		
	Eng Mech 327: Mechanics of Materials Laboratory		1		
	Biol 212: Principles of Biology II	3			
Fall, Junior Year	AE 363: Agri-Industrial Applications of Electric Power and Electronics		4		
	ME 330: Thermodynamics OR ChE 381: Chemical Engineering Thermodynamics		3		
	Chem 331: Organic Chemisry	3			
	Chem 331L: Laboratory in Organic Chemisry	1			

Year; Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics *Check if Contains <u>Significant</u> Design (✓)*	General Education	Other
	Biological Elective	3			
	Engl 309: Report and Proposal Writing OR Engl 314: Technical Communication OR Sp Cm 212: Fundamentals of Public Speaking OR Ag Eds 311: Presentation and Sales Strategies for Agricultural Audiences			3	
Spring, Junior Year	AE 301: Junior Seminar in Agricultural Engineering				1
	ChE 356: Transport Phenomena I OR EM 378: Mechanics of Fluids		3		
	Technical Elective		3		
	Chem 332: Organic Chemistry	3			
	Chem 332L: Laboratory in Organic Chemistry	1			
	Social Science / Humanities Course			3	
	Biological Elective	3			
Fall, Senior Year	AE 401: Senior Seminar				1
	AE 404: Instrumentation for Agricultural and Biological Engineering		3 (✓)		
	AE 415: Agricultural Engineering Design I		2 (✓)		
	ChE 357: Transport Phenomena II OR ME 436: Heat Transfer		3 OR 4		
	Micro 302: Biology of Microorganisms	3			
	Technical Elective		3 OR 2		
Spri	U.S. Diversity Course			3	

Year; Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics *Check if Contains <u>Significant</u> Design (✓)*	General Education	Other
	AE 416: Agricultural Engineering Design II		2 (✓)		
	International Perspectives Course			3	
	AE 480: Engineering Quantification of Biological Processes		3		
	Technical Elective				4
TOTALS-ABET REQUIREMENTS		51	48 (10)	21.5	8
OVERALL TOTAL FOR DEGREE	128.5				
PERCENT OF TOTAL		39.7	37.4	16.7	6.2
Totals must satisfy one set	Minimum semester credit hours	32 hrs	48 hrs		
	Minimum percentage	25%	37.5 %		

Table I-1.C. Basic Level Curriculum (Agricultural Engineering –Power and Machinery Engineering Option)

Year; Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics *Check if Contains <u>Significant</u> Design (✓)*	General Education	Other
Fall, Freshman Year	Engl 104: First Year Composition I			3	
	Library 160: Library Instruction			0.5	
	Math 165: Calculus I	4			
	Chem 167: General Chemistry for Engineering Students	4			
	Chem 167L: Laboratory in General Chemistry for Engineering	1			
	Engr 101: Engineering Orientation		0		

Year; Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics *Check if Contains <u>Significant</u> Design (✓)*	General Education	Other
	Engr 170: Engineering Graphics and Introductory Design		3 (✓)		
Spring, Freshman Year	Engl 105: First Year Composition II			3	
	Math 166: Calculus II	4			
	Phys 221: Introduction to Classical Physics I	5			
	Engr 160: Engineering Problems with Computer Applications Laboratory		3		
	AE 110: Experiencing Agricultural and Biological Engineering				1
Fall, Sophomore Year	AE 203: Computer Applications and Systems Modeling		3		
	Eng Mech 274: Statics of Engineering		3		
	Mat E 272: Principles of Materials Science and Engineering		3		
	Phys 222: Introduction to Classical Physics II	5			
	Agron 154: Fundamentals of Soil Science	3			
Spring, Sophomore Year	Stat 305: Engineering Statistics	3			
	Social Science / Humanities Course			3	
	AE 201: Sophomore Seminar in Agricultural Engineering				1
	AE 216: Fundamentals of Agricultural and Biological Engineering		3		
	Math 266: Differential Equations	3			
	Eng Mech 324: Mechanics of Materials		3		

Year; Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics *Check if Contains <u>Significant</u> Design (✓)*	General Education	Other
	Eng Mech 327: Mechanics of Materials Laboratory		1		
Fall, Junior Year	AE 271: Engineering Applications of Parametric Solid Modeling OR AE 272 Parametric Solid Models, Drawings, and Assemblies using Pro/E		1		
	AE 340: Functional Analysis and Design of Agricultural Field Machinery OR AE 478: Design of Agricultural Structures		3 (✓)		
	AE 363: Agri-Industrial Applications of Electric Power and Electronics		4		
	EM 345: Dynamics		3		
	ME 330: Thermodynamics		3		
	Engl 309: Report and Proposal Writing OR Engl 314: Technical Communication OR Sp Cm 212: Fundamentals of Public Speaking OR Ag Eds 311: Presentation and Sales Strategies for Agricultural Audiences			3	
Spring, Junior Year	AE 301: Junior Seminar in Agricultural Engineering				1
	AE 342: Agricultural Tractor Power		3		
	ME 324: Manufacturing Engineering		3		
	EM 378: Mechanics of Fluids		3		
	Social Science / Humanities Course			3	

Year; Semester	Course (Department, Number, Title)	Category (Credit Hours)			
		Math & Basic Science	Engineering Topics *Check if Contains <u>Significant</u> Design (✓)*	General Education	Other
	Department-approved biological and/or natural resource course	3			
Fall, Senior Year	AE 401: Senior Seminar				1
	AE 404: Instrumentation for Agricultural and Biological Engineering		3 (✓)		
	AE 415: Agricultural Engineering Design I		2 (✓)		
	AE 413: Fluid Power Engineering		3		
	ME 325: Machine Design		3 (✓)		
	U.S. Diversity Course			3	
Spring, Senior Year	Technical Elective		3		6
	AE 416: Agricultural Engineering Design II		2 (✓)		
	International Perspectives Course			3	
TOTALS-ABET REQUIREMENTS		35	61 (16)	21.5	10
OVERALL TOTAL FOR DEGREE	127.5				
PERCENT OF TOTAL		27.5	47.8	16.9	7.8
Totals must satisfy one set	Minimum semester credit hours	32 hrs	48 hrs		
	Minimum percentage	25%	37.5 %		

Table I-2. Course and Section Size Summary for AE Program.

Course No.	Title	No. of Sections offered in Current Year	Avg. Section Enrollment	Type of Class[1]			
				Lecture	Laboratory	Recitation	Other
AE 110	Experiencing Agricultural and Biosystems Engineering	2	20		2		
AE 201	Sophomore Seminar in Agricultural Engineering	1	31	1			
AE 203	Computer Applications and Systems Modeling	2	21	2	2		
AE 216	Fundamentals of Agricultural and Biosystems Engineering	1	35	2	2		
AE 271	Engineering Applications of Parametric Solid Modeling	2	25	1	2		
AE 272	Parametric Solid Models, Drawings, and Assemblies Using Pro/ENGINEER	2	26	1	2		
AE 301	Junior Seminar in Agricultural Engineering	1	4	1			
AE 342	Agricultural Tractor Power	2	21	2	3		
AE 363	Agri-Industrial Applications of Electric Power and Electronics	2	14	3	2		
AE 401	Senior Seminar	1	28	1			
AE 403/503[2]	Modeling and Controls for Agricultural Systems	Not taught		3			
AE 404/504[2]	Instrumentation for Agricultural and Biosystems Engineering	2	14	2	2		
AE 406X/506X[2]	Applied Computational Intelligence	1	0				

Course No.	Title	No. of Sections offered in Current Year	Avg. Section Enrollment	Type of Class[1]			
				Lecture	Laboratory	Recitation	Other
AE 408/508[2]	GIS and Natural Resources Management	1	7	2	2		
AE 413	Fluid Power Engineering	3	14	2	2		
AE 415	Agricultural Engineering Design I	2	15	1	2		
AE 416	Agricultural Engineering Design II	2	13	1	2		
AE 431	Natural Resource Conservation Engineering	1	10	2	3		
AE 451/551[2]	Food Process Engineering	Not taught		2	3		
AE 465/565[2]	Physical Properties of Biological Materials	Not taught		2	2		
AE 469/569[2]	Grain Processing and Handling	1	10	2	3		
AE 472/572[2]	Design of Environmental Modification Systems for Animal Housing	1	9	3			
AE 473/573[2]	Microbial Systems Engineering	Not taught, taught F04		3			
AE 478/578[2]	Design of Agricultural Structures	Not taught, taught S05		3			
AE 480	Engineering Quantification of Biological Processes	1	10	2	2		

[1] Hours
[2] Reported enrollment is for 400-level only

Table I-3. Faculty Workload Summary

Faculty Member	FT or PT	Classes Taught (course no/credit hrs) Term and Year	Total Activity Distribution		
			Teaching	Research	Other
Anex, Robert	FT		25%	75%	Sab-batical Leave
Bern, Carl	FT	F05 – AE 363, 3 credits	60%	40%	
		F05 – AST 360, 3 credits			
		S06 – AE 469/569, 3 credits			
		S06 – AST 460, 2 credits			
Birrell, Stuart	FT	F05 – AST 335, 4 credits	50%	50%	
		F05 – AE 340, 3 credits			
		S06 – AE 342, 3 credits			
		S06 – AST 330, 3 credits			
Brumm, Thomas	FT	F05 -AE 694, 2 credits	75%	25%	
		F05 - AST 110, 1 credit			
		F05 - AST 210, 3 credits			
		F05 - AST 397, R credit			
		F05 - AST 399, 2 credits			
		F05 -AST 403, 1 credit			
		S06 -AE 694, 2 credits			
		S06 – AST 203, 1 credit			
		S06 – AST 303, 1 credit			
		S06 – AST 362, 3 credits			
		S06 – AST 397, R credit			
		S06 – AST 399, 2 credit			
Chen, Joseph	FT	F05 - ITec 410, 3 credits	50%	50%	
		F05 – ITec 435, 3 credits			
		S06 – ITec 435, 3 credits			
		S06 – ITec 502, 3 credits			
Freeman, Steven	FT	F05 - ITec 575, 2 credits	25%	25%	50%
		S06 – AE 201, 1 credit			
		S06 – AE 301, 1 credit			
		S06 – AE 598, 1 credit			
Glanville, Thomas	FT	F05 – AST 425, 2 credits	25%	50%	25%
Grewell, David	FT	F05 – ITec 130, 3 credits	50%	50%	
		F05 – ITec 231, 3 credits			
		S06 – ITec 231, 3 credits			

Faculty Member	FT or PT	Classes Taught (course no/credit hrs) Term and Year	Total Activity Distribution		
			Teaching	Research	Other
Harmon, Jay	FT	F05 – AE 415, 2 credits	25%	25%	50%
		F05 – AE 416, 2 credits			
		S06 – AE 415, 2 credits			
		S06 – AE 416, 2 credits			
Helmers, Matthew	FT			50%	50%
Hoff, Steven	FT	F05 – AE 363, 1 credit	50%	50%	
		F05 – AE 404/504, 3 credits			
		S06 – AE 216, 3 credits			
		S06 – AE 472/572, 3 credits			
Hurburgh, Charles	FT		13%	71%	17%
Kaleita, Amy	FT	F05 – AE 203, 1 credit	50%	50%	
		F05 – AE 431/531, 3 credits			
		S06 – AST 324, 3 credits			
Kanwar, Rameshwar	FT	F05 – AE 661, 1 credits	10%	20%	70%
		S06 – AST 372X, 1 credit			
Keren, Nir	FT	F05 – Itec 296, 3 credits	50%	50%	
		S06 – Itec 472X, 4 credits			
Koziel, Jacek	FT	F05 – AST 373, 3 credits	50%	50%	
		F05 – AST 115, 3 credits			
		S06 – AST 475, 3 credits			
		S06 – CE 524, 2 credits			
Mickelson, Steven	FT	F05 – Engr 101, R credit	40%	20%	40%
		F05 – Engr 170, 4 credits			
		F05 – AE 397, R credit			
		F05 – AE 401, 1 credit			
		S06 – AE 110, 1 credit			
		S06 – AE 110, 1 credit			
		S06 – AE 397, R credit			
		S06 – Engr 170, 1 credit			
Raman, Raj	FT	S06 - AE 480/580, 3 credits	50%	50%	
Schwab, Charles	FT	F05 – AST 435, 3 credits	25%	25%	50%
		S06 – AST 497, 3 credits			

Faculty Member	FT or PT	Classes Taught (course no/credit hrs) Term and Year	Total Activity Distribution		
			Teaching	Research	Other
Shahan, James	FT	F05 – AE 271, 1 credit	100%		
		F05 – AE 272, 1 credit			
		F05 – Engr 170, 1 credit			
		F05 – Engr 170, 2 credit			
		F05 – Engr 170, 2 credit			
		F05 – I Tec 224, 3 credits			
		F05 – I Tec 224, 3 credits			
		S06 – AE 271, 1 credit			
		S06 – AE 272, 1 credit			
		S06 – Engr 170, 2 credits			
		S06 – I Tec 224, 3 credits			
		S06 – I Tec 224, 3 credits			
Smith, Shana	FT	F05 - I Tec 120, 3 credits	50%	50%	
		F 05 - I Tec 525, 3 credits			
		S06 – I Tec 120, 3 credits			
		S06 – Engr 170, 3 credits			
Steward, Brian	FT	F05- AE 388X, 1 credit	50%	50%	
		F05 – AE 506, 1 credit			
		F05 – AE 413, 3 credits			
		S06 – AST 337, 3 credits			
Tang, Lie	FT	F05 – AE 203, 3 credits	50%	50%	
		F05 – AE 506, 2 credits			
		S06 – I Tec 446, 3 credits			
Tim, U. Sunday	FT	F05 – AE 408/508, 3 credits	50%	50%	
		F05 – AST 333, 3 credits			
		S06 – AST 433, 3 credits			
Xin, Hongwei	FT			70%	30%

Table I-4. Faculty Analysis

Name	Rank	FT or PT (%)	Highest Degree	Institution from which Highest Degree Earned & Year	Years of Experience			Professional Registration (Indicate state)	Level of Activity (high, med. low, none)		
					Govt./ Industry Practice	Total Faculty	This Institution		Professional Society	Research	Consulting/ Summer Work in Industry
Anex, Robert	Associate	FT	Ph.D.	UC-Davis, 95	9	10	3		ISIE-M AICHE-M	H	M
Bern, Carl	Full	FT	Ph.D.	ISU, 73	0	35	32	IA	ASABE H ASEE-L CAST-L	M	L
Birrell, Stuart	Associate	FT	Ph.D.	U of Ill, 95	.5	3	2		ASABE-M ASEE-L CAST-L	H	N
Brown, Robert	Full	C*	Ph.D.	Michigan State U., 80	3	22	22		ASME-H AICHE-H	H	L
Brumm, Thomas	Associate	FT	Ph.D.	Iowa State University, 90	10	6	6		ASABE-H ASEE-H	M	M
Burns, Robert	Associate	FT	Ph.D.	Univ. of Tennessee, 95	1	11	1	TN	ASEE-L ASABE-H AWMA-L	H	M
Chen, Joseph	Full	FT	Ph.D.	Auburn Univ., 94	8	11	11	IA	NAIT-M	L	N
Freeman, Steve	Associate	FT	Ph.D.	Purdue, 93		7	3		NAIT-M ASABE-L ASSE-M IFSC-L NIFS-M		L
Glanville, Thomas	Full	FT	Ph.D.	ISU, 87	3	22	22		ASABE-L	M	L

Name	Rank	FT or PT (%)	Highest Degree	Institution from which Highest Degree Earned & Year	Years of Experience			Professional Registration (Indicate state)	Level of Activity (high, med. low, none)		
					Govt./ Industry Practice	Total Faculty	This Institution		Professional Society	Research	Consulting/ Summer Work in Industry
Grewell, David	Assistant	FT	Ph.D.	The Ohio St. Univ., 89	13	1	1		SPE-H	M	N
Han, Shufneg	Associate	C*	Ph.D.	Univ. of Illinois, 92	6	2	1	WA	ASABE-H SAE-L	M	H
Harmon, Jay	Full	FT	Ph.D.	VPI & SU, 89	0	11	7	SC	ASABE-M PEI-L NFBA-L	M	M
Helmers, Matthew	Assistant	FT	Ph.D.	U of Nebraska –Lincoln, 03	2	2	2		ASABE-M SWCS-L ASCE-L AWRA-L	M	L
Hoff, Steven	Full	FT	Ph.D.	Minn, 90	0	10	10	IA	ASABE– M AWMA-L	H	M
Hurburgh, Charles	Full	FT	Ph.D.	ISU, 81	3	22	22		AACC- L ASABE– L IAS-L GEAPS-L AOCS-L SAS-L IRDC-L CNIRS-L	M	L
Johnson, Lawrence	Full	C*	Ph.D.	Kansas St., 78	4	27	20		AOCS-H AACC-H IFT-L ASABE-L	H	M

Name	Rank	FT or PT (%)	Highest Degree	Institution from which Highest Degree Earned & Year	Years of Experience			Professional Registration (Indicate state)	Level of Activity (high, med. low, none)		
					Govt./ Industry Practice	Total Faculty	This Institution		Professional Society	Research	Consulting/ Summer Work in Industry
Kaleita, Amy	Assistant	FT	Ph.D.	Univ. of Illinios, 03	0	2	2		ASABE-M ASEE-L IAHS-L	M	N
Kanwar, Rameshwar	Full	FT	Ph.D.	ISU, 81	0.5	25	24		ASAE – H AWRA-L IAHS-L	H	H
Keren, Nir	Assistant	FT	Ph.D.	Texas A&M, 03	10	1	1		NAIT-L ASSE-L AIChE-M	M	N
Koziel, Yacek	Assistant	FT	Ph.D.	Univ. of Texas – Austin, 98	0	5	1		ASABE-L ACS-M AWMA-M ASEE-L	H	N
Mickelson, Steven	Associate.	FT	Ph.D.	ISU, 91	1	23	23		ASABE - H ASEE-H	M	L
Misra, Manjit	Full	FT	Ph.D.	Univ. of Missouri, 78	0	21	21		ASABE - M	H	M
Powers, Wendy	Associate	C*	Ph.D.	Univ. of Florida, 97		3	3		ASABE-M ASAS-L ADSA-M CAST-L	H	N
Raman, Raj	Associate	FT	Ph.D.	Cornell Univ.	0	12	0.5		ASABE-M IBE-L	M	N

Name	Rank	FT or PT (%)	Highest Degree	Institution from which Highest Degree Earned & Year	Years of Experience			Professional Registration (Indicate state)	Level of Activity (high, med. low, none)		
					Govt./ Industry Practice	Total Faculty	This Institution		Professional Society	Research	Consulting/ Summer Work in Industry
Schwab, Charles	Full	FT	Ph.D.	Univ. of Kentucky, 89	11	10	10		ASABE-L ASEE-L ASSE-L NAIT-L IFSC-L NCS-L NIFS-H	M	N
Shahan, James	Assistant	FT	M.S.	ISU, 85	4	15	15	IA	ASEE – M	N	L
Smith, Shana	Associate	FT	Ph.D.	ISU, 97	2	9	4		ASEE-M NAIT-M SME-L IIE-L ASME-M	H	N
Steward, Brian	Associate	FT	Ph.D.	Univ. of Illinois, 99	5	1	1		ASABE– M ASEE-L	M	N
Tang, Lie	Assistant	FT	Ph.D.	Univ. of Illinois, 02	0	4	2		ASABE - M	M	N
Tim, U. Sunday	Associate	FT	Ph.D.	Concordia, (CAN), 87	3	16	10		AWRA – M	L	L
Van Leeuwen, Hans*	Full	C*	Ph.D	Univ. of Pretoria	9	24	6		IOA-H OSE-H	M	H

Name	Rank	FT or PT (%)	Highest Degree	Institution from which Highest Degree Earned & Year	Years of Experience			Professional Registration (Indicate state)	Level of Activity (high, med. low, none)		
					Govt./ Industry Practice	Total Faculty	This Institution		Professional Society	Research	Consulting/ Summer Work in Industry
Xin, Hongwei	Full	FT	Ph.D.	U of Neb., 89	0	7	7		ASABE – H ASHRAE-L PSA-L	H	L

*Collaborator

Table I-5. Support Expenditures

Expenditure Category	Expenditures ($)			
	2004 (prior to previous year)	**2005 (previous year)**	**2006* (current year)**	**2007 (year of visit)**
Operations[1] (not including staff)	306,715	455,107	562,442	562,442
Travel[2]	90,885	119,528	115,834	115,834
Equipment[3]	69,769	232,282	400,299	400,299
Institutional Funds	43,492	136,022	56,990	56,990
Grants and Gifts[4]	26,277	96,260	343,309	343,309
Graduate Teaching Assistants	25,661	121,985	68,916	68,916
Part-time Assistance[5] (other than teaching)	299,524	265,049	325,182	325,182

*The current fiscal year reflects actual expenditures through January 2006 and estimated expenditures through the remaining fiscal-year end.

Appendix 1.B. Course Syllabi

AE 110. Experiencing Agricultural and Biosystems Engineering.
Required - all options

2005-2007 Catalog Description:

Experiencing Agricultural and Biosystems Engineering. (0-2) Cr. 1. S. Laboratory-based, team-oriented experiences in a spectrum of topics common to the practice of agricultural and biosystems engineering. Report writing, co-ops, internships, careers, registration planning.

Prerequisite(s): None

Textbook(s) and/or other required material: No textbook is required for this course. Individual laboratory instructors provide the necessary handouts and materials.

Course objectives:
Build community for freshman within Agricultural Engineering
Increase student involvement within the Department of ABE
Increase involvement in professional society and student branch
Increase student interaction with upperclassmen
Increase student retention in the AE program

Specific Course Objectives:

After completing this course students should be able to:

1. Choose an option within the agricultural engineering curriculum.
2. Register for classes for the next semester appropriate for their chosen option.
3. Carry out and report on experiments related to each option within the agricultural engineering curriculum.
4. Create a professional resume.
5. Pursue and conduct a search for summer, internship, or cooperative education work.
6. Understand the role of an agricultural engineering in society.
7. Communicate with upperclassman and faculty.

Topics covered:

1. Team building (1 labs)
2. Groundwater flow (1 lab)
3. Electric Motor Testing (1 lab)
4. Career development/job opportunities (1 lab)
5. Tractor engines (1 lab)
6. Introduction to tractors and machinery (1 lab)
7. Seed quality (1 lab)
8. Biodiesel (1 lab)
9. Environmental control/instrumentation for livestock and poultry (1 lab)
10. Biofeedback/controls (1 lab)

11. Environmental systems – ventilation fan controllers (1 lab)
12. Registration guidance (1 lab)
13. Industry visit (2 labs)

Class/laboratory schedule, i.e. number of sessions each week and duration of each session: The course meets for a two-hour laboratory period once a week.
T or R 10-12 AM, Room 124 I Ed II

Contribution of course to meeting the professional component:

General Education

Relationship of course to program outcomes:

This course addresses the following outcomes: a, b, d, g, j, k, l, and m

Person(s) who prepared this description and date preparation: Steven K. Mickelson, Associate Professor, of Agricultural and Biosystems Engineering, 6/1/06

AE 201 Sophomore Seminar
Required - all options

2005-2007 Catalog Description:

Sophomore Seminar. (1-0) Cr. 1. F. Prereq: Sophomore classification in A E. Ethics, competencies, portfolios, professionalism, career development.

Prerequisite(s): Sophomore classification in A E

Textbook(s) and/or other required material: No textbook is required for this course. Individual laboratory instructors provide the necessary handouts and materials.

Purpose: The purpose of this course is to help in your development to become a practicing professional.

Course objectives:
Upon the completion of this course, you should have enhanced your:
- understanding of professional and ethical responsibility
- recognition of the need for, and ability to engage in life-long learning
- ability to communicate effectively through the development of student electronic portfolios for the demonstration of workplace competencies.
- ability to create, plan and conduct your professional career

Topics covered:
Introduction / Internships
Behavioral-based interviewing
Outcomes, competencies and accreditation
Developing a career management plan
ePortfolios
Conflict resolution
Ethical decision making models
Ethics case studies
Developing a life-long learning plan
Developing a cultural adaptability plan

Student Performance Assessment:
Attendance: 25%
Assignments: 50%
Portfolio: 25%

Class/laboratory schedule, i.e. number of sessions each week and duration of each session:
The course meets for a one hour period once a week.
Wednesday 4:10-5:00pm – 101 I Ed II

Contribution of course to meeting the professional component: General Education

Relationship of course to program outcomes: This course addresses the following outcomes: c, f, g, and i

Person(s) who prepared this description and date preparation: Steve Freeman, Associate Professor, of Agricultural and Biosystems Engineering, 6/9/06

AE 203. Computer Applications and Systems Modeling
Required – All Options

2005-2007 Catalog Description:

A E 203. Computer Applications and Systems Modeling. (2-2) Cr. 3. F. *Prereq:* Engr 160, Math 166. Computer aided solution of agricultural engineering problems by use of numerical techniques and mathematical models. Systems analysis and optimization applicable to agricultural and biological systems.

Prerequisite(s):
Engr 160 (Engineering Problems with Computer Applications Laboratory)
Math 166 (Calculus II)

Textbook:
Numberical Methods for Engineers, 5th edition. S.C. Chapra & R. P. Canale

Coordinator: Lie Tang, Assistant Professor of Agricultural and Biosystems Engineering

Class/Laboratory Schedule:
Two 1-hour lectures and one 2-hour laboratory per week.

General Course Objectives:
1. To help student understand how to formulate problem statements in a way that facilitates computer solutions;
2. To help students improve skills in applying numerical methods in engineering problem solving;
3. To help students understand the uses and limitation of available software for numerical solutions to engineering problems.

Specific Course Outcomes:

After completing this course, the student should be able to:
1. Understand the fundamental principles of numerical analysis.
2. Apply numerical methods to solve engineering problems.
3. Mathematically formulate engineering problems in a way that facilitates computer solution.
4. Program the numerical algorithms by using high level computer languages.

Topics:
1. Engineering economics.
2. Visual Basic for Applications.
3. Roots for non-linear algebraic functions.
4. Linear algebra and Gaussian Elimination.
5. Regression and interpolation.
6. Integration and differentiation.
7. Differential equations.

8. Constrained optimization.

Student Performance Assessment
Homework and quizzes, 15%; labs, 25%; lab exam, 10%; two 1-hour exams, 30%; one 2-hours final exam, 20%.

Relationship of course to program outcomes: This course addresses the following outcomes: a, b, e, g, j, k, l, m, and n

Contribution to Professional Component (Criterion 4):

Engineering Topics: This course equips students with fundamental knowledge and skills of applying numerical methods to solve engineering problem.

Prepared by:
Lie Tang , 6/15/06

AE 216. Fundamentals of Agricultural and Biosystems Engineering II
Required – All Options

2005-2007 Catalog Description:
Fundamentals of Agricultural and Biosystems Engineering. (2-2) Cr. 3. S. Prereq: 110, Engr 160, credit or enrollment in Math 166. Application of mathematics and engineering sciences to energy and mass balances in agricultural and biological systems. Emphasis is on solving engineering problems in the areas of air and water vapor systems; electrical systems, grain systems; food systems, hydrologic systems, and bioprocessing.

Prerequisites:
AE 110 (Seminar)
Engr 160 (Engineering Problems w/Computation Laboratories)
Math 166 (Calculus II)

Textbook:
Manual developed using department faculty.
Selected chapters from: Managing Grain After Harvest (C.J. Bern and C.R. Hurburgh, 1999)
Fundamentals of Food Process Engineering (Toledo, 1999)
Bioprocess Engineering Principles (Doran, 1995)

Coordinator: Steven J. Hoff, Associate Professor of Agricultural and Biosystems Engineering

Class/Laboratory Schedule:
Class meets for two 1-hour lectures and one 2-hour lab oratory per week

General Course Objectives:
1. To help students understand various systems of units and the conversion to and from each.
2. To help students understand the concepts of potential, flow, and resistance and the similarities between analogous systems.
3. To help students recognize and develop control volumes for conducting mass and energy balances.
4. To help students recognize differences between conduction, convection, radiation, and evaporation heat transfer.
5. To help students understand dry air-water vapor mixtures.
6. To help students develop governing relations for determining both sensible and latent heat transfers.
8. To help students apply fundamental energy and mass balance equations to animal environment, grain drying, food processing, and biological systems.

Specific Course Outcomes:

After completing this course, the student should be able to:
1. Determine the potential forces and resistances for electrical, thermal, and fluid flow applications.
2. Calculate mixed-mode heat transfer rates in ventilation and food processing applications.
3. Calculate all psychrometric properties and be able to set-up and solve common moist air processes.
4. Perform an energy and mass balance on applied problems in animal housing, grain drying, food processing, and biosystems.

Topics:
1. Dimensions and units
2. Analogous systems
3. Developing control volumes
4. Component mass balances
5. Component energy balances
6. Mass and energy balance of the earth/sun system
7. Mass and energy balances applied to animal systems
8. Mass and energy balances applied to grain drying/food processing systems
9. Mass and energy balances applied to biological systems

Student Performance Assessment
Two 1-hour exams, 50%; homework/labs, 20%; final 2-hour exam, 30%

Relationship of course to program outcomes: This course addresses the following outcomes: a, b, c, d, e, g, h, k, l, m, and n

Contribution to Professional Component (Criterion 4):
Engineering Topic: Students in this course will utilize fundamental mass and energy balances to solve problems in thermal sciences. This experience, combined with two team design projects, will help prepare students for their senior design experience.

Prepared by:
Steven J. Hoff, June 1, 2006

AE 271 – Engineering Applications of Parametric Solid Modeling
Elective – All options

2005 - 2007Catalog Description:
AE 271. **Engineering Applications of Parametric Solid Modeling**. (1-2) Cr. 1. 8 weeks. F.S. Prereq: Engr 170 or AST 215 or equivalent. Creating, editing, and documenting part and assembly models using Autodesk Inventor or Solidworks.

Prerequisites:
ENGR 170 (Engineering Graphics and Introductory Design)
Or
AST 215 (Computer-aided Graphics Applications)

Textbook:
Planchard, David C. 2005. Engineering Design with SolidWorks 2005.

Coordinator: James C. Shahan, Adj. Asst. Professor of Agricultural and Biosystems Engineering

Class/Laboratory Schedule:

The course meets for one one-hour lecture / demonstration period, and one two-hour laboratory per week.

General Course Objectives:

1. To help students gain / expand knowledge of the features and capabilities of current CAD software.
2. To help students gain the ability to apply parametric solid modeling software to engineering practice.
3. To help students improve their ability to utilize the software for the communication of design ideas and engineering problem solving.

Specific Course Outcomes:

After completing this course, the student should be able to:

1. Apply concepts learned from studying the tutorial / text based problems to larger, more complicated projects.
2. Use the software to analyze the geometric properties of objects.
3. Create and visualize geometric models of parts and assemblies of parts.
4. Completely document the computer models with engineering drawings.
5. Understand how the software is utilized as part of the engineering design process.

Topics:

1. Fundamentals of 3D Modeling (1 week)
2. Fundamentals of Assembly Modeling (1.5 week)
3. Fundamentals of Drawing (1 week)
4. Extrude and Revolve Features (1.5 week)
5. Sweep and Loft Features (1 week)
6. Top Down Assembly Modeling (1 week)

Student Performance Assessment

Exams (40%), Portfolio (30%), Assignments (15%), Progress Reports (15%).

Relationship of course to program outcomes: This course addresses the following outcomes: a, c, g, k

Contribution to Professional Component (Criterion 4):

General Education: This course complements the engineering science and engineering design material taught in the other courses. It is all about the computer modeling and documentation of the designs and the design process.

Prepared by:

James C. Shahan March 22, 2006

AE 272 – Parametric Sold Models, Drawings, and Assemblies Using Pro/ENGINEER
Elective – all options

2005-2007 Catalog Description:

AE 272. Parametric Solid Models, Drawings, and Assemblies Using Pro/ENGINEER.
(1-2) Cr. 1. 8 weeks. F.S. Prereq: Engr 170 or AST 215 or equivalent. Application of the Pro/ENGINEER software to create 3D solid models of parts and assemblies. Utilizing the solid models to create design documentation: standard drawing views, dimensions, and notes.

Prerequisite(s):
Engr. 170 (Engineering Graphics and Introductory Design)
Or
AST 215 (Computer-aided Graphics Applications)

Textbook:
Roger, Toogood, SDC Publications. "Pro/ENGINEER Wildfire 2.0 Tutorial and MultiMedia CD

Coordinator: James C. Shahan, Adj. Asst. Professor of Agricultural and Biosystems Engineering

Class/Laboratory Schedule:

The course meets for one one-hour lecture / demonstration period, and one two-hour laboratory per week.

General Course Objectives:

4. To gain / expand knowledge of Pro/ENGINEER's features and capabilities.
5. An ability to apply Pro/ENGINEER to engineering practice.
6. An ability to utilize the software for the communication of design ideas and engineering problem solving.

Specific Course Outcomes:

After completing this course, the student should be able to:

6. Apply concepts learned from studying tutorial / text based problems to larger more complicated projects.
7. Use Pro/ENGINEER to analyze the geometric properties of objects.
8. Create and Visualize geometric models of parts and assemblies of parts.
9. Completely document the computer models with engineering drawings.
10. Understand how the software is utilized as part of the engineering design process.

Topics:

7. User Interface, View Controls, Model Structure, Creating a Simple Object (1 week).
8. Revolved Protrusions, Mirror Copies, Rounds, Chamfers, Modeling Utilities (1 week)
9. Datum Planes, Sketcher Tools, Patterns, Copies (1 week)
10. Engineering Drawings, Assembly Fundamentals (1 week)
11. Assembly Operations, Sweeps and Blends (1 week)
12. Reverse Engineering Project (2 weeks)
13. Finish Course: Portfolio, Project, Exams (2 weeks)

Student Performance Assessment

Exams (40%), Portfolio (30%) Assignments (15%), Progress Reports (15%).

Relationship of course to program outcomes: This course addresses the following outcomes: a, c, g, and k

Contribution to Professional Component (Criterion 4):

General Education: This course complements the engineering science and engineering design material taught in the other courses. It is all about the computer modeling and documentation of the designs and the design process.

Prepared by:

James C. Shahan March 22, 2006

AE 301 Junior Seminar
Required – all option

2005-2007 Catalog Description:

A E 301. Junior Seminar. (1-0) Cr. 1. F. Prereq: Junior classification in A E. Ethics, competencies, portfolios, professionalism, career development.

Prerequisite(s): Junior classification in A E

Textbook(s) and/or other required material: No textbook is required for this course. Individual laboratory instructors provide the necessary handouts and materials.

Course objectives:
Upon the completion of this course, you should have enhanced your:
- understanding of professional and ethical responsibility
- recognition of the need for, and ability to engage in life-long learning
- ability to communicate effectively through the development of student electronic portfolios for the demonstration of workplace competencies.
- ability to create, plan and conduct your professional career

Topics covered:
Internships
Behavioral-based interviewing
Outcomes, competencies and accreditation
Developing a career management plan
ePortfolios
Conflict resolution
Ethical decision making models
Ethics case studies
Developing a life-long learning plan
Developing a cultural adaptability plan

Student Performance Assessment:
Attendance: 25%
Assignments: 50%
Portfolio: 25%

Class/laboratory schedule, i.e. number of sessions each week and duration of each session:
The course meets for a one hour period once a week.
Thursday 4:10-5:00p – 101 I Ed II

Contribution of course to meeting the professional component: General Education

Relationship of course to program outcomes: This course addresses the following outcomes: c, f, g, and i

Person(s) who prepared this description and date preparation: Steve Freeman, Associate Professor, of Agricultural and Biosystems Engineering, 6/9/06

AE 342 – Agricultural Tractor Power
Required – Power and Machinery Engineering Option

2005 - 2007 Catalog Description:

A E 342. Agricultural Tractor Power. (2-3) Cr. 3. S. *Prereq:* M E 330. Thermodynamic principles and construction of tractor engines. Fuels, combustion, and lubrication. Kinematics and dynamics of tractor power applications; drawbar, power take-off and traction mechanisms. Nonmajor graduate credit.

Prerequisite(s):
ME 330 (Thermodynamics)

Textbook:
Liljedahl J.B., Turnquist P.K., Smith D.W. and Hoti M. 1996. Tractor and their power units 4th Ed. ASAE St. Joseph, MI 49085.

Goering C.E. 1998. Engine and Tractor Engineering. Unpublished Photoduplicated notes courtesy, C.E. Goering, University of Illinois, Urbana, IL.

Coordinator: Stuart Birrell, Assistant Professor of Agricultural and Biosystems Engineering

Class/Laboratory Schedule:
The course meets for two one-hour lecture periods per week. Students meet for one three-hour laboratory per week.

General Course Objectives:
- To help students understand the principles of internal combustion engines, engine testing and their application in agricultural tractors.
- To provide students with a fundamental understanding of the concepts of traction and chassis mechanics.
- Improve student's communication/teamwork skills. Provide exposure to problems that require judgement decisions and justification of those decisions, even in the case of incomplete information.

Specific Course Outcomes:
After completing this course, the student should be able to:
- Understand the terminology and basic design principles governing the performance of an engine
- Understand the interaction between weight transfer, slip and traction based on the Wismer Luth principles.
- Analyze simple planar chassis mechanics and limitations of tractor performance based on traction, stability and/or engine torque.
- Calculate the power flows through the engine, drive train and final drawbar power.
- Complete the design/modeling of a "virtual tractor" with teams responsible for individual subsystems and co-ordination between teams to ensure compatibility.

Topics Covered:

Work / Energy / Power
Engine Performance
Engine Cycles
Fuels
Fuels/Combustion
Engine Design
SI/CI Engine
CI Engine
Turbocharging/Aftercooling
Weight Transfer
Tires / Traction
Traction
Tractive Performance
Chassis Mechanics
Clutches,/Transmissions
Transmissions/Differentials
Hydraulics
Electronics, CAN

Class/Laboratory Schedule:
Lectures on MW 11-11:50 AM, Room 115 Davidson Hall
Labs Section A: M 12:10-3:00 PM, Room 147 Davidson Hall
Labs Section B: M 3:10-6:00 PM, Room 147 Davidson Hall

Student Performance Assessment

Course Component	Percent of Final Grade
Problem Sets/Lab Reports	15%
Project	20%
Exam1, Exam 2, Exam 3	45% (each worth 15%)
Final	20%

Relationship of course to program outcomes: This course addresses the following outcomes: a, b, c, d, e, g, k, l, m, and n

Contribution to Professional Component (Criterion 4): Engineering Topics

Prepared by: Stuart Birrell June 28, 2006

AE 363 - Agri-Industrial Applications of Electric Power and Electronics
Required – all options

2005 - 2007 Catalog Description:

AE 363. Agri-Industrial Applications of Electric Power and Electronics. (3-2) Cr. 4. F. *Prereq:* Phys 222. Single phase and three phase circuit design. Electrical safety. Electric motors and controls. Programmable logic controllers. Digital logic, instrumentation and sensors. Nonmajor graduate credit.

Prerequisite(s):
Physics 221 (Intro. to Classical Physics)

Textbooks
Bern, C. J., Olson, D. O. 2002 Electricity for Agricultural Applications. Ames, IA: Iowa State Press

Hiatt, R. S. (ed) 2002 Agricultural Wiring Handbook, 13th or later edition. Columbia, MO: National Food and Energy Council. Inc.

Bern, C. J. 2005 AE 363 Laboratory Manual. Course Works, ISU Bookstore

Coordinator: Carl J. Bern, Professor of Agricultural and Biosystems Engineering; Steven J. Hoff, Associate Professor of Agricultural and Biosystems Engineering.

Class/Laboratory Schedule:

The course meets for two one-and-one-half-hour lecture periods, and one three-hour laboratory per week.

General Course Objectives:

- To help students understand basic electricity, electronics, and electrical machines as applied in Agricultural and Biosystems Engineering.
- To help students attain the ability to make electrical measurements.
- To help students improve skills in communications, problem solving, and team working.
- To help students understand electrical code rules and electrical design procedures.

Specific Course Outcomes:

- After completing this course, the student should be able to:

- Work safely with, and make measurements on, live AC circuits.
- Determine by circuit analysis how to correct the power factor of an AC circuit.
- Determine experimentally the electrical and mechanical operating characteristics of an electric motor.

- Specify electric motors to drive defined loads.
- Design an electric circuit to supply an electric motor or other load.
- Design the electrical system for a building used in an agricultural enterprise.
- Develop signal conditioning parameters for transducer-based sensors.
- Select appropriate analog-to-digital conversion hardware.

Topics:

1. Basic electricity DC circuits, AC circuits (7 lectures, 3 labs).
2. Electrical safety, ethics (2 lectures, 1 lab)
3. Electrical system design (2 lectures, 2 labs)
4. Electrical motor principles, controls, and application (6 lectures, 2 labs)
5. Programmable controller programming and applications (1 lecture, 1 lab)
6. Digital control circuits (3 lectures, 2 labs)
7. Signal conditioning (3 lectures, 2 labs)
8. Analog-to-digital conversion (3 lectures, 2 labs).

Student Performance Assessment

Three hour exams: 60%, 10 lab reports: 25%, homework assignments, quizzes: 15%

Relationship of course to program outcomes: This course addresses the following outcomes: a, b, c, e, f, g, k, l, and n

Contribution to Professional Component (Criterion 4):

Engineering Topics: This course includes engineering science and engineering design topics related to electric power utilization, automatic control systems, machine systems, and instrumentation systems.

Prepared by:

Prepared by Carl Bern June 12, 2006

AE 401 Senior Seminar
Required - all options

2005 - 2007 Catalog Description

AE 401. Senior Seminar. (1-0) Cr. 1. F. *Prereq:* Senior classification in A E. Ethics, competencies, portfolios, professionalism, career development.

Prerequisite(s):
Senior classification

Textbook:
None

Coordinator: Steven K. Mickelson, Associate Professor, Agricultural and Biosystems Engineering

Class/Laboratory schedule:

The course meets for one-hour per week.

General Course Objectives:

1. An ability to apply knowledge of mathematics, science, engineering and technology;
2. An ability to design and conduct experiments, as well as to analyze and interpret data;
3. An ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
4. An ability to function on multi-disciplinary teams;
5. An ability to identify and solve technology problems;
6. An understanding of professional and ethical responsibility;
7. An ability to communicate effectively; the broad education necessary to understand the impact of solutions in a global, economic, environmental, and societal context;
8. A recognition of the need for, and
9. An ability to engage in life-long learning;
10. A knowledge of contemporary issues;
11. An ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice.

Specific Course Outcomes:

After completing this course the student should be able to:

1. Ability to create, plan and conduct your professional career,
2. Ability to communicate effectively,
3. Recognition of the need for, and ability to engage in, lifelong learning,

4. Ability to understand professional, ethical, and social responsibilities, and
5. Respect for diversity and a knowledge of contemporary professional, societal, and global issues.

Student Performance Assessment:
Attendance: 25%
Communication assignments: 50%
Portfolio: 25%

Relationship of course to program outcomes: This course addresses the following outcomes: f, g, h, i, and k

Contribution to Professional Component (Criterion 4):

General Education

Prepared by:

Steven K. Mickelson, 6/15/06

AE 404. Instrumentation for Agricultural and Biosystems Engineering
Required – All options

2005 - 2007 Catalog Description:

AE 404. Instrumentation for Agricultural and Biosystems Engineering. (Dual-listed with 504.) (2-2) Cr. 3. F. Prereq: 363 or Cpr E 210. Interfacing techniques for computer-based data acquisition and control systems. Basic interfacing components including A/D and D/A conversion, signal filtering, multiplexing, and process control. Sensors and theory of operation applied to practical monitoring and control problems.

Prerequisites:
AE 363 (Agri-Industrial Applications of Electric Power)
or CprE 210 (Introduction to Digital Techniques and Circuits)

Textbook:
Manual, Transducer Based Instrumentation (S.J. Hoff, 2005)
Digital Systems, Principles and Applications, 7th Edition, Prentice-Hall

Coordinator: Steven J. Hoff, Professor of Agricultural and Biosystems Engineering

Class/Laboratory Schedule:
Two 1-hour lectures and one 2-hour laboratory per week.

General Course Objectives:
1. To help students understand and use the binary number system.
2. To help students understand Boolean logic and algebra.
3. To help students understand data latching and enabling.
4. To help students develop logic circuits for performing practical engineering control and monitoring.
5. To help students understand the importance of developing and controlling input/output ports.
6. To help students understand control, address, and data busses and the software control thereof.
7. To help students understand D/A and A/D logic, resolution, and quantization error.
8. To help students understand the need and techniques for signal conditioning and multiplexing.
9. To help students understand the need and techniques for signal filtering.
10. To introduce students to common transducer techniques and theory of operation.
11. To help students understand and develop software control for PC-based data acquisition and control systems using Visual Basic.

Specific Course Outcomes:

After completing this course, the student should be able to:
1. Develop simplified logic circuits for performing practical tasks.
2. Develop hardware for storing logic states.
3. Interface and software control PC-based CPU architecture.
4. Develop signal conditioning hardware to synchronize transducer output to A/D input requirements.
5. Develop hardware filtering of analog signals to remove the effects of unwanted frequencies.

Topics:
1. Numbering systems.
2. Boolean logic and algebra.
3. Digital design, logic circuits.
4. Data latching, flip-flops.
5. Software development using Visual Basic.
6. Input/output port design and control.
7. D/A conversion.
8. A/D conversion.
9. Signal multiplexing.
10. Signal conditioning (op-amps, wheatstone bridge, voltage dividers, etc.).
11. Signal filtering (hardware, software).
12. Transducer-based sensors.
13. Data acquisition and control.

Student Performance Assessment
One 1-hour exam, 25%; homework/labs, 10%; one 2-hour final exam, 25%; design project, 40%.

Relationship of course to program outcomes: a, b, c, d, e, g, and k

Contribution to Professional Component (Criterion 4):
Students are involved in an intensive design project throughout the semester. Design projects are open-ended with few restrictions.

Prepared by:
Steven J. Hoff, April 2006

AE 408. GIS and Natural Resources Management
Elective – All options

2005 - 2007 Catalog Description:

A E 408. GIS and Natural Resources Management. (Dual-listed with 508, same as EnSci 408.) (2-2) Cr. 3. F. *Prereq: Working knowledge of computers and Windows environment.* Introduction to fundamental concepts and applications of GIS in natural resources management with specific focus on watersheds. Topics include: basic GIS technology, data structures, database management, spatial analysis, and modeling; visualization and display of natural resource data. Case studies in watershed and natural resource management using ArcView GIS.

Prerequisites:
Working knowledge of computers and Windows environment

Textbook: None. Material reading list.

Coordinator: U. Sunday Tim, Associate Professor of Agricultural and Biosystems Engineering

Class/Laboratory Schedule:
Two 2-hour lectures and one 2-hour laboratory per week.

General Course Objectives:
The overall goal of this course is to provide students the ability to plan, design, and implement a GIS project and to develop enterprise applications for natural resources management and environmental planning. Upon completion of the course, students should be able to:

- Demonstrate an understanding of fundamental concepts and principles of GIS
- Understand different techniques and technologies for acquiring natural resources data
- Conduct spatial and logical queries on geodatabases
- Demonstrate a working knowledge of GIS strengths and weaknesses in natural resources management
- Develop and communicate the results of GIS analysis a non-technical audience
- Demonstrate proficiency in using quantitative GIS-based analysis in natural resources management
- Gain a practical understanding of GIS concepts, technical issues, and applications.
- Learn where GIS fits in the global information technology infrastructure, how GIS is unique, and why it is important
- Know the issues involved in choosing a GIS package, obtaining and evaluating data, and implementing and managing a GIS project.
- Understand GIS career options and how to pursue them.
- Gain practical experience using ArcGIS and related software and hardware

Topics:

Basics of Geographic Information Systems/Geographic Information Science
Exploring ArcView, Extensions, and Functionality: Introducing ArcGIS
Spatial Data Models and Data Structures
Exploring ArcView, Extensions, and Functionality: Introducing ArcGIS
Creating/Capturing Natural Resource Data for GIS-I
Exploring ArcView, Extensions, and Functionality: *Working with Views, Charts, and Layouts*
Creating/Capturing Natural Resource Data for GIS-II
Exploring ArcView, Extensions, and Functionality: Editing Spatial Data
Geographic Location and Representation
Exploring ArcView, Extensions, and Functionality: Geocoding, map Projection, and coordinate systems
Managing/Querying Natural Resource Data/Data Warehousing
Exploring ArcView, Extensions, and Functionality: Manipulating Attributes Tables I
Exploring ArcView, Extensions, and Functionality: Manipulating Attributes Tables II
Analysis of Natural Resource Data: Vector Processing
Analysis of Vector Themes I
Advanced Algorithms for Vector Data/Object Oriented Data Structure
Analysis of Raster Themes II
Basic and Advanced Algorithms for Raster Data
Analysis of Raster Themes I&II
GIS & NRM: Case Study I (NPS & TMDL)
Customizing ArcGIS
GIS & NRM: Case Study II (Wetlands/Habitat Assessment)
Introduction to ArcIMS
Emerging Issues in NRM (Homeland Security; Biocomplexity)
Developing enterprise applications
Course Review/*Project Presentation*
Project Presentation

Student Performance Assessment

2 Exams (@ 20%)	40%
Final Exam	25%
Lab exercises	20%
Class assignments	15%
Total	100%

Relationship of course to program outcomes:

a, b, c, d, e, g, j, k, m, and n

Contribution to Professional Component (Criterion 4):
Engineering Topic

Prepared by: U. Sunday Tim

AE 413 – Fluid Power Engineering
Required – Power and Machinery Engineering Option

2005 - 2007 Catalog Description:

AE 413. Fluid Power Engineering. (Same as M E 413.) (2-2) Cr. 3. F. Prereq: Credit or enrollment in EM 378 or ME 335, AE 216 or ME 270. Properties of hydraulic fluids. Performance parameters of fixed and variable displacement pumps and motors. Hydraulic circuits and systems. Hydrostatic transmissions. Characteristics of control valves. Analysis and design of hydraulic systems for power and control functions. Nonmajor graduate credit.

Prerequisites:
EM 378 (Mechanics of Fluids) or ME 335 (Fluid Flow.
AE 216 (Fundamentals of Agricultural and Biosystems Engineering)
or
ME 270 (Introduction to Mechanical Engineering Design.)

Textbooks:
Norvelle, F. D. 1995. Fluid Power Technology. West Publishing Company.
Steward, B.L. 2005. Application of Hydraulic Power. Photoduplicated notes, Agricultural and Biosystems Engineering Department, Iowa State University.

Coordinator: Brian L. Steward, Associate Professor of Agricultural and Biosystems Engineering

Class/Laboratory Schedule:
The course meets for two one-hour classroom periods, and one two-hour laboratory period per week.

General Course Objectives:
1. To help students understand the concepts and application and design of fluid power systems.
2. To help students improve skills in carrying out experiments and interpreting results, communication, problem solving, and team work.

Specific Course Outcomes:
After completing this course, the student should be able to:
- Read a specification sheet for a hydraulic component or fluid and be able to explain the meaning of the specifications.
- Analyze power flows, efficiencies, and heat generation of a hydraulic system.
- Analyze and design different types of hydraulic circuits.
- Creatively design the hydraulic system for a product.
- Size closed and open circuit hydraulic systems.
- Use computer simulation software to assess the performance of a hydraulic system.
- Communicate effectively about fluid power topics.
- Work effectively in a team.
- Build a hydraulic circuit as described by a schematic diagram.

- Identify internal components of a pump and hydrostatic transmission.
- Describe the operation of a hydromechanical transmission
- Simulate the dynamics of a simple hydraulic circuit.
- Critically evaluate technical publications on applications of hydraulic power.

Topics:

- ISO fluid power graphic symbols (1 lab)
- Basic hydraulic circuit analysis and concepts (3 classes)
- Fluid properties, Aeration and cavitation and frictional losses (2 classes, 0.5 labs)
- Fluid power safety (0.5 labs)
- Pumps, motors and hydrostatic transmissions- operation, efficiencies, and sizing (6 classes, 1 lab)
- Hydromechanical Transmissions (1 class, 1 lab)
- Hydraulic Cylinders (1 class)
- Valves (4 classes, 1 lab)
- Electrohydraulics (1 class, 1 lab)
- Hydraulic Systems and Circuits (5 classes, 4 labs)
- Heat generation and transfer, contamination and filtration (1 class)
- Testing and manufacturing hydraulic components (1 lab).
- Dynamic simulation of hydraulic systems (1 lab)
- Application of hydraulics to agricultural and off-road equipment (3 labs).

Student Performance Assessment

Team project 15%, problems sets 15%, lab reports and activities 20%, two hour exams 25%, learning assessments 5%, and final exam 20%.

Relationship of course to program outcomes: a, b, c, d, e, g, and k

Contribution to Professional Component (Criterion 4):

This course includes engineering science topics related to fluid power systems.

Prepared by:

Brian L. Steward June 12, 2006

A E 415- Agricultural Engineering Design I
Required – All Options

2005 - 2007 Catalog Description:

A E 415. Agricultural Engineering Design I. (1-2) Cr. 2. F.S. *Prereq: 271 or 272, E M 324.* Identification of current design problems in agricultural engineering. Development of alternate solutions using creativity and engineering analysis and synthesis techniques. Nonmajor graduate credit.

Prerequisites:
AE 271 or 272 Parametric Solid Modeling
E M 324 Mechanics of Materials

Textbooks:
The Mechanical Design Process. David G. Ullman. McGraw Hill. Third Edition. 2003.

Coordinator: Dr. Jay Harmon, P.E., Agricultural and Biosystems Engineering

Class/Laboratory Schedule:
Lecture for two hours per week. Arranged meeting of the team with the instructor.

General Course Objectives:
Upon successfully completing this course, you should be able to:

- Integrate knowledge, acquired in undergraduate courses and work/life experiences, in an open-ended design effort.
- Apply this integrated knowledge to the solution of a contemporary engineering problem.
- Practice and improve oral and written communication skills.
- To experience the life cycle of a design project while working as a team.
- To learn how-to-learn on a need-to-learn basis using traditional and information age resources.
- To develop an attitude of professionalism in making engineering judgments, ethical judgments and in dealing with people on a daily basis.

Topics:
Overview; Policies and Procedures; Possible Projects
Logbooks, Engineering Design Process
Problem Formulation and Design Tools
Concept Generation & Evaluation
Quality Function Deployment
Teamwork and Team Effectiveness
Project Planning
Engineering Tolerances & Performance
Engineering Economics
Writing and Speaking Effectively
Solid Modeling

Professionalism & Registration
Engineering Failure Case Studies
Final Oral Presentations

Student Performance Assessment

Project Log Book	5 %
Homework	30 %
Design Project Report	30 %
Final Oral Presentation	30 %
Professionalism	5 %

Relationship of course to program outcomes: a, b, c, d, e, f, g, h, i, j, k, l, m, and n.

Contribution to Professional Component (Criterion 4):

Engineering Topics

Prepared by:

Jay Harmon June 12, 2006

A E 416- Agricultural Engineering Design II
Required – All Options

2005 - 2007 Catalog Description:

A E 416. Agricultural Engineering Design II. (1-2) Cr. 2. F.S. *Prereq: 415.* Selection of promising solutions to design problems identified in 415 for development by design teams. Presentation of designs through oral and written reports and prototypes. Nonmajor graduate credit.

Prerequisites:
AE 415 Agricultural Engineering Design I

Textbooks:
The Mechanical Design Process. David G. Ullman. McGraw Hill. Third Edition. 2003.

Coordinator: Dr. Jay Harmon, P.E., Agricultural and Biosystems Engineering

Class/Laboratory Schedule:
One hour of lecture per week and arranged team meetings with the instructor.

General Course Objectives:
Upon successfully completing this course, you should be able to:

- Integrate knowledge, acquired in undergraduate courses and work/life experiences, in an open-ended design effort.
- Apply this integrated knowledge to the solution of a contemporary engineering problem.
- Practice and improve oral and written communication skills.
- To experience the life cycle of a design project while working as a team.
- To learn how-to-learn on a need-to-learn basis using traditional and information age resources.
- To develop an attitude of professionalism in making engineering judgments, ethical judgments and in dealing with people on a daily basis.

Topics:
Group meeting with instructor each week.
Progress reports four times a semester
Log book.
Oral and written presentations

Student Performance Assessment

Project Log Book (each student)	5%
Progress Reports (3)	15%
Group Meetings (7)	21%
Design Project Report	30%
Final Oral Presentation	25%
Professionalism	4 %

Relationship of course to program outcomes: a, b, c, d, e, f, g, h, i, j, k, l, m, and n.

Contribution to Professional Component (Criterion 4):

Engineering Topics

Prepared by:

Jay Harmon June 12, 2006

AE 431. Natural Resource Conservation Engineering.
Required - Agricultural and Environmental Systems option, an elective for others

2005 - 2007 Catalog Description:

AE 431. Natural Resource Conservation Engineering. (Dual-listed with 531.) (2-3) Cr. 3. F. *Prereq:* E M 378 or Ch E 356. Planning and design of systems to conserve and utilize natural resources in the agricultural environment. Small watershed hydrology, water movement and utilization in the soil-plant- atmosphere system, agricultural water management, best management practices for control of erosion, and agricultural water quality.

Prerequisite(s):
EM 378 (Mechanics of Fluids)
CH E 356 (Transport Phenomena I)

Textbook:
Soil and Water Conservation Engineering, 5th Edition. Fangmeier, Elliot, Workman, Huffman, and Schwab. 2005.

Coordinator: Amy Kaleita, Assistant Professor of Agricultural and Biosystems Engineering

Class/Laboratory Schedule:
The course meets twice a week and lab session is once a week.

General Course Objectives:
To help students:
1. understand, analyze, and interpret hydrologic data for land and water resources engineering and environmental protection;
2. interpret and synthesize processes leading to natural resources degradation, formulate solutions, and design systems for land and water resource protection;
3. evaluate alternative scenarios and conduct engineering analysis to justify use of conservation solutions to protect valuable natural resources.

Specific Course Outcomes:
Successful completion of this course involves development and/or demonstration of the following competencies:
1. Engineering knowledge - Students must understand basic engineering principles involved in design and evaluation of structures and systems for the conservation of soil and water resources.
2. General knowledge - Students must be able to adapt a design to different regional and cultural constraints. Students must consider their general knowledge of social, economic, and political factors affecting the appropriateness of a given design.
3. Continuous learning - Students must identify data sources and alternative techniques using their own research and review skills.
4. Cultural adaptability - Students must be able to adapt their design to different cultural conditions.

5. Analysis and judgment - In critical review of others' designs, students must demonstrate analysis and judgment skills.
6. Planning - Students will use their design and analysis skills to plan conservation systems across a range of scales (field to watershed).
7. Integrity - Students must demonstrate respectful and courteous behavior towards the instructor and other students, and must consider and adhere to the engineering code of ethics in completion of their coursework.
8. Customer focus - Because for any situation, a variety of acceptable technical solutions are possible, students must select an appropriate course of action based on the particular needs, capabilities, and limitations.
9. Communication – Because students technical memos are required for each weekly lab assignment, and exams contain an oral portion, students must demonstrate effective communication skills for technical material.

Topics:

- Hydrologic cycle, watersheds and water balance
- Precipitation measurement and mapping
- Hydrologic data and frequency analysis
- Infiltration
- Evapotranspiration
- Runoff & runoff estimation
- Open channel flow
- Vegetated Waterways
- Soil Erosion & soil loss estimation
- Soil conservation practices
- Water Quality
- Dams and reservoirs
- Routing
- Hydrology models
- Natural & constructed wetlands
- Subsurface drainage
- Irrigation

Student Performance Assessment

Assessment of the competencies for this course are as follows.

1. Engineering knowledge: Exams and homework assignments
2. General knowledge: Lab exercises and homework
3. Continuous learning: Exams, lab exercises and homework
4. Cultural adaptability: Lab exercises and homework
5. Analysis and judgment: Exams, in-class exercises, and labs
6. Planning: Lab exercises and homework
7. Integrity: In-class exercises and labs
8. Customer focus: In-class exercises and labs
9. Communication: Exams and labs

Grade distribution is

- Two 1-hour exams, 40%;
- Homework and in-class excercises, 20%
- Labs, 20%
- Final 2-hour exam, 20%

Relationship of course to program outcomes: a, b, c, d, e, f, g, and k

Contribution to Professional Component (Criterion 4):

This course is designated as an engineering topics course. It contains a significant design component, as students are required to design conservation systems and structures, as well as to critically analyze others' designs.

Prepared by:

Amy Kaleita, June 12, 2006

AE 451/551 – Food Process Engineering
Required – Food Process and Biosystems Options

2005 - 2007 Catalog Description:

AE 451. Food Process Engineering. (Dual-listed with 551.) (2-3) Cr. 3. Alt. S., offered 2006. *Prereq:* Ch E 357 or M E 436. Application of momentum, heat, and mass transfer in food processing. Analysis of selected unit operations used in food processing. Extrusion, dehydration, thermal processing.

Prerequisite(s):
Ch E 357 (Heat & Mass Transfer)
ME 436 (Heat Transfer)

Textbook:

Coordinator: None at this time

Class/Laboratory Schedule:

The course meets for three one-hour lecture periods.

General Course Objectives:

- To help students gain an understanding of fundamental heat, mass, and momentum phenomena.
- To help students apply heat, mass, and momentum phenomena to food and bioprocess engineering.
- To provide students with critical information and necessary tools to deal with unique problems in the food industry.

Specific Course Outcomes:

After completing this course, the student should be able to:

- Utilize Matlab to solve an array of computational problems found in food engineering.
- Design food processing systems including proper equipment sizing and operational parameters for thermal processing, evaporation, dehydration, separation, extraction.
- Obtain critical food properties necessary for engineering calculations from published literature and handbooks, or via experimental methods.
- Critically evaluate current publications concerning food engineering topics.

Topics:

- Transport phenomena
- Mixing
- Kinetics of chemical reactions
- Thermal processing
- Evaporation
- Dehydration
- Separation
- Extraction

Student Performance Assessment:

Two hour exams, 30%; Project 1, 25%; Project 2, 30%; Course portfolio, 20%

Course portfolio consists of homework problems, writing assignments, and projects. Completeness is assessed upon the collection of the portfolios, which will be twice during the semester. Weekly writing assignments will vary in subject matter, format, and length. Written assignment collected the next class period following peer-review.

Relationship of course to program outcomes: a, b, c, d, e, j, k, l, m and n.

Contribution to Professional Component (Criterion 4):

This course applies engineering science topics and engineering design principles to food processing unit operations. Requirements include computer applications to solve food engineering problems, and projects that assess case studies in food and bioprocessing.

Prepared by:

Steven Mickelson 6/28/06

AE 465 – Physical Properties of Biological Materials
Required – Food Process and Biosystems Options

2005 - 2007 Catalog Description:

AE 465. Physical Properties of Biological Materials. (Dual-listed with 565.) (2-2) Cr. 3. Alt. F., offered 2006. Prereq: 216. Properties of agricultural and food materials needed in design, application, and evaluation of unit operations used in processing biological materials into finished products. Rheological, thermal, viscoelastic, hygroscopic, aerodynamic, and mechanical properties.

Prerequisite(s):
AE 216 (Fundamentals of Agricultural and Biosystems Engineering)

Reference Books
Mohsenin, N.N. 1986. Physical Properties of Plant and Animal Materials, 2nd Ed. McGraw-Hill. New York.

Wainwright, S.A., W.D. Biggs, J.D. Curry, and J.M Gosline. 1976. Mechanical Design in Organisms. Princeton University Press. Princeton, NJ.

Coordinator: None at this time

Class/Laboratory Schedule
The course meets for two one-hour lecture periods and one two-hour lab.

General Course Objectives
1. **To help students gain an understanding of the importance of physical properties of associated with biological materials necessary for engineering calculations.**
2. To help students define specific physical properties of biological and materials.
3. To help students design experiments, and evaluate uncertainty of bioproperty measurements.
4. To help students apply measurement methods and use equipment for determining physical properties of biological materials.

Specific Course Outcomes:
After completing this course, the student should be able to:

1. Determine physical properties necessary for engineering design calculations.
2. Formulate experimental objectives, design experiments, statistically analyze data, and deduct conclusions based on data.
3. Prepare concise experimental reports.
4. Critically evaluate published literature on physical properties of biological systems.

Topics
1. Size and shape
2. Density and porosity
3. Structure and composition
4. Water activity
5. Chemical and water potential
6. Mechanical properties
7. Viscoelasticity
8. Newtonian and non-Newtonian flow
9. Thermal properties and analysis
10. Electrical Properties

Student Performance Assessment:
Two one-hour exams, 20%
Final exam, 20%
Homework, 10%
Lab reports, 50%

Laboratories span across three weeks and cover a topic pertaining to physical properties. Four to five separate laboratories will be conducted for each lab group. No lab groups conduct the same experiment. The task performed in week 1 is the pre-lab report, which includes literature review, objective development, experimental design, and material and methods. The pre-lab report must be pre-approved by the instructor prior to proceeding to the next stage. Week 2 and 3 is reserved for data collection and analysis, and final report preparation. Five-minute oral reports will be given in class following the conclusion of the experiment. Presenters are rotated through lab group members.

Relationship of course to program outcomes: a, b, c, d, e, j, k, l, m and n.

Contribution to Professional Component (Criterion 4)
This course evaluates physical properties associated with biomaterials necessary for a complete understanding of engineering science topics and engineering design principles. Requirements include a complete laboratory experience including literature review, objective formulation, experimental design, data collection and analysis (including statistical assessment), and conclusions.

Prepared by:
Steven Mickelson 6/28/06

AE 469 - Grain Processing and Handling
Required - Food and Process Engineering Option, Biosystems Engineering Option

2005 - 2007 Catalog Description:

AE 469. Grain Processing and Handling. (Dual-listed with 569.) (2-3) Cr. 3. Alt. S., offered 2007. Prereq: 216. Cereal grain and oilseed properties, quality measurement, processing, and end-use value. Design of drying systems using computer simulation. Corn wet and dry milling. Soybean oil extraction. Grain handling systems.

Prerequisite(s):
AE 216 (Fundamentals of Agricultural and Biosystems Engineering)

Instructor
Carl Bern *(cjbern@iastate.edu)*
217 Davidson 294-1270
Office: M,W 8:30-9:30, T,F 9-10
Or by appointment, or use email

Textbooks
Bern, C. J., C. R. Hurburgh, , T. J. Brumm 2006 *Managing grain after harvest.* Duplicated textbook. ISU Bookstore.

Bern, C. J. 2006 *AE 469/569 Lab manual.* Course Works, ISU Bookstore.

Purpose
To build on a background of sciences, math, and engineering to allow engineering students to learn fundamentals and practice of grain engineering, and grain and oilseed processing and preservation.

Class/Laboratory Schedule:

The course meets for two one-hour lecture periods, and one three-hour laboratory per week.

Student Learning Outcomes
Upon completion of this course, you should be able to:
- Design a fan-grain-bin system for a specific application.
- Design a natural-air or heated-air grain dryer.
- Plan, carry out and report on an experiment related to grain or oilseed preservation.
- Critically evaluate a grain storage system.
- Critically evaluate operation of a grain dryer, a size-reduction machine, a corn wet-milling process, and a soybean oil extraction process.
- Critically evaluate technical publications on grain or oilseed preservation, processing or handling.

Topics:

- Review grain engineering principles (2 lectures).
- Term project (4 labs plus 2-hour presentation session)
- Drying theory, methods, thin-layer drying (2 lectures, 1 lab)
- Drying simulation, dryer design (3 lectures, 1 lab)
- Soybean processing (3 lectures, 2 labs-Cargill Tour, Mycal tour)
- Corn wet-milling (2 lectures)
- Size reduction (3 lectures, 1 lab)
- Infrared measurement techniques (2 lectures, 1 lab)
- Grain handling (4 lectures, 1 lab, West Central tour)
- High-moisture preservation (2 lectures)

Student Performance Assessment

2 hour exams @ 100		200
Labs, homework and other assignments about		150
Term project		100
	Total	450

Relationship of course to program outcomes: a, b, c, d, e, g, h, l, m and n.

Contribution to Professional Component (Criterion 4):

This course includes engineering science and engineering design topics related to grain handling, preservation, and processing systems, and grain quality analysis. It includes 10 open-ended design assignments.

Prepared by:

Carl J. Bern 5/12/06

AE 472. Design of Environmental Modification Systems for Animal Housing.
Required – Agricultural and Environmental Systems Engineering Option

2005 - 2007 Catalog Description:

AE 472. Design of Environmental Modification Systems for Animal Housing. (Dual-listed with 572.) (3-0) Cr. 3. S. *Prereq:* 216, M E 330. Principles and design of animal environmental control systems. Insulation, heat and mass transfer, fans, ventilation, air distribution, heating and cooling equipment, duct design, controls.

Prerequisites:
AE 216 (Fundamentals of Agricultural and Biosystems Engineering)
ME 330 (Thermodynamics)

Textbook:
Environment Control for Animals and Plants, L.D. Albright, ASAE Publishers

Coordinator: Steven J. Hoff, Professor of Agricultural and Biosystems Engineering

Class/Laboratory Schedule:
Two 1.5-hour lectures per week with some lectures substituted with laboratory/field-trip exercises.

General Course Objectives:
1. To help students understand and analyze processes involving dry air and water vapor mixtures.
2. To help students understand mass and energy balances for animal housing systems.
3. To help students understand energy audits for animal housing systems.
4. To help students understand fan and inlet performance curves.
5. To help students understand building fan/inlet operating points.
6. To help students understand principles and factors that influence fresh-air distribution.
7. To help students design ventilation systems for thermal and air quality control.
8. To help students develop software analysis tools for evaluating ventilation system characteristics.

Specific Course Outcomes:

After completing this course, the student should be able to:
1. Analyze multi-step psychrometric processes common to livestock housing systems.
2. Perform an energy audit for livestock housing.
3. Develop a system characteristics graph for any ventilation arrangement used in livestock housing.
4. Analyze and predict air distribution patterns for isothermal and non-isothermal airflow.
5. Develop software in Excel and Visual Basic to perform ventilation analysis.

Topics:
1. Psychrometric properties.
2. Psychrometric processes.
3. Heat transfer fundamentals.
4. Building energy analysis.
5. Inlet systems and analysis.
6. Fan systems and analysis.
7. Air distribution assessment and analysis.
8. Ventilation system characteristic technique.
9. Air quality control.
10. Instrumentation for assessing the environment.

Student Performance Assessment
One 1-hour exam, 30%; homework/labs, 30%; one 2-hour final exam, 40%.

Relationship of course to program outcomes: a, b, c, d, e, j, k, l, m and n.

Contribution to Professional Component (Criterion 4):
A significant portion of this course is devoted to a continuous development of a design software program that students develop throughout the course for the design of animal housing ventilation systems. This program, when completed, will allow students to evaluate and design all aspects of an animal housing design situation.

Prepared by:

Steven J. Hoff, April 2006

AE 473 – Microbial Systems Engineering
Elective – all options

2005 - 2007 Catalog Description:

AE 473. Microbial Systems Engineering. (Dual-listed with 573.) (3-0) Cr. 3. Alt. F., offered 2006. *Prereq:* Chem 167, Ch E 356 or E M 378. Principles of chemistry, microbiology, and engineering applied to microbial system analysis and design. Bioenergetics, kinetics, and transport phenomena in microbial systems, with applications to solid- state fermentation and other microbial bioconversion processes. Nonmajor graduate credit.

Prerequisites:
Chem 167 (General Chemistry for Engineering Students)
Ch E 356 (Transport Phenomena I) or EM 378 (Mechanics of Fluids)

Textbook:
Natural Resource Conservation Service (NRCS). 1992 and subsequent revisions. National Engineering Handbook (NEH) Part 651 - Agricultural Waste Management Field Handbook. Current version available on the web at: http://www.ftw.nrcs.usda.gov/awmfh.html
Supplemental readings through library reserve.

Coordinator: Tom L. Richard, Assistant Professor of Agricultural and Biosystems Engineering

Class/Laboratory Schedule:
The course meets for three 1-hour lecture periods each week, with two 4-hour laboratories.

General Course Objectives:
- To help students understand the concepts and practice required to treat and use manure and other agricultural byproducts.
- To help students improve skills in generating alternative strategies, formulating problems, finding or generating appropriate input data, and analyzing the results.
- To help students improve skills in communication and collaborative teamwork.
- To help students evaluate the ethical and environmental implications of their work

Specific Course Outcomes:
After completing this course, the student should be able to:
- Calculate manure quantities generated from a variety of livestock production systems.
- Design and treatment systems including settling basins, anaerobic digestors, lagoons, and composting systems for a defined organic byproduct stream.
- Analyze the bioconversion of energy and nutrients by aerobic and anaerobic treatment systems.
- Design byproduct utilization schemes for crop nutrient, energy, and livestock feeding applications.
- Analyze the effect of odor treatment and mitigation strategies on downwind odor impacts.

- Critically evaluate the environmental and ethical dimensions of alternative waste management systems and regulatory strategies.

Topics:

- Systems perspectives on manure treatment and bioconversion (2 lectures, 4 hour field trip)
- Characteristics and quantities of manure generation (1 lecture)
- Nutrient and energy cycles in agro-ecosystems (2 lectures)
- Physical and chemical treatment systems (2 lectures)
- Aerobic and anaerobic biological treatment systems (10 lectures)
- Byproduct utilization (4 lectures)
- Ecological engineering of wetland and riparian systems (2 lectures)
- Odor generation, impact, and mitigation (3 lectures)
- Economic, regulatory, health and safety issues (3 lectures, 3 hour lab)
- Project presentations (2 hours)

Student Performance Assessment
Two hour exams 20%, Final exam 15%, team project 20%, homework and quizzes 40%, class participation 5%.

Relationship of course to program outcomes: a, b, c, d, e, j, k, l, m and n.

Contribution to Professional Component (Criterion 4):

Engineering Topic: This course includes engineering and science and engineering design topics related to environmental management, bioprocessing and utilization of manures and other agro-industrial byproducts. In includes 6 open-ended design assignments and one major interdisciplinary team project.

Prepared by:
Steven Mickelson, 6/28/06

AE 478 – Design of Agricultural Structures
Required – Agricultural and Environmental Systems Engineering option

2005 - 2007 Catalog Description:

A E 478. Design of Agricultural Structures. (Dual-listed with 578.) (3-0) Cr. 3. Alt. S., offered 2007. *Prereq:* 216, E M 324. Design of light-framed structures using cold-formed steel and wood. Includes building codes, pressures from granular materials and analysis of wind, snow, dead, and live loads. Applications include grain storage, animal housing, and machine storage. Analysis of structures utilizing FEA Software.

Prerequisite(s):
AE 216 (Fundamentals of Agricultural and Biosystems Engineering)
EM 324 (Mechanics of Materials)

Textbook:
Wood Engineering and Construction Handbook, 3rd Edition, 1997, Keith R. Faherty, Thomas G. Willliamson, McGraw-Hill Handbooks
Cold-Formed Steel Design, 3rd Edition, 2000, Wei-Wen Yu, John Wiley & Sons

Coordinator: Jay Harmon, Professor of Agricultural and Biosystems Engineering

Class/Laboratory Schedule:
The course meets for three one-hour lecture per week.

General Course Objectives:
The purpose of this course is to help students develop key workplace competencies necessary and sufficient for an engineering graduate to be successful in industry and in life. These competencies include technical knowledge, analysis and judgment, teamwork, initiative, continuous learning, and communication.

Upon successfully completing this course, you should have:
- gained a basic knowledge and appreciation of the fundamental principles of light frame structural design;
- increased your ability to apply current knowledge and adapt to emerging applications
- improved your ability to identify, analyze, and solve technical problems.

Topics:

Ag Stuctures: Intro
Ag Structures : Materials and Construction
Introduction to STAAD (Shahan)
Ag Stuctures: Analysis of Elements
Analysis of Structures
Wind, Snow and Earthquake loads

Wood Properties
Preliminary Design Considerations
Introduction Materials used in CFS construction
Strength of thin elements and design Criteria
Columns
Bending Members
Trusses
Structural Wood Panels
Diaphragms and Shear walls
Arches
Misc. Wood Stuctures
Wood foundations structures
Adhesives
Flexural Members
Compression Members
Combined Axial Load and Bending
Cylindrical Tubular members
Connections
Steel shear diaphragms and shell roof structures
Corrugated Sheets
Composite Design
Introduction to Stainless Steel
Computer-aided design/Residential Construction

Student Performance Assessment

Team computer problems	35%
Homework	35%
Tests	30%

Relationship of course to program outcomes: a, b, c, d, e, j, k, l, m and n.

Contribution to Professional Component (Criterion 4):

This course includes engineering science and engineering design topics in light gage steel structures, wind, snow and grain pressures. The course includes a design of a light frame building including purlins, girts, trusses, braces, columns, circular tanks, and grain pressures.

Prepared by:

Jay Harmon, 6/28/06

AE 480 – Engineering Quantification of Biological Processes
Required: Food and Biological Systems Option

2005 - 2007 Catalog Description:

AE 480. Engineering Quantification of Biological Processes. (Dual-listed with 580.) (2-2) Cr. 3. S. Prereq: 216, Math 266; Biol 101 or 211 or 212; M E 330. Prediction of biological systems behavior by computer simulation of mathematical system models. Focus on mathematical representation of biological processes including population dynamics, growth, development, diffusion, bioenergetics, enzyme kinetics. Flow diagrams for representing systems and constructing mathematical models. Finite difference techniques for continuous system simulation including examples of plant growth and soil water balances. Students enrolled in AE 580 will be required to answer an additional final exam question, to report on two journal articles, and to complete a more comprehensive class project than students enrolled in AE 480.

Prerequisite(s):
AE 216 Fundamental of ABE
Biol 101 or 211 or 212 Introductory Biology or Principle of Biology I or II
ME 330 Thermodynamics

Textbook: None

Coordinator: Raj Raman, Associate Professor of Agricultural and Biosystems Engineering

Class/Laboratory Schedule:
MW 1:10 –2:00 Davidson 124; F 1:10 – 3:00 Davidson 125D (computer lab)

Course Objectives:
Purpose: To learn how to use mathematical models and computer simulation to capture and understand complex biological systems.

Student Learning Objectives:
Upon completion of this course, you should be able to do the following:

- Describe mathematical models appropriate to enzyme kinetics, microbial growth in resource-limited environments, predator-prey relations, and to other important biological systems and processes.
- Develop simple mathematical models for novel biological situations, based upon an understanding of the fundamental principles governing the situation. That is, be able to translate an understanding of how a part of the physical world works into the mathematical equations.
- Implement solutions to mathematical models of biological systems in computer programming languages, including direct code (MatLab) and block-diagram methods (Simulink). This includes having an understanding of the stability of these models, and of the tradeoffs between speed and precision in these models.
- Determine and implement an appropriate strategy to test a computer model of a biological system, to ensure that the model is functioning correctly.

- Critically evaluate a computer model and its output, and know how to perform a sensitivity analysis to assist with the evaluation.

Topics:

Weeks	*Topics*
1 – 2	Foundations – programming, mathematics
3 – 4	Modeling enzyme kinetics – derivations, inhibition, transform methods, kinetic parameter estimation
5 – 8	Population Dynamics – resource limitations, predation, simulation approaches (discrete time step – MatLab)
9 – 11	Bioreactors – reactor types, numerical solutions to ODEs, block diagram implementations of ODE solutions
12 – 13	Continuum system modeling using finite difference methods
14 – 15	Exemplar presentations and critiques by graduate students, review and project submission

Student Performance Assessment

Performance Component	**Weight – AE480**
Class participation • timely attendance 2% • contributions 2% • homework & quizzes 6%	10%
Exams (2 or 3)	40%
Class Project(s)	20%
Comprehensive Final	30%

Relationship of course to program outcomes: a, b, e, k, l, and n.

Contribution to Professional Component (Criterion 4):

Engineering Topic

Prepared by:

Raj Raman, 6/20/06

Acct 284. Financial Accounting.

Elective

1. Course Name: Acct 284. Financial Accounting. (Cr. 3)

2. 2005-2007 Catalog Description: Introduction to the basic concepts and procedures of financial accounting from a user perspective. The course examines the accounting cycle, business terminology, basic control procedures, and the preparation and evaluation of financial reports, with an emphasis on financial statement analysis.

3. Prerequisites:

4. Textbook(s) and/or Other Required Material

- "Financial Accounting," 4th edition by Libby, Libby, and Short - Purchase access to online homework system, Homework Manager - Four-function calculator recommended. Programmable calculators not permitted.

5. Course Learning Objectives

This course is designed to provide students with an understanding of financial statements and the impact that varying business actions will have on the financial statements.

6. Topics Covered

7. Class/Laboratory Schedule

Three 50 minute lectures.

8. Contribution of Course to Meeting Professional Component

This is a foundation course, providing students with the background in accounting necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

This course is one component of learning outcomes related to working on multidisciplinary teams and designing a system/process within realistic constraints.

10. Person(s) who Prepared this Description and Date of Preparation

Janet Putnam - March, 2006

Agron 154. Fundamentals of Soil Science.

Biological Elective

1. Course Name: Agron 154. Fundamentals of Soil Science. (Cr. 3)

2. 2005-2007 Catalog Description: Manu. Introduction to physical, chemical, and biological properties of soils, their formation, classification, and distribution. Use of soil survey and computer databank information in balancing agronomic, economic, and environmental concerns in soil management. Credit for only one of 154, 155, or 156 may be applied toward graduation, not both.

3. Prerequisites: Chem 163

4. Textbook(s) and/or Other Required Material
"Soils and Soil Fertility" by Troeh and Thompson, 4th Edition (optional). Lab manuals: "SOILS (Student Oriented Independent Learning of Soils), by Schafer, 11th Edition. "Site Evaluation Workbook" by Schafer and Hasselman, 10th Edition.

5. Course Learning Objectives
To simplify the complex nature of soils and present it to students at a steady pace in an understandable matter. To present students with multiple opportunities to verify their understanding and mastery of course objectives.

6. Topics Covered
Fundamentals of soil science examines the basic physical, chemical and biological properties of soils, their formation, classification, and distribution. The course has a laboratory component that uses soil survey and computer databank information in balancing agronomic, economic, and environmental concerns in soil management.

7. Class/Laboratory Schedule
Two 50 minute lectures, 2 to 4 hours individualized study (arranged).

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in agronomy necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the sciences related outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet W. Putnam - March 2006

Biol 211. Principles of Biology I.

Required – FBE Option

1. Course Name: Biol 211. Principles of Biology I. (Cr. 3)

2. 2005-2007 Catalog Description: Introduction to the nature of life, including the cellular basis of life; the nature of heredity; evolution; diversity of microbial, plant, and animal life; and principles of ecology. Intended for life science majors. Only one of 101 or 211 may count toward graduation.

3. Prerequisites: High school biology and chemistry or credit or enrollment in Chem 163 or 177

4. Textbook(s) and/or Other Required Material
N. Campbell and J. Reece. 2005. Biology, 7th ed. Pearon/Benjamin Cummings Publilsher

5. Course Learning Objectives

6. Topics Covered
Introduction, History of Life, Diversity of Life Major Groups: Viruses, Prokaryotes, Protists, Plants: bryophytes through ferns, seed plants – gymnosperms, angiosperms. Fungi, Animals :sponges to lophophorates, mollusks, annelids to arthropods, echinoderms to chordates, vertebrates. Cells: tour de cell, organelles, cytoskeleton etc. Cell cycle: mitosis, cancer, meiosis. Genetics: Mendel. Chromosomes, human genetics. Evolution: evidence, mechanisms, microevolution, variation, types of selection, speciation, and macroevolution. Phylogeny, human evolution, populations: growth. Demography, life history, human population, communities, ecosystems: Trophic levels. Chemical cycles, human impact, climate, biomes, aquatic systems.

7. Class/Laboratory Schedule
Three 50-minutes lectures. Biol 211L (lab) available but not required for course.

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing the students with the background in biology necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the biological sciences related learning outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Biol 212. Principles of Biology II.

Required – FBE Option

1. Course Name: Biol 212. Principles of Biology II. (Cr. 3)

2. 2005-2007 Catalog Description: Introduction to the nature of life, including the cellular basis of life; energy relationships; the nature of heredity; evolution; form and function of microbial, plant, and animal life.

3. Prerequisites: 211

4. Textbook(s) and/or Other Required Material
Biology(6th edition), by Neil Campbell and Jane Reece. Pearson/Benjamin Cummings 2002 or the 7th edition 2005.

5. Course Learning Objectives
To examine the structure and function of biological systems, including genetic mechanisms, cells, and multicellular plants and animals.

6. Topics Covered
Using quantitative techniques and statistics, modeling biological molecules; determining the properties of an enzyme, measuring cellular respiration, working with diverse bacteria; isolating DNA and working with plasmids; investigating plant cells tissues and primary growth, primary and secondary growth in roots and stems, leaf structure and photosynthesis, angiosperms: reproduction germination and development, the digestive and gas exchange systems, circulatory and urogenital systems, nervous and sensory systems, the properties of muscle and skeletal systems.

7. Class/Laboratory Schedule
three 50-minute lectures, one 3-hour lab.

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing the students with the background in biology necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the biological sciences related learning outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Biol 313. Principles of Genetics.

Required – FBE Option

1. Course Name: Biol 313. Principles of Genetics. (Cr. 3)

2. 2005-2007 Catalog Description: Introduction to the principles of transmission and molecular genetics of plants, animals, and bacteria. Recombination, structure and replication of DNA, gene expression, cloning, quantitative and population genetics. Students may receive graduation credit for no more than one of the following: 313 and 313L, Gen 260, Gen 313, Gen 320, and Agron 320.

3. Prerequisites: 211L and 212 L, credit or enrollment in organic chemistry

4. Textbook(s) and/or Other Required Material
Concepts of Genetics, 8th Edition by W.S. Klug, M.R. Cummings and C.A. Spencer.

5. Course Learning Objectives
To provide working knowledge of the concepts and applications of genetics as well as some appreciation for the history of this central discipline in the biological sciences. This will prepare students for upper-division genetics courses.

6. Topics Covered
Intro to genetics, meiosis and mitosis, Mendelian genetics, pedigree analylsis, multiple alleles and gene interactions, chromosome mapping in eukaryotes, genetics of bacteria and bacteriophages, sex determination, chromosome mutations, extranuclear inheritance, DNA structure, replication, and organization in chromosomes, genetic code and transcription, translation and proteins, mutation, DNA repair and transposition, regulation of gene expression in prokaryotes and eukaryotes, genetics of cancer, recombinant DNA technology, geonomics, human applications and ethics, developmental genetics, genetics of quantitative traits, population genetics, evolutionary genetics, conservation genetics, and genetics of model organisms.

7. Class/Laboratory Schedule
Three 50-minute lectures

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing the students with the background in biology necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the biological sciences related learning outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Ch E 356. Transport Phenomena I.

Required: FBE Option or EM 378

1. Course Name: Ch E 356. Transport Phenomena I. (Cr. 3)

2. 2005-2007 Catalog Description: Momentum and mechanical energy balances. Incompressible and compressible fluid flow. Applications to fluid drag, piping system design, filtration, packed beds and settling.

3. Prerequisites: 210, Phys 221, credit or enrollment in Math 267

4. Textbook(s) and/or Other Required Material
Transport Phenomena, 2nd Edition, by Bird, Stewart, and Lightfoot. Wiley 2002. (Optional) Unit Operations of Chemical Engineering, 6th Edition, by McCabe et al.

5. Course Learning Objectives
1. Learn how to apply the principles of conservation of mass and momentum to differential control volumes to derive differential equations describing fluid motion. 2. Learn how to properly select boundary conditions to solve the differential equations of motion. 3. Learn how to reduce the generalized equations of motion in various coordinate systems to describe a specific problem. 4. Develop an understanding of the anomolous behavior of non-Newtonian fluids such as paint, blood, polymers, and suspensions. 5. Learn how to apply conservation of mass, momentum, and energy to finite control volumes. 6. Learn how to predict the relationships between flow rate, pressure changes, pipe diameter and length, and fluid properties for simple and complex pipe networks. 7. Learn how to determine the flow-pressure relations for flow through packed beds. 8. Gain some physical understanding of turbulence and how it affects drag forces and pressure changes. 9. Estimate drag forces on falling or submerged objects. 10. Develop design skills in fluid transport, including consideration of safety concerns.

6. Topics Covered
Principles of conservation of mass and momentum, boundary conditions, anomolous behavior of non-Newtonian fluids, flow rate and flow pressure, turbulence, drag forces.

7. Class/Laboratory Schedule
Three 50-minute lectures

8. Contribution of Course to Meeting Professional Component

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam

Ch E 357. Transport Phenomena II.

Required – FBE Option or ME 436

1. Course Name: Ch E 357. Transport Phenomena II. (Cr. 3)

2. 2005-2007 Catalog Description: Conduction and diffusion, convective heat and mass transfer, boiling and condensation, radiation, and design of heat exchange equipment. Introduction to diffusion.

3. Prerequisites: Credit or enrollment in 310; 356

4. Textbook(s) and/or Other Required Material
Fundamentals of Heat and Mass Transfer, 5th Edition, by F.P. Incropera and D.P. DeWitt, Wiley 2002. (Supplemental) Unit Operations of Chemical Engineering, by McCabe, Smith, and Harriott.

5. Course Learning Objectives
1. Enable the student to understand and apply the principles of convective heat transfer, conductive heat transfer, heat exchanger design, and radiative heat transfer. 2. Enable the student to analyze and apply the principles of diffusion, mass transfer, and simultaneous heat and mass transfer. 3. Enhance the student's ability to apply material, energy, and momentum balances. 4. Provide and opportunity for the student to develop skill in the use of computational techniques. 5. Enhance the student's ability to identify, formulate, and solve engineering problems. 6 Provide an opportunity for the student to develop design skills in heat and mass transfer, including consideration of safety and environmental issues. 7. Provide an opportunity for the student to work effectively as a member of a team. 8. Provide an opportunity for the student to demonstrate knowledge through written communication. 9. Provide an opportunity for the student to understand the impact of engineering solutions.

6. Topics Covered
Intro to heat transfer, steady-state conduction, transient conduction, diffusion mass transfer, introduction to convection, external and internal flow, heat exchanges, radiation.

7. Class/Laboratory Schedule
Three 50-minute lectures.

8. Contribution of Course to Meeting Professional Component

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - May 2006

Chem 155. Foundations of Chemistry for Engineers.

Elective

1. Course Name: Chem 155. Foundations of Chemistry for Engineers. (Cr. 3)

2. 2005-2007 Catalog Description: The first semester of a two semester sequence covering principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. Chem 155 may not be counted for credit toward graduation in any engineering curriculum. Credit may not be applied toward graduation for both 160 and another chemistry course. Only one of 163, 165, 167, and 177 may count toward graduation. Only one of 155, 163, 167, and 177 may count toward graduation.

3. Prerequisites: Math 140 or the high school equivalent

4. Textbook(s) and/or Other Required Material
Chemistry, by Raymond Chang, (8th Edition), McGraw-Hill, 2005. Optional: Math Survival Gide: Tips and Tricks for Science Students by Jeffrey R. Appling and Jean C. Richardson, (2nd Edition), John Wiley, 2005.

5. Course Learning Objectives

6. Topics Covered
Atoms, Molecules and Ions; Mass Relationships in Chemical Reactions; Reactions in Aqueous solutions; Gases; Thermodynamics; Quantum Theory and Electronic Structure of Atoms; Periodic Relationships Among the Elements; Chemical Bonding.

7. Class/Laboratory Schedule
Two 50-minute lectures, one 50-minute recitation.

8. Contribution of Course to Meeting Professional Component
This course is the first of a two-course chemistry sequence, with the credits of the second course meeting the basic science requirement. This sequence is an alternative to Chemistry 167 and over similar topics over two semesters. The two course sequence provides the student with the background in chemistry necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
The course is one component of the chemistry-sciences related outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - May 2006

Chem 165. Foundations of Chemistry for Engineers.

Required – All Options or Chem 167

1. Course Name: Chem 165. Foundations of Chemistry for Engineers. (Cr. 4)

2. 2005-2007 Catalog Description: Continuation of 155. Principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. Chem 165 or 167 satisfies the chemistry requirement in engineering curricula. Credit may not be applied toward graduation for both Chem 160 and another chemistry course. Only one of 163, 165, 167, and 177 may count toward graduation. Only one of 155, 163, 167, and 177 may count toward graduation.

3. Prerequisites: 155

4. Textbook(s) and/or Other Required Material
Chemistry, by Raymond Chang, (8th Edition), McGraw-Hill, 2005. Optional: Student Solutions Manual for Chang's Chemistry, by Chang and Cruickshank, (8th Edition), McGraw-Hill, 2005

5. Course Learning Objectives

6. Topics Covered
Chemical Bonding II; Intermolecular Forces; Chemical Kinetics; Chemical Equilibrium; Acids and Bases; Electrochemistry; Nuclear Chemistry; Organic Chemistry; Polymers.

7. Class/Laboratory Schedule
Two 50-minutes lectures, two 50-minute recitations. Lab not required. If elected, Chem 167L is one 3 hr (170 minute) laboratory.

8. Contribution of Course to Meeting Professional Component
This is a foundation course, which along with Chem 155, provides the student with the background in chemistry necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the chemistry-sciences related outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - May 2006.

Chem 167. General Chemistry for Engineering Students.

Required – All Options or Chem 165

1. Course Name: Chem 167. General Chemistry for Engineering Students. (Cr. 4)

2. 2005-2007 Catalog Description: Principles of chemistry and properties of matter explained in terms of modern chemical theory with emphasis on topics of general interest to the engineer. This is an accelerated course designed for students with an excellent preparation in math and science and is a terminal course intended for engineering students who do not plan to take additional courses in chemistry. Credit may not be applied toward graduation for both 160 and another chemistry course. Only one of 163, 165, 167, and 177 may count toward graduation. Only one of 155, 163, 167, and 177 may count toward graduation. Credit by examination (test-out exams) for 167 is available only to students who are not currently enrolled in the course.

3. Prerequisites: Math 140 or the high school equivalent and one year of traditional college prep chemistry or Chem 50

4. Textbook(s) and/or Other Required Material
Chemistry, by Raymond Chang and Brandon Cruickshank (8th Edition), McGraw-Hill, 2005.

5. Course Learning Objectives

6. Topics Covered
Molecules, mass relationships, aqueous solutions, gases, thermochemistry, electrochemistry, quantum chemistry, chemical bonding, liquids and solids, kinetics, equilibrium, acids/bases, nuclear chemistry, atmospheric chemistry.

7. Class/Laboratory Schedule
Two 50-minute lectures, one 50-minute recitation. Lab not required. If elected, Chem 167L is one 3 hr (170 minute) laboratory.

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in chemistry necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the chemistry-sciences related outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Chem 167L. Laboratory in General Chemistry for Engineering.

Required – All Options

1. Course Name: Chem 167L. Laboratory in General Chemistry for Engineering. (Cr. 1)

2. 2005-2007 Catalog Description: Laboratory to accompany 167. Only one of 163L, 167L, and 177L may count toward graduation.

3. Prerequisites: Credit or enrollment for credit in 167 or 165

4. Textbook(s) and/or Other Required Material

5. Course Learning Objectives

6. Topics Covered

7. Class/Laboratory Schedule

8. Contribution of Course to Meeting Professional Component

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

10. Person(s) who Prepared this Description and Date of Preparation

Chem 331. Organic Chemistry.

Required – FBE Option

1. Course Name: Chem 331. Organic Chemistry. (Cr. 3)

2. 2005-2007 Catalog Description: The first half of a two semester sequence. Modern organic chemistry including nomenclature, synthesis, structure and bonding, reaction mechanisms. For students majoring in physical and biological sciences, premedical and preveterinary curricula, chemistry and biochemistry. Students desiring only one semester of organic chemistry should take 231 and 231L, not 331. Only one of 231 and 331 may count toward graduation.

3. Prerequisites: 178, enrollment in 331L highly recommended

4. Textbook(s) and/or Other Required Material
"Organic Chemistry", McMurry, 6th edition. (Optional: Study Guide to Organic Chemistry)

5. Course Learning Objectives

6. Topics Covered
structure and bonding, polar bonds, alkanes and cycloalkanes, stereochemistry, organic reactions, alkenes (reactivity and structure), alkenes (reactions and sysnthesis), alkynes, stereo-chemistry, alkyl, Reactions of Halides, Mass Spec/IR, dienes/UV, aromaticity

7. Class/Laboratory Schedule
Three 50-minute lectures, one 50-minute recitation. Chem 331L: one 2 hr. laboratory.

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in chemistry necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the chemistry-sciences related outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Chem 331L. Laboratory in Organic Chemistry.

Required – FBE Option

1. Course Name: Chem 331L. Laboratory in Organic Chemistry. (Cr. 1)

2. 2005-2007 Catalog Description: Laboratory to accompany 331. Only one of 231L and 331L may count toward graduation.

3. Prerequisites: Credit or enrollment for credit in 331

4. Textbook(s) and/or Other Required Material

5. Course Learning Objectives

6. Topics Covered

7. Class/Laboratory Schedule

8. Contribution of Course to Meeting Professional Component

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

10. Person(s) who Prepared this Description and Date of Preparation

Chem 332. Organic Chemistry.

Required – FBE Option

1. Course Name: Chem 332. Organic Chemistry. (Cr. 3)

2. 2005-2007 Catalog Description: Continuation of 331. Modern organic chemistry including nomenclature, synthesis, structure and bonding, reaction mechanisms, natural products, carbohydrates and proteins. For students majoring in physical and biological sciences, premedical and preveterinary curricula, chemistry and biochemistry. 332M: For chemistry and biochemistry majors.

3. Prerequisites: 331, enrollment in 332L highly recommended

4. Textbook(s) and/or Other Required Material

"Organic Chemistry," J. McMurry, 6th edition., "Study Guide and Solutions Manual for McMurry's Organic Chemistry," S. McMurry, 6th edition.

5. Course Learning Objectives

6. Topics Covered

Aromatic substitution, alcohols and phenols, ethers and epoxides, aldehydes and ketones, carboxylic acids, carboxylic acid derivatives, carbonyl reactions, carbonyl condensations, amines, heterocycles, polymers, orbital symmetry, carbohydrates.

7. Class/Laboratory Schedule

Three 50-minutes lectures, one 50-minute recitation.

8. Contribution of Course to Meeting Professional Component

This is a foundation course, providing the student with the background in chemistry necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

This course is one component of the chemistry-sciences related outcomes.

10. Person(s) who Prepared this Description and Date of Preparation

Janet Putnam - March, 2006

Chem 332L. Laboratory in Organic Chemistry.

Required – FBE Option

1. Course Name: Chem 332L. Laboratory in Organic Chemistry. (Cr. 1)

2. 2005-2007 Catalog Description: Laboratory to accompany 332.

3. Prerequisites: 331L, credit or enrollment for credit in 332

4. Textbook(s) and/or Other Required Material

5. Course Learning Objectives

6. Topics Covered

7. Class/Laboratory Schedule

8. Contribution of Course to Meeting Professional Component

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

10. Person(s) who Prepared this Description and Date of Preparation

Civil Engineering (CE) 332: Structural Analysis I
Required – AES option

Course description: (2-2) Cr. 3. F.S. Prereq: E M 324. Loads, shear, moment, and deflected shape diagrams for beams and framed structures. Approximate methods. Deformation calculations. Application of flexibility methods to frames and continuous beams. Application of moment distribution and stiffness methods to continuous beams and braced frames. Influence lines for determinate and in determinate beams using Muller-Breslau principle. Computer applications to analyze beams and frames. Nonmajor graduate credit.

Textbook(s): (a) Structural Analysis, Sixth Ed., by Hibbeler, R.C., published by Prentice Hall

Course Outcomes: Required as agreed upon by CE Structural Engineering
a. an ability to apply knowledge of mathematics, science, and engineering
e. an ability to identify, formulate and solve engineering problems
k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Students should be able to:
1. Interpret a structural framing plan to determine loads on structural members
2. Sketch idealized structure for analysis
3. Utilize mathematical models to analyze determinate structures
4. Apply knowledge to analyze indeterminate structural systems using alternative analyses methods
5. Use computer software to analyze different structures
6. Check accuracy of computer generated results
7. Utilize knowledge gained from the class to analyze practical problems

Topics to be covered:
- Type of structures and loads.
- Moment, shear, axial loads of determinate structures.
- Deflections in statically determinate structures such as trusses, beams and frames by energy and work method.
- Analysis of statically indeterminate structures by:
  a) force method (consistent deformation)
  b) moment distribution
  c) displacement method
- Computer application using the STAAD III program.
- Influence lines and maximum effects for determinate and indeterminate structures. Calculation of the maximum moments and shear required for design.
- Application of approximate methods to analyze indeterminate structures under gravity and lateral loads.

Contribution of course to meeting the professional components: The course presents a broad base knowledge in civil engineering that includes but is not limited to understanding of mathematics and physical science, use of computers as a tool for analysis and emphasis and the importance of indeterminate structures. The course requires students to utilize the knowledge gained from the prerequisite course to achieve the desired solution.

Class/Laboratory Schedule: Two 50-minute lectures/recitation and one 2-hour laboratory/recitation per week.

Person(s) who prepared this description:

Prepared by: Fouad Fanous May, 2006.

Civil Engineering (CE) 334: Reinforced Concrete Design I
AES Option Elective

Course description: (2-2) Cr. 3. F.S.SS. Prereq: 332, E M 327. Analysis and design of beams, one-way slabs, and columns. Preliminary design of building frames using pattern loading and moment coefficients. Nonmajor graduate credit.

Textbook:

1. Design of Concrete Structures, 13th edition, by Darwin, published by McGraw-Hill
2. Building Code Requirements for Structural Concrete (ACI 318-05) and Commentary by American Concrete Institute
3. Notes on ACI 318-05 Building Code Requirements for Structural Concrete by Portland Cement Association

Course Outcomes:

a. Demonstrate an understanding of the application of mathematics and science to the solution of engineering problems as related to reinforced concrete design.
c.. Demonstrate an ability to design a reinforced concrete system, component, or process to meet the desired loads and needs.
c. Demonstrate the ability to consider alternative engineering problem approaches and solutions.
c. Develop teamwork skills in the design process.
e. Demonstrate an ability to identify, formulate, and solve engineering problems related to reinforced concrete.
f. Promote an understanding of professional and ethical responsibilities.
g. Demonstrate an ability to communicate effectively.
i. Promote recognition for the need to engage in life-long learning.
k. Identify the sources of data and tools available to solve engineering problems.

Topics to be covered:

1. Introduction to the concepts of reinforced concrete design and review of shear, moment, and deflection diagrams and relationships.
2. Flexural analysis and design.
    a. Analysis by alternate design method (working stress design) using cracked and allowable moment concepts
    b. Strength analysis of singly reinforced rectangular beams
    c. Strength of under-reinforced, balanced and over-reinforced beams
    d. Strength design
        1. Single reinforced rectangular beams and one-way slabs
        2. Allowable deflections and distribution of reinforcement
        3. Doubly reinforced rectangular beams
        4. T-beams
3. Shear strength.
    a. Beams without web reinforcement
    b. Beams with web reinforcement
4. Development, length, and anchorage.

a. Bar cutoffs
b. Development lengths

5. Complete design of continuous one-way slabs and beams for flexure, shear, and development.
   a. Continuous one-way slab design
   b. Continuous beam design problem
   c. Design project (in teams)
6. Short columns.
   a. Analysis of axial loaded short columns
   b. Tied
   c. Spiral
   d. Analysis of short columns with axial load plus bending
      1. Interaction diagram
      2. Column design using interaction diagrams
7. Footings.
   a. Design of one-way footing
   b. Design of two-way footing

Class/laboratory schedule: Two 50-minute lectures/recitations per week and one 2-hour laboratory/recitation period per week.

Contribution of course to meeting the professional component: CE 334, serves as a senior level design course bringing together various individual civil engineering components in the utilization of design and analysis solutions as applied to reinforced concrete and civil engineering structures. The course requires the student to seek information from several of the prerequisite courses to achieve the desired solutions. The students obtain information in this course to be utilized in many different kinds of civil engineering structural applications to achieve a safe and potentially economical solution of reinforced concrete structures.

Relationship of course to program objectives:

1. have a comprehensive education in the fundamentals of civil engineering
2. are prepared to undertake civil engineering design tasks
3. demonstrate effective communication skills and teamwork in multi-disciplinary projects
4. play a constructive role to address the needs of society and the environment
5. are motivated to continue their professional development

Prepared by: Max L. Porter on April 19, 1999, and revised spring and fall 2005.

Civil Engineering (CE) 360: Soil Engineering
Elective – AES Option

Course Description: (2-3) Cr. 3. F.S. Prereq: E M 324, credit or enrollment in Geol 201. Introduction to soil engineering and testing. Identification and classification tests, soil water systems, principles of settlement, stresses in soils, and shear strength testing; slope stability, retaining walls, bearing capacity. Non-major graduate credit.

Textbook: Das, B.M., 2006, Principles of Geotechnical Engineering, 6th Ed., Thomson Canada Limited., Toronto, Ontario 686 pp.

Course Outcomes:
1. Apply physical sciences principles to geotechnical engineering processes and problems.
2. Effectively communicate the results of geotechnical engineering tests and analyses in writing.
3. Use graphical presentation techniques to effectively communicate the results of geotechnical engineering tests and analyses.
4. Be able to describe and conduct geotechnical engineering laboratory tests.
5. Be able to analyze and interpret data from geotechnical engineering laboratory tests.
6. Be able to effectively work within a team.
7. Demonstrate an introductory knowledge of the discipline of geotechnical engineering by being able to solve problems associated with soil properties and principles of fundamental soil behavior and their application to soil structure and soil-structure interaction problems.

Topics Covered:
1. Soil properties: formation of engineering soils, particle structure and composition of soils, particle size distributions and test principles, soil consistency and test principles, weight-volume relationships, engineering classification.
2. Soil compaction: Proctor compaction test principles, compaction methods and specifications, quality control methods, compacted soil properties.
3. Soil water: capillary water, seepage and pore pressures, flow nets, effective stresses, seepage forces.
4. Soil stresses: geostatic stresses, Mohr theory, stresses from applied loads.
5. Soil consolidation: consolidation test principles, magnitude and rate of settlement.
6. Shear strength: measurement of shear strength, Mohr-Coulomb theory, shear strength of cohesive and cohesionless soils (3 classes).
7. Lateral earth pressures: Rankine active and passive cases, pressures and forces on retaining walls.
8. Geotechnical site investigations.
9. Slope stability analysis: infinite slopes, slopes with geologic contact, method of slices.
10. Bearing capacity of shallow foundations: bearing capacity equation, shallow foundations on cohesive and cohesionless soils.

Class/Laboratory Schedule: Two 50-minute lectures/recitations per week and one 3-hour laboratory period per week.

Contribution to Professional Component: CE 360 serves to apply earth science knowledge from Geology 201 to civil engineering practice and to extend the engineering mechanics principles from EM 324 to the analysis of engineering soils. The course introduces the student to the discipline of geotechnical engineering, including soil properties and principles of fundamental behavior and their application to soil structure and soil-structure interaction problems. Working in small teams, the students learn to conduct geotechnical laboratory tests, to analyze and interpret data and to apply the data in simplified geotechnical engineering projects. Students will build on their written communication skills by preparing reports on the simplified geotechnical engineering projects. In addition, students will learn effective graphical communication of geotechnical test results and analyses. CE 360 enhances the student's competitiveness for engineering coop, internship and summer positions by developing rudimentary geotechnical engineering testing and analysis skills that would be useful to engineering organizations.

Prepared by: David J. White, March 2006

Civil Engineering (CE) 372. Engineering Hydrology and Hydraulics
Required – AES Option

Course description: (3-2) Cr. 4. F. S. Prereq: E M 378, a course in statistics from the approved department list. The hydrologic cycle: precipitation, infiltration, runoff, evapotranspiration, groundwater, and streamflow. Hydrograph analysis, flood routing, frequency analysis and urban hydrology. Applied hydraulics including pipe and channel flow with design applications in culverts, pumping, water distribution, storm and sanitary sewer systems. Nonmajor graduate credit.

Textbook(s): Hydrology and Hydraulic Systems, by Ram S. Gupta, 2001, 2nd edition, Waveland Press

Course Outcomes:

1. To develop a fundamental understanding and related skills pertaining to hydrological science and engineering hydraulics so that students in the class will

    a. be more knowledgeable about the availability, movement, utilization and control of one of the most important human life sustaining elements—water,
    b. become confident in carrying out the preliminary analysis for engineering projects involving water, and
    c. know what to do to pursue further knowledge and where to go to find additional information on the subjects.

2. To solve basic and practical problems. Students should be able to do:

    a. analyses:
        i. make water balance,
        ii. analyze rainfall data,
        iii. determine infiltration and direct runoff,
        iv. derive unit hydrograph,
        v. change unit hydrograph duration,
        vi. apply unit hydrograph,
        vii. perform flood frequency by data plotting and theoretical analysis, and
        viii. conduct flood routing through reservoirs and rivers.

    b. designs: applications of hydrology and hydraulics in open channel, pipe systems, pumps, stormwater drainage system, detention pond, and storage/control structures.

    c. groundwater computations and analysis.

Topics to be covered:

1. Hydrologic Analyses: hydrologic cycle and components, water balance, precipitation, evaporation & transpiration, flow measurement, Infiltration and direct surface runoff,

streamflow hydrographs, unit hydrographs, Synthetic Unit Hydrograph, design hydrographs, flood routing, and flood frequency analysis.
2. Open Channel Flow: open channel flow principles, uniform flow and design of channels, critical flow and gradually varied flow.
3. Groundwater Hydraulics: groundwater flows, Darcy's law, confined and unconfined aquifers.
4. Pressure Flows--pipe system, pumps and turbines.
5. Urban Drainage System: urban hydrology, computation of stormwater, flow in storm sewers, urban drainage system design, detention pond, roadway drainage system—culverts.
6. Design of storm and sanitary sewer systems, highway culverts, storage and control structures and pumping systems.

Contribution of course to meeting the professional components: The course presents a broad base knowledge in civil engineering that includes but is not limited to understanding of mathematics and physical science, use of computers as a tool for analysis and emphasis and the importance of engineering hydrology and hydraulics. The course requires students to utilize the knowledge gained from the prerequisite course to achieve the desired solution.

Class/Laboratory Schedule: Three 50-minute lectures/recitation and one 2-hour laboratory/problem-solving session per week.

Person(s) who prepared this description: Roy Gu, September, 2005

E M 274. Statics of Engineering.

Required – All Options

1. Course Name: E M 274. Statics of Engineering. (Cr. 3)

2. 2005-2007 Catalog Description: Vector and scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, second moments of areas, principal second moments of area, radius of gyration, internal forces, shear and bending moment diagrams.

3. Prerequisites: Credit or enrollment in Math 166; credit or enrollment in Phys 111 or 221

4. Textbook(s) and/or Other Required Material

"Engineering Mechanics: Statics." 2nd Edition, by W.F. Riley and L.D. Sturges. John Wiley and Sons, Inc., New York. 1996

5. Course Learning Objectives

1. Determine the components of a force in rectangular or nonrectangular coordinates. 2. Determine the resultant of a system of forces 3. Draw complete and correct free-body diagrams and write the appropriate equilibrium equations from the free-body diagram. 4. Determine the support reactions on a structure 5. Determine the connection forces in trusses and in general frame structures 6. Determine the internal reactions in a beam, draw correct shear-force and bending moment diagrams, and write equations for the shear-force and bending moment as functions of position along the beam 7. Analyze systems that include frictional forces 8. Locate the centroid of an area 9. Calculate the second moment of an area, calculate the principal second moments of an area. Each class period will have specific learning outcomes that, collectively over the semester, will accomplish the course learning objectives.

6. Topics Covered

• Scalars and vectors, scalar and vector products • Moment of a force, couple, and equivalent force-couple systems • Centroid, center of mass, center of gravity • Free-body diagrams, types of support reactions • Particle equilibrium, planar equilibrium, and 3-D equilibrium • Trusses, methods of joints and sections. • Frames and machines. • Internal forces; load, shear, and bending moment diagrams. • Friction, belt friction. • Second moment of area, principal second moments.

7. Class/Laboratory Schedule

(3-0) Credit 3. F.S.SS. Three 50-minute class periods per week, 44 class periods total

8. Contribution of Course to Meeting Professional Component

Engineering Science 100%

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

This course substantively addresses learning outcomes: • Apply a basic knowledge of mathematics and/or science to fundamental engineering mechanics problems • Solve engineering

problems This course moderately addresses learning outcomes: • Apply knowledge of engineering to fundamental engineering mechanics problems • Identify and formulate fundamental engineering mechanics problems • Develop and demonstrate written communication skills • Develop the ability to engage in life-long learning

10. Person(s) who Prepared this Description and Date of Preparation
Janet W. Putnam, May, 2006

E M 324. Mechanics of Materials.

Required – All options

1. Course Name: E M 324. Mechanics of Materials. (Cr. 3)

2. 2005-2007 Catalog Description: Plane stress, plane strain, stress-strain relationships, and elements of material behavior. Application of stress and deformation analysis to members subject to centric, torsional, flexural, and combined loadings. Elementary considerations of theories of failure, buckling.

3. Prerequisites: 274

4. Textbook(s) and/or Other Required Material

Mechanics of Materials, W. F. Riley, L.D. Struges, and D.H. Morris. Published by John Wiley & Sons, Inc., New York. 1999.

5. Course Learning Objectives

By completion of the course, students will be able to: • Understand the concepts of stress at a point, strain at a point, and the stress-strain relationships for linear, elastic, homogeneous, isotropic materials • Determine the state of stress from strain rosette measurements • Calculate the stresses and strains associated with axial loads, torsional loads, bending loads, and pressurized circular cylinders both individually and in combination • Determine and illustrate principal stresses, maximum shearing stresses, and the stresses acting on any plane within a structural element • Determine and illustrate the deflections and rotations for axial loading, torsional loading, and bending • Calculate the Euler buckling load on a long, slender column • Apply stress concentration factors and utilize theory of failure criterion Each class period will have specific learning outcomes that, collectively over the semester, will accomplish the course learning objectives.

6. Topics Covered

• Stress, Mohr's circle analysis of stresses • Strain, strain rosette analysis • Stress-strain relationships, thermal effects, design loads • Axial loads, systems of axially-loaded bars • Thin-walled pressure vessels • Torsionally loaded shafts • Flexural loads, flexural stresses and shear stresses in beams • Principal stresses in beams • Deflection of beams using integration, singularity functions, and superposition methods • Combined loading situations • Buckling of columns, Euler formula

7. Class/Laboratory Schedule

(3-0) Credit 3. F.S.SS. Three 50-minute class periods peer week, 44 class periods total

8. Contribution of Course to Meeting Professional Component

Engineering Science 70% Engineering Design 30% Several of the assigned problems involve the design of a member (sizing, picking the most "efficient" member, etc.) or the specification of maximum loads

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

This course substantively addresses learning outcomes: • Apply a basic knowledge of mathematics and/or science to fundamental engineering mechanics problems • Identify and formulate fundamental engineering mechanics problems • Solve engineering problems This course moderately addresses learning outcomes: • Apply knowledge of engineering to fundamental engineering mechanics problems • Analyze and evaluate structural elements • Develop and demonstrate written communication skills • Develop the ability to engage in life-long learning

10. Person(s) who Prepared this Description and Date of Preparation

Janet Putnam - May, 2006

E M 327. Mechanics of Materials Laboratory.

Required – All options

1. Course Name: E M 327. Mechanics of Materials Laboratory. (Cr. 1)

2. 2005-2007 Catalog Description: Experimental determination of mechanical properties of selected engineering materials. Experimental verification of assumptions made in 324. Use of strain measuring devices. Preparation of reports. Students who are not present for the first laboratory meeting of their own sections may qualify for continuation in the course only by attending the first laboratory meeting of some other section of the course.

3. Prerequisites: Credit or enrollment in 324

4. Textbook(s) and/or Other Required Material
Locally printed Laboratory Manual

5. Course Learning Objectives
By completion of the course, students will be able to: • Obtain a general understanding of how different materials behave under uniaxial tensile loading • Determine and compare material properties of various materials • Use Rockwell and Brinell hardness measurements on different steel specimen to compare trends in hardness with other material properties • Determine Poisson's Ratio and the Modulus of Elasticity for several different materials • Conduct a compression test on three types of wood and obtain material properties for the tested sample • Determine the change in stress induced by the introduction of stress concentrations • Study the behavior of strain hardened steel and compare with annealed and cold worked samples • Determine the maximum principal strain and stress for a thin-wall pressure vessel • Develop (shear) stress-strain diagram for three materials in the elastic range and determine the Modulus of Rigidity for the tested materials • Study the combined effects of torsion and axial loading by observing the behavior of a helical spring in compression • Develop a load-deflection diagram from a flexure test of wood and use the results from the experiment to predict material properties • Explore the effects of the moment of inertia in flexure loading • Study the combined effects of bending and axial loading by measuring the strain distribution for a member subjected to an eccentric tensile load • Study the combined effects of torsion and flexural loading by observing the behavior of a circular shaft loaded in torsion and bending • Investigate the stresses and deflection of an I-beam and determine the Modulus of Elasticity of the specimen • Determine the effects of different beam cross-sections n column buckling and predict the critical buckling load for known materials

6. Topics Covered
• Tensile tests • Hardness tests • Poisson's Ratio • Compression loading • Stress Concentrations • Strain Hardening • Thin-wall pressure vessels • Torsion loading • Flexure • Combined effects of torsion and axial loading • Combined effects of torsion and flexural loading • Stresses, deflection, and Modulus of Elasticity of I-beam • Eccentric loading • Column buckling

7. Class/Laboratory Schedule
(0-2) Credit 1. F.S.SS

8. Contribution of Course to Meeting Professional Component
Engineering Science 100%

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course moderately addresses learning outcomes: • Become proficient in the use of laboratory equipment representative of aerospace engineering practice • Understand how to conduct experiments • Analyze and interpret experimental data • Develop and demonstrate written communication skills • Develop and demonstrate teamwork skills • Develop and demonstrate leadership skills This course substantively addresses program educational objectives: • Understand the relationship between theoretical calculations and experimental results. • Understand basic techniques employed in analyzing and interpreting experimental data. This course moderately addresses program educational objectives: • Improve written communication skills. • Improve teamwork skills. • Improve leadership skills.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - May, 2006

E M 345. Dynamics.

Required – PME Option

1. Course Name: E M 345. Dynamics. (Cr. 3)

2. 2005-2007 Catalog Description: Particle and rigid body kinematics, NewtonÆs laws of motion, kinetics of plane motion, rigid body problems using work-energy, linear, and angular impulse-momentum principles, vibrations.

3. Prerequisites: 274, credit or enrollment in Math 266 or 267

4. Textbook(s) and/or Other Required Material
Dynamics, 2nd Ed., W.F. Riley and L.D. Sturges. Published by John Wiley & Sons, Inc., New York. 1996.

5. Course Learning Objectives
By completion of the course, students should be able to: • Calculate the velocity and acceleration of a particle in rectangular coordinates, in polar coordinates, in normal/tangential coordinates • Relate the velocity and acceleration of points in a rigid body using the absolute motion approach and using the relative motion approach • Solve particle kinetics problems using Newton's second law, using work-energy methods, or using impulse-momentum methods • Solve rigid body planar motion problems using the equations of motion, using work-energy methods, using impulse-momentum methods • Solve particle and rigid body impact problems • Solve one-degree-of-freedom vibration problems of particles and rigid bodies in undamped free vibration or damped free vibration Each class period will have specific learning outcomes that, collectively over the semester, will accomplish the course learning objectives.

6. Topics Covered
• Particle kinematics in rectilinear motion • Particle kinematics in rectangular coordinates, polar coordinates, and in path coordinates • Rigid body kinematics • Particle and rigid body kinetics using Newton's second law • Particle and rigid body kinetics using work and energy methods • Particle and rigid body kinetics using impulse and momentum methods • Particle and rigid body impact problems • Free vibrations

7. Class/Laboratory Schedule
(3-0) Credit 3. F.S.SS Three 50-minute class periods per week, 44 class periods total.

8. Contribution of Course to Meeting Professional Component
Engineering Science 100%

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is intended to familiarize students with basic concepts of particle and rigid body kinematics and kinetics as a basis for continued work in dynamics, machine design, vibrations, and space flight dynamics. Generally, the course develops student abilities in the application of fundamental principles of physics to the solution of engineering problems. This course

substantively addresses learning outcomes: • Apply a basic knowledge of mathematics and/or science to fundamental engineering mechanics problems • Identify and formulate fundamental engineering mechanics problems • Solve engineering problems • Develop the ability to engage in life-long learning This course moderately addresses learning outcomes: • Apply knowledge of engineering to fundamental engineering mechanics problems • Develop and demonstrate written communication skills

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - May, 2006

E M 378. Mechanics of Fluids.

Required – All Options or Ch E 356 for FBE

1. Course Name: E M 378. Mechanics of Fluids. (Cr. 3)

2. 2005-2007 Catalog Description: Properties of fluids. Fluid statics. Kinematics and kinetics of fluid flow. Mass, momentum, and energy conservation laws; dimensional analysis; flow in pipes and channels. Selected laboratory experiments.

3. Prerequisites: 274

4. Textbook(s) and/or Other Required Material
A Brief Introduction to Fluid Mechanics 3rd. Edition, by Donald F. Young, Bruce R. Munson, Theodore H. Okiishi, 2004. John Wiley & Sons, Inc., ISBN 0-471-45754-4; and locally printed lab manual

5. Course Learning Objectives
By completion of the course, students will be able to: • Determine the hydrostatic forces on planar and curved structures • Use the control volume approach to fluid mechanics to solve various engineering problems associated with the conservation of mass and momentum • Use the Bernoulli equation and understand its limitations • Use the energy equation in conjunction with head losses and pump or turbine characteristics to solve various engineering problems • Use dimensional analysis and modeling principles to transform problems into dimensionless form, determine appropriate model test conditions, and scale the model result • Determine flow conditions (pressure drop, flow rate, velocity, power required) for various piping systems • Determine lift and rag (based on lift and drag coefficients) on various objects often found in engineering applications • Determine the flow rate and conditions in open channel flows of uniform cross-section • Use and understand the physical principles of simple measuring devices such as manometers, barometers, Pitot-static tubes, flow meters, sluice gates, and weirs • Prepare brief written reports relative to various simple experiments performed in the laboratory • Work effectively as a team member to perform simple experiments and write laboratory reports about the experiments

6. Topics Covered
• Properties of fluids • Forces on planar and curved areas • Buoyancy • Bernoulli Equation • Control volume • Reynolds transport theorem • Conservation of mass • Liner momentum transfer • Conservation of energy • Dimensional analysis • Modeling • Laminar flow in a pipe • Turbulent flow in a pipe • Moody chart • Minor losses, noncircular conduits • Flow rate measurements • Drag • Life • Open Channel Flow • Uniform depth flow

7. Class/Laboratory Schedule
(2-2) Credit 3. F.S.SS

8. Contribution of Course to Meeting Professional Component
Engineering Science 100%

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

This course moderately addresses learning outcomes: • Understand how to conduct experiments • Analyze and interpret experimental data • Develop and demonstrate written communication skills • Develop and demonstrate teamwork skills • Develop and demonstrate leadership skills This course substantively addresses educational objectives: • Understand the relationship between theoretical calculations and experimental results • Understand basic techniques employed in analyzing and interpreting experimental data This course moderately addresses educational objectives: • Improve written communication skills • Improve teamwork skills • Improve leadership skills This course slightly addresses learning outcomes: • Become proficient in the use of laboratory equipment representative of aerospace engineering practice

10. Person(s) who Prepared this Description and Date of Preparation

Janet Putnam - May, 2006

Econ 101. Principles of Microeconomics.

Elective

1. Course Name: Econ 101. Principles of Microeconomics. (Cr. 3)

2. 2005-2007 Catalog Description: Resource allocation, opportunity cost, comparative and absolute advantage. Supply and demand. Marginal analysis. Theories of production and consumption, pricing, and the market system. Perfect and imperfect competition and strategic behavior. Factor markets. Present discounted value.

3. Prerequisites:

4. Textbook(s) and/or Other Required Material

"Microeconomics" by Paul Krugman and Robin Wells, 2004. (Different section - "Microeconomics: Principles and Applications", by Robert E. Hall and Marc Lieberman. 2005. 3rd Edition.)

5. Course Learning Objectives

6. Topics Covered

a. Fundamental principles of microeconomics including decision making processes of consumers and firms. b. Gains from exchange. c. Role of prices in markets. d. Importance of variable costs versus sunk & fixed costs in decision making. e. Social gains from competition. f. Causes & effects of imperfect competition. g. Role of government regulation.

7. Class/Laboratory Schedule

Three 50 minute lectures.

8. Contribution of Course to Meeting Professional Component

This is a foundation course, providing the student with the background in economics necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

This course is one component of learning outcomes related to development of a student's awareness of the impact of engineering in an economic context.

10. Person(s) who Prepared this Description and Date of Preparation

Janet Putnam - March, 2006

Engl 104. First-Year Composition I.

Required – All Options

1. Course Name: Engl 104. First-Year Composition I. (Cr. 3)

2. 2005-2007 Catalog Description: Introduction to college-level writing strategies with emphasis on critical reading and thinking skills. Six to eight major writing assignments with readings from a variety of sources.

3. Prerequisites:

4. Textbook(s) and/or Other Required Material
Odell, Lee, and Katz, Susan M. Writing in a Visual Age. Boston: Bedford/St. Martin's, 2006. Muth, Marcia F., and Kitalong, Karla Saari. Getting the Picture: A Brief Guide to Understanding and Creating Visual Texts. Boston: Bedford/St. Martin's, 2004. Faigley, Lester. The Brief Penguin Handbook. New York: Pearson, 2003. Student's Guide to English 104-105

5. Course Learning Objectives
The purpose of English 104 is to prepare students for communicating well within their academic courses, as well as for their future career. While most of the course will be devoted to writing, students will also participate in small group discussions, interviewing others, analyzing and creating visual communication, and learning how to compose professional email correspondence.

6. Topics Covered
Written - Adapting writing to specific purposes and audiences, using organizational strategies, integrating informational sources into an essay, developing strategies to revise their own writing, avoiding errors that distract/confuse the reader, reflect on/evaluate personal communication processes, strengths, goals, and growth. Oral – Interviewing, being an effective member in a small group (listener/contributor), giving brief oral presentations. Visual – Learning appropriate layout formats, analyzing visual communication, and using "visuals" effectively in presentations. Electronic – Using appropriate languages in emails, developing word processing skills (attachments, tables, etc.)

7. Class/Laboratory Schedule
3 hours lecture/recitation per week.

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in communication skills necessary for further professional development. The course has expanded to include oral, visual and electronic skills development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
Develops written, oral, visual and electronic communication skills. This course is one component of communication-related outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam 2/6/06 - 3/06

Engl 105. First-Year Composition II.

Required – All Options

1. Course Name: Engl 105. First-Year Composition II. (Cr. 3)

2. 2005-2007 Catalog Description: Development of college-level writing strategies with emphasis on arguing a position, analyzing texts, and using primary and secondary sources. Five to seven major writing assignments.

3. Prerequisites: 104 or exemption from 104; credit for or concurrent enrollment in Lib 160

4. Textbook(s) and/or Other Required Material
"Everything's an Argument", 3rd Edition. Andrea A. Lunsford, John J. Ruszkiewicz, and Keith Walters. Boston: Bedford/St. Martin's, 2004. "The Brief Penguin Handbook", Lester Faigley, New York: Pearson, 2003. "Student Guide: English 104-105, Iowa State University, Department of English, 2005-2006.

5. Course Learning Objectives
(See topics covered.)

6. Topics Covered
Written: Analyze professional writing to assess its purpose, audience, and rhetorical strategies; construct arguments that integrate logical, ethical, and emotional appeals; write source papers analyzing a rhetorical situation and identifying and accurately documenting appropriate source material; avoid distracting on confusing sentence-level errors; reflect systematically upon all of your communication processes, strengths, goals, and growth. Oral: give oral presentations (individually or as team) using effective invention, organization, language, and delivery strategies; be effective team member (contributor, listener, presenter). Visual: Rhetorically analyze visual communication (advertisement, film, etc.) and create visual arguments. Electronic: Rhetorically analyze electronic communication, such as emails or websites.

7. Class/Laboratory Schedule
Three 50-minute lecture/recitations

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in communication skills necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of communication outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Engl 314. Technical Communication.

Elective

1. Course Name: Engl 314. Technical Communication. (Cr. 3)

2. 2005-2007 Catalog Description: Theories, principles, and processes of effective written communication in the technical disciplines. Attention to the major strategies for composing technical discourse; techniques of analyzing audiences and writing situations, and for organizing data and information. H. Honors.

3. Prerequisites: 105, junior classification

4. Textbook(s) and/or Other Required Material
"Technical Communication" by Rebecca E. Burnett, 5th Edition..

5. Course Learning Objectives
Understand and apply rhetorical principles to technical communication b. Understand the generic requirements of selected technical documents c. Demonstrate principles of effective document design d. Recognize the influences of organizational settings and communities of practice e. Distinguish one's own disciplinary communication conventions from those of other disciplines f. Participate in the collaborative planning and design of team projects

6. Topics Covered
Written communication in technical contexts (see above). Informational memo, technical articles, data display, creating a proposal. Working in a team to develop and present a project.

7. Class/Laboratory Schedule
Three 50-minute lectures/recitations per week.

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in teamwork, communication skills, and ethical considerations necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of learning outcomes related to – a.teamwork b.communication skills c.consideration of engineering in a context of ethics.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Engr 101. Engineering Orientation.

Required – All Options

1. Course Name: Engr 101. Engineering Orientation. (Cr. R)

2. 2005-2007 Catalog Description: Introduction to the College of Engineering and the engineering profession. Considerations in choosing an engineering curriculum. Information concerning university and college policies, procedures, and resources. Opportunities to interact with departments.

3. Prerequisites:

4. Textbook(s) and/or Other Required Material

5. Course Learning Objectives

To introduce students to other engineering students and encourage them to make friends and form study groups, familiarize students with Iowa State University and the College of Engineering, provide them with knowledge and resources to succeed at ISU and beyond, identify potential barriers to success and familiarize students with engineering and the different engineering disciplines.

6. Topics Covered

Time management, resume writing, learning styles assessment, career development competencies, functions of engineering, Academic Success Center, sessions presented by different engineering 'majors', study abroad opportunities. Students are encouraged to attend the Study Abroad Fair and Career Expo.

7. Class/Laboratory Schedule

One 50-minute lecture for 15 weeks.

8. Contribution of Course to Meeting Professional Component

This is a foundation course, providing students with an introduction to the profession of engineering on which to continue further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

This course contributes to learning outcomes related to life-long learning and engineering applications in a global context.

10. Person(s) who Prepared this Description and Date of Preparation

Janet Putnam - March, 2006

Engr 160. Engineering Problems with Computer Applications Laboratory.

Required – All Options

1. Course Name: Engr 160. Engineering Problems with Computer Applications Laboratory. (Cr. 3)

2. 2005-2007 Catalog Description: Solving engineering problems and presenting solutions through technical reports. Significant figures. Use of SI units. Graphing and curve-fitting. Flowcharting. Introduction to material balance, mechanics, electrical circuits, statistics and engineering economics. Use of spreadsheet programs to solve and present engineering problems. Solution of engineering problems using computer programming languages. (The honors section includes application of programming to mobile robotics).

3. Prerequisites: Satisfactory scores on mathematics placement examinations; credit or enrollment in Math 142, 165

4. Textbook(s) and/or Other Required Material

"Engineering Fundamentals and Problem-Solving", 4th Edition, Eide et al. "Engr 160 & 160H Course Supplement", edited by Martha Selby, 200-2006 (pages in italics).

5. Course Learning Objectives

1. To develop in students a systematic approach to engineering problem solving. 2. To give students an understanding of an essential set of computer programming skills. 3. To develop in students an understanding of a variety of ways in which a spreadsheet program can be used as a problem solving tool. 4. To increase written communication skills, including the use of graphs and charts. 5. To increase group functioning skills and oral communication skills.

6. Topics Covered

Engineering presentation/Writing, Engineering solutions, dim., units and significant figures, graphing, Excel graphing, Flowcharting, VBA (Visual Basic) functions, procedures, files, one-dimensional arrays, two-dimensional arrays, Excel VBA applications, Statistics, statistics using Excel, Mechanics (statics), Engineering Economics.

7. Class/Laboratory Schedule

Two 2-hr lecture/labs

8. Contribution of Course to Meeting Professional Component

This is a foundation course, providing background in engineering concepts necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

This course helps engineering programs meet the following ABET outcomes – an ability apply knowledge of mathematics, science, and engineering, to identify, formulate, and solve engineering problems, to communicate effectively and function on multi-disciplinary teams.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Engr 170. Engineering Graphics and Introductory Design.

Required – All Options

1. Course Name: Engr 170. Engineering Graphics and Introductory Design. (Cr. 3)

2. 2005-2007 Catalog Description: Integration of fundamental graphics, computer modeling, and engineering design. Applications of multiview drawings and dimensioning. Techniques for visualizing, analyzing, and communicating 3-D geometries. Application of the design process including written and oral reports. Freehand and computer methods.

3. Prerequisites: Satisfactory scores on mathematics placement examinations; credit or enrollment in Math 142

4. Textbook(s) and/or Other Required Material
This course contributes to learning outcomes related to life-long learning and engineering applications in a global context.

5. Course Learning Objectives
Represent and control mental images, graphically represent technical designs using accepted standard practices, use plan and solid geometric forms to create and commuinicate design solutions, solve technical design problems using CAD, communicate graphically using sketches and CAD, apply technical graphics principles to many engineering disciplines, learn the design process through reverse engineering, and apply the design process to an open-ended design problem.

6. Topics Covered
Introduction to graphics communication; Integrated design and 3-D modeling with CAD; Constraints and construction geometry; 3-D construction, 3-D sweeps, parametric equations, global parameters; assembly modeling; sketching, modeling, and visualization; coordinate space; multiview drawings; pictorial drawings; auxiliary views; section views; dimensioning and tolerancing practices; reading and constructing working drawings; oral/written communication; engineering design process

7. Class/Laboratory Schedule
Two 2-hour sessions, lecture integrated with laboratory.

8. Contribution of Course to Meeting Professional Component
Course includes 1 cr. of engineering design, 1 credit of traditional graphics, and 1 credit of computer-aided design.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

Addresses following ABET criteria. a. An ability to apply knowledge of mathematics, science, and engineering. b. An ability to design a system, component, or process to meet desired needs. c. An ability to function on multidisciplinary teams. d. An understanding of professional and ethical responsibility. e. An ability to communicate effectively. f. Recognition of the need for and an ability to engage in lifelong learning.

10. Person(s) who Prepared this Description and Date of Preparation

Janet Putnam - March, 2006

I E 305. Engineering Economic Analysis.

Elective

1. Course Name: I E 305. Engineering Economic Analysis. (Cr. 3)

2. 2005-2007 Catalog Description: Economic analysis of engineering decisions under uncertainty. Financial engineering basics including time value of money, cash flow estimation, and asset evaluation. Comparison of project alternatives accounting for taxation, depreciation, inflation, and risk.

3. Prerequisites: Math 166

4. Textbook(s) and/or Other Required Material

"Fundamentals of Engineering Economics", by Chan Park. Pearson Prentice Hall 2004. ISBN: 0-13-030791-2

5. Course Learning Objectives

Upon successfully completing this course, students will: 1. Understand the role of engineers in business. 2. Be able to apply the principle of the time value of money in business and personal economic decisions. 3. Be able to compare alternative projects on the basis of equivalence methods and rate of return analysis. 4. Be able to develop after-tax cash flows for a project. 5. Know how to account for risk and uncertainty in economic decision-making.

6. Topics Covered

Rational Decision-Making Process Time Value of Money Equivalence Calculations Inflation Present-Worth Analysis Annual Equivalence Analysis Rate of Return Analysis Accounting for Depreciation and Income Taxes Project Cash Flow Development Sensitivity, Break-Even and Scenario Analysis Probabilistic Risk Analysis

7. Class/Laboratory Schedule

Three 50-minute lectures per week.

8. Contribution of Course to Meeting Professional Component

Students will learn the key concepts of engineering economic analysis, and how to apply these concepts in identifying, formulating, and solving economic decision problems that are relevant to manufacturing and service enterprises. Students will also learn the quantitative and analytical techniques typically used in the problem solving processes. Also, students will gain team project experience in realistic industry-motivated case study projects. 3 credits of engineering topics.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

This course is one component of learning outcomes related to the development of engineering analysis and judgements.

10. Person(s) who Prepared this Description and Date of Preparation

Sarah Ryan 3/10/06 for Janet Putnam

Lib 160. Library Instruction.

Required – All Options

1. Course Name: Lib 160. Library Instruction. (Cr. 0.5)

2. 2005-2007 Catalog Description: Use of libraries and information sources, both print and electronic, including locations and services of the University Library with an emphasis on basic library research tools and information literacy concepts. To be taken as early as possible in the studentÆs undergraduate career. See course descriptions of Engl 105 and 105H for prerequisite related to Lib 160.

3. Prerequisites: for students whose native language is not English: Completion of English 101 requirement

4. Textbook(s) and/or Other Required Material
"Library 160 Independent Study Manual" Fall 2005. ISU.

5. Course Learning Objectives
Introduce students to the use of academic and research libraries, available library services, and electronic information resources, with an emphasis on information literacy and research process. This course promotes student self-directed learning and provides a foundation for life-long learning.

6. Topics Covered
Library Facilities Orientation; Searching the Library Catalog by Author, Title or Subject Heading; Searching the Library Catalog by Keyword; Electronic Indexes to Periodical Literature; Print Indexes to Periodical Literature.

7. Class/Laboratory Schedule
8 weeks course, Classes begin with the Introductory Lecture (1 hr) : Monday-Friday, the first week. Completion of the course is on an independent basis with assignments due each week and a final exam the last week.

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in utilizing library resources necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of learning outcomes related to life-long learning.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

M E 324. Manufacturing Engineering

Required – PME Options

Course (catalog) description

Plastic deformation and work hardening. Manufacturing processes including forming, machining, casting and welding with emphasis on manufacturing considerations in design. Modern manufacturing practices. Laboratory exercises will be an integral component of the course.

Prerequisite(s)

ME 270, Introduction to Mechanical Engineering Design; Mat E 272, Principles of Materials Science and Engineering; EM 324, Mechanics of Materials

Textbook(s) and/or other required material

1. Kalpakjian, S. and Schmid, S., *Manufacturing Processes for Engineering Materials*, Fourth Edition, Prentice Hall, 2004
2. Laboratory Manual on *Teksoft Milling*

Course objectives

After taking this course students will be able to:

1. Identify the capabilities and limitations of different manufacturing processes in terms of their feasibility, capital needs, economic considerations, etc.
2. Plan sequentially the steps in processing a part taking into account the geometrical complexity, process capabilities, surface finish, and tolerances for assembly
3. Analyze the feasibility of manufacturing processes in terms of the material properties, capital equipment needs, worker skill, and ecological considerations
4. Analyze the effect of a manufacturing process on the properties of the end product including surface integrity and residual stresses
5. Apply the design and manufacturing integration approach to produce quality product at minimum cost
6. Use teamwork to produce a part by reverse engineering and for communication of results

Topics covered

- Tensile Test**:** Mechanical properties of materials including tensile, hardness, impact and fatigue
- Casting**:** Solidification phenomena, cast structures, castability of materials, casting defects, casting processes, design the casting process for fabrication of a part, AFS solidification software for casting design
- Welding**:** Arc, resistance and special welding processes, weldability of different materials, effect of welding on microstructure and mechanical properties, weld distortion and residual stresses, weldment design, robotic arc welding
- Forming**:** Work-hardening behavior of materials, effect of cold-working on mechanical properties, analysis of processes such as forging, extrusion, wire drawing, etc. by ideal work and slab methods, design forming sequence involving cold working and annealing concepts,

sheet metal forming sequence of operations in compound and progressive dies, and forming limit diagrams

- Machining: Cutting parameters and their effect on chip formation, heat build-up, and surface integrity, selection of proper cutting conditions, calculation of cutting power requirements, cutting tool materials, tool geometry on cutting conditions and surface finish. Machinability, economics of machining, CNC program for making a part, and the capabilities of numerical, adaptive, and robotic controls as applied to manufacturing.

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week
One two-hour laboratory session per week

Laboratory schedule

- Casting processes such as sand casting, lost foam and investment casting
- Welding processes such as oxyacetylene welding, arc welding – different kinds, robotic welding, spot welding
- Coldworking and annealing treatments, forging, extrusion and bending
- Machining operations and cutting tools, surface roughness measurement
- Group project involving CNC machining with project written report

Contribution of course to meeting the professional component

Engineering Topics with Design: 4 credits

Relationship of course to program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives
- Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints
- Students will not only be able to apply their engineering knowledge to real-life design problems but also to critically evaluate the solutions

Person(s) who prepared this description and date of preparation

Molian, February 7, 2006

M E 325. Machine Design
Required – PME Option

Course (catalog) description

Philosophy of design and design methodology. Consideration of stresses and failure modes useful for static and fatigue loading. Analysis, selection and synthesis of machine elements.

Prerequisite(s)

Engr 170, Engineering Graphics and Introductory Design; EM 324, Mechanics of Materials; Stat 305, Engineering Statistics.

Textbook(s) and/or other required material

Shigley, Mischke and Budynas, *Mechanical Engineering Design*, 7th edition, McGraw-Hill, 2004

Course objectives

Upon completion of ME 325, students should be able to:

1. Apply design theory and methodology to the task of generating design alternatives.
2. Identify the functional characteristics of various machine elements.
3. Evaluate design alternatives using a utility function.
4. Design or select bearings, gears and shafts for a specific application.
5. Apply static and fatigue failure theories to the design of machine components.
6. Work effectively with team members in achieving final design results.
7. Communicate design results in written and oral reports.
8. Appreciate mechanism and machine design in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Topics covered

- Machine element failure theories (static and fatigue)
- Design/select specific machine elements
- Shafts
- Bearings
- Gears
- Team-based design project

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week

Contribution of course to meeting the professional component

Engineering Topics with Design: 3 credits

Relationship of course to program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.
- Students will not only be able to apply their engineering knowledge to real-life design problems but also to critically evaluate the solutions.
- Students will learn to effectively work in teams to solve engineering problems involving a disciplined process of critical thinking that crosses content boundaries.

Person(s) who prepared this description and date of preparation

Flugrad; February 20, 2006

M E 330. Thermodynamics.

Required – All Options

Course Name: M E 330. Thermodynamics. (Cr. 3)

Course (catalog) description

For students electing one course in engineering thermodynamics. First and second laws of thermodynamics. Properties and processes for pure substances. Selected applications including cycles for power and refrigeration. Psychrometrics. Credit for either 231 or 330, but not both, may be applied toward graduation. Majors in mechanical engineering may not apply M E 330 toward a degree in mechanical engineering.

Prerequisite(s)

Phys 222, Introduction to Classical Physics II

Textbook(s) and/or other required material

3. Moran, M. and Shapiro, H., *Fundamentals of Engineering Thermodynamics*, Fifth Edition, John Wiley and Sons, 2004.
4. Shapiro, H., Van Gerpen, J., and Bathie, W., *Property Tables and Figures for Engineering Thermodynamics*, John Wiley Custom Services, 2000.

Course objectives

1. Use thermodynamic terminology and concepts appropriately.
2. Define appropriate system boundaries for analyzing a variety of thermodynamic components and systems.
3. Determine and calculate the appropriate energy transfers and system properties to solve closed system processes and cycles.
4. Determine and calculate the appropriate mass and energy transfers and properties to solve steady flow open system applications with any number of heat, work, or mass flows crossing the system boundary.
5. Determine and calculate appropriate mass and energy transfers and properties to solve transient open system applications.
6. Use tables, charts, equations, and software to fix states of a pure substance and determine relationships among pressure, temperature, specific volume, internal energy, enthalpy, and entropy.
7. Determine when a process is reversible, irreversible, or impossible.
8. Calculate states and performance parameters for vapor power cycles based on the Rankine cycle with superheat, reheat, and regeneration.
9. Appreciate thermodynamics in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Topics covered

- Definition of units and thermodynamic quantities (3 days)
- First law concepts applied to closed systems (6 days)
- Property evaluations for generalized thermodynamic substances and ideal gases (8 days)

- Energy and mass analysis for control volumes (9 days)
- Second law of thermodynamics (4 days)
- Entropy evaluations (9 days)
- Vapor power systems (6 days)

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week

Contribution of course to meeting the professional component

Engineering Topics with Design: 3 credits

Relationship of course to the program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will be aware of social and environmental aspects of engineering, as well as the ethical standards of the engineering profession.

Person who prepared this description and date of preparation

Nelson, February 10, 2006

M E 436. Heat Transfer

Elective – PME Option or FBE Option

Course (catalog) description

Heat Transfer by conduction, convection, and radiation. Similarity concepts in heat, mass, and momentum transfer. Methods for determination of heat transfer coefficients. Combined modes of heat transfer. Heat exchangers. Lab experiments and experiments emphasizing concepts in thermodynamics and heat transfer. Written reports are required. Nonmajor graduate credit.

Prerequisite(s)

ME 335, Fluid Flow

Textbook(s) and/or other required material

Incropera, F. P. and Dewitt, D. P., *Fundamentals of Heat and Mass Transfer*, Fifth Edition, John Wiley and Sons, 2002

Course objectives

After taking this course students will be able to:

1. Identify the primary mode(s) of heat transfer applicable to a specific situation and perform energy balances across control volumes and surfaces.
2. Recognize symmetry and the simplifications it provides in heat transfer problem solution.
3. Translate a physical situation into the appropriate form of the conduction equation and the corresponding boundary and initial conditions to compute temperature distributions and heat flows in objects that may or may not be generating heat.
4. Compute the enhancement of heat transfer resulting from the use of extended surfaces.
5. Develop the ability to recognize the conditions necessary for the application of approximate and detailed techniques for the computation of temperature variations with time and space in solids.
6. Identify the flow regimes and boundary conditions in external and internal flows and use pertinent non-dimensional variables to compute heat transfer coefficients while distinguishing between local and average coefficients.
7. Obtain an awareness of the various empirical correlations for forced and natural convection and recognize their applicability to different physical situations.
8. Predict heat transfer due to radiation from ideal and actual surfaces and enclosures, while accounting for directional and spectral variations in surface properties.
9. Gain an appreciation of the different types of heat exchangers and their applicability to particular situations.
10. Predict heat exchanger performance given size and inlet conditions, and also design the geometry of a heat exchanger required to deliver a desired heat transfer rate.
11. Compute spatial and temporal temperature variations and heat flows in 1- or 2-dimensional objects using the appropriate numerical techniques.
12. Measure thermal conductivities of solids, and compute heat transfer coefficients and heat duties from measured temperatures and flow rates and report and discuss experimental results.

13. Appreciate heat transfer in the context of contemporary issues and the interplay of technological, social, and political factors in resolving or exacerbating problems facing society.

Topics covered

Class Topics:

- Heat transfer and its relation to thermodynamics, conservation of energy, modes of heat transfer (4 days)
- Steady-state conduction in plane, cylindrical and spherical systems, resistance networks (5 days)
- Extended surface heat transfer, fin efficiency, finned-surface efficiency (2 days)
- Unsteady conduction (lumped capacitance, plane walls and cylinders, semi-infinite solids) (3 days)
- Numerical analysis of steady and unsteady conduction (1 day)
- Convection boundary layers, laminar and turbulent flow, non-dimensionalization of variables (4 days)
- External flow, empirical heat transfer correlations, variable fluid properties (4 days)
- Internal flow empirical heat transfer correlations, variable fluid properties (4 days)
- Natural convection on surfaces and enclosures, mixed convection (2 days)
- Heat exchangers: types, LMTD method, ε-NTU method, fouling, finned and cross-flow (4 days)
- Radiation physics, black body radiation exchange, shape factors, gray, diffuse surfaces, solar radiation (6 days)
- Multimode heat transfer (2 days)

Laboratory Topics:

- Linear heat conduction
- Extended surfaces
- Unsteady heat transfer
- External convection
- Internal convection
- Free convection
- Heat exchangers
- Radiation heat transfer

Class/laboratory schedule, i.e., number of sessions each week and duration of each session

Three one-hour class sessions per week
Eight two-hour laboratory sessions during the semester

Contribution of course to meeting the professional component

Engineering Topics with Design: 4 credits

Relationship of course to program objectives

This course addresses the following program objectives:

- Students will attain the basic knowledge required to understand and analyze mechanical engineering systems.
- Students will be able to apply engineering principles to create, analyze or improve processes, devices or systems to accomplish desired objectives.
- Students will develop engineering judgment through open-ended problems that require establishment of reasonable engineering assumptions and realistic constraints.
- Students will not only be able to apply their engineering knowledge to real-life design problems, but also to critically evaluate the solutions.

Person(s) who prepared this description and date of preparation: Battaglia and Heindel, February 2006

Mat E 272. Principles of Materials Science and Engineering.

Required – PME Option

1. Course Name: Mat E 272. Principles of Materials Science and Engineering. (Cr. 2)

2. 2005-2007 Catalog Description: Introduction to the structure of metals, polymers and ceramics. Crystal structure and imperfections in metals. Diffusion, mechanical properties, and failure mechanisms. Phase equilibrium diagrams and heat treatment principles for steels, cast irons, composite materials, and aluminum alloys. Corrosion and electrical properties. Engineering applications. Only one of 211, 272, or 392 may count toward graduation.

3. Prerequisites: Chem 167 or 177

4. Textbook(s) and/or Other Required Material

The textbook covers more material, in more depth, than the lectures or the course notes. You are ONLY responsible for the topics I go over in class and presented in the course notes. The textbook, therefore, should be used to elucidate concepts discussed in class and provide additional examples of numerical calculations. The course notes are meant as a note taking aid so that you (and I) don't have to do a lot of writing.

5. Course Learning Objectives

To develop an understanding of; 1) the relationships that exist between the structure of a material and its mechanical properties and, 2) the engineering methods used in modifying or controlling structure to achieve desired properties. The first part of the course is designed to introduce the student to the basic structure of materials (e.g. lattices, lattice geometry, crystal structure, defects, microstructure), phase diagrams, diffusion and stress-strain behavior in materials. The remainder of the course focuses on the application of these concepts to the various material systems - metals, ceramics, polymers and composites. Several lectures are devoted to specific, technologically important materials such as steel, aluminum, concrete and common structural polymers. The second page of the syllabus details the specific topics covered in the course.

6. Topics Covered

There will be TWO ~18 question multiple-choice exams during the semester (1 hour each, in class). You will only need to answer ~16 questions correctly to receive a 100% on the exam. Some questions may have partial credit answers. I will grade all the questions on the exam and you will score either 100% or the total of all questions. In that way you can make several errors and still score 100%. Approximately 1/3 of the questions on the exams will be questions from the Practice Problems or Quizzes. No "cheat sheets" will be allowed. I will provide basic equations and constants. No makeup exams are allowed unless pre-approved or you have a very good excuse. Practice Exams are Located at the back of the Course Packet.

7. Class/Laboratory Schedule

See schedule on office door. TA Office Hours: TBA

8. Contribution of Course to Meeting Professional Component

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam, June 2006

Math 142. Trigonometry and Analytic Geometry.

Elective – required proficiency in college

1. Course Name: Math 142. Trigonometry and Analytic Geometry. (Cr. 3)

2. 2005-2007 Catalog Description: May be taken concurrently with 140. Trigonometric functions and their inverses, solving triangles, trigonometric identities and equations, graphing, polar coordinates, complex numbers, standard equations of lines and conic sections, parametric equations. Students in the College of Liberal Arts and Sciences may not count Math 140, 141, 142, 149, or 195 toward Group III of the General Education Requirements. Only one of 141, 142 may count toward graduation.

3. Prerequisites: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of high school geometry, or enrollment in 140

4. Textbook(s) and/or Other Required Material

Precalculus", by Sullivan, 7th Edition.

5. Course Learning Objectives

This course is designed to meet the needs of students planning to take Calculus and other courses requiring analytical geometry and numerical aspects of trigonometry.

6. Topics Covered

Angles and their formulas, trig functions and identities, phase shift, inverse sine cosine and tangent functions, sum and different formulas, product-to-sum and sum-to-product formulas, law of sine and cosine, polar coordinates-equations and graphs, complex plane, DeMoivre's Theorem, conics, parabola, ellipse, hyperbola, rotation of axes, plane curves and parametric equations.

7. Class/Laboratory Schedule

Two 50-minute lectures, one 50-minute recitation. Also offered "on-line" with two 50-minute 'help sessions' per week.

8. Contribution of Course to Meeting Professional Component

- Prepares students to succeed in upper-level foundation mathematics courses necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

This course is an additional component of mathematics computation related learning outcomes.

10. Person(s) who Prepared this Description and Date of Preparation

Janet Putnam - March, 2006

Math 165. Calculus I.

Required – all options

1. Course Name: Math 165. Calculus I. (Cr. 4)

2. 2005-2007 Catalog Description: Differential calculus, applications of the derivative, introduction to integral calculus. Only one of 151 or 160 or the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

3. Prerequisites: Satisfactory performance on placement exam, 2 years of high school algebra, 1 year of geometry, 1 semester of trigonometry or enrollment in 141 or 142

4. Textbook(s) and/or Other Required Material
"Calculus" Varberg, Purcell and Rigdon, 8th Edition.

5. Course Learning Objectives
a. Use graphical and numerical evidence to estimate limits and identify situations where limits fail to exist. b. Apply rules to calculate limits. c. Use the limit concept to determine where a function is continuous. d. Use the limit definition to calculate a derivative or to determine when a derivative fails to exist. e. Calculate derivatives (of first and higher orders) with pencil and paper, without calculator or computer algebra software f. Use the derivative to find tangent lines to curves g. Calculate derivatives of functions defined implicitly h. Interpret the derivative as a rate of change. Solve problems involving rates of change of variables subject to a functional relationship. i. Approximate functions by using linearization (differentials.) j. Find critical points, and use them to locate maxima and minima. k. Use critical points and signs of first and second derivatives to sketch graphs of functions. l. Use differential calculus to solve optimization problems. m. Apply the Mean Value Theorem. n. Use Newton's method to improve approximate roots of equations. o. Find antiderivatives of functions: apply antiderivatives to solve separable first-order differential equations. p. Use the definition to calculate a definite integral as a limit. q. Apply the Fundamental Theorem of Calculus to evaluate definite integrals and to differential functions defined as integrals. r. Calculate elementary integrals with pencil and paper, without calculator or computer algebra software. s. Use the relation between the derivative of a one to one function and the derivative of its inverse. t. Calculate with exponentials and logarithms to any base. u. Use Logarithmic differentiation. v. Use models describing exponential growth and decay.

6. Topics Covered
Limits, the derivative, applications of the derivative, the integral, and transcendental functions.

7. Class/Laboratory Schedule
Four 50-minute lectures or three 50-minute lectures, one 50-minute recitation.

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in mathematics necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the mathematics computation related learning outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Math 166. Calculus II.

Required – all options

1. Course Name: Math 166. Calculus II. (Cr. 4)

2. 2005-2007 Catalog Description: Integral calculus, applications of the integral, infinite series. Only one of 151, 160, the sequence 165-166, or the sequence 181-182 may be counted towards graduation.

3. Prerequisites: Grade of C- or better in 165, 165H, or high math placement scores

4. Textbook(s) and/or Other Required Material
"Calculus", by Varberg, Purcell and Rigdon. 8th Edition.

5. Course Learning Objectives
a. Develop problem solving ability and flexibility in using the tools of integral calculus and vectors in problem solving. This includes appropriate use of technology and the ability to use graphical, numerical, and symbolic techniques in investigating problems. b. Understand the definition of the definite integral and use the definition to obtain approximations of integrals c. Evaluate simple integrals by hand, more complicated integrals with the aid of tables and reduction formulas d. Be able to use a calculator or computer to implement a numerical integration procedure (trapezoid rule, midpoint rule, or Simpson's rule.) e. Use a partition-sum approach to model phenomena that can be studied with the integral (work, center of mass, volume, etc.) f. Be able to use vectors to analyze motion in two and three dimensions, including analysis of acceleration in terms of tangent and normal components g. Be able to use vectors to analyze motion in two and three dimensions, including analysis of acceleration in terms of tangent and normal components h. Know the definition of linear function and be able to show that a function is linear (or that it is not.) i. Be able to work with matrices, including representation of linear functions and applications involving determinants j. Understand and be able to work with lines and planes in three dimensions. k. Be able to analyze an equation for a function of two variables and use this analysis to draw a graph or interpret a graph produced by a graphics package. Understand parametric representation of surfaces and, for simple functions, select an appropriate parametric representation (for example, one that would produce a good picture when used in a plotting package.) l. Understand cylindrical and spherical coordinates, their relationship to parametric representations, and be able to sketch graphs of simple functions expressed in these coordinate systems. m. Understand the definition of partial derivative and be able to calculate partial derivatives. n. Be able to calculate and work with the gradient function.

6. Topics Covered
Applications of the integral, techiques of integration, indeterminate forms and improper integrals, infinite series, conics and polar coordinates.

7. Class/Laboratory Schedule
Four 50-minute lectures or Three 50-minute lectures and one 50-minuite recitation.

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in mathematics necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the mathematics computation related learning outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Math 265. Calculus III.

Elective

1. Course Name: Math 265. Calculus III. (Cr. 4)

2. 2005-2007 Catalog Description: Analytic geometry and vectors, differential calculus of functions of several variables, multiple integrals, vector calculus.

3. Prerequisites: Grade of C- or better in 166 or 166H

4. Textbook(s) and/or Other Required Material
"Calculus", Varberg, Purcell and Rigdon, 8th Edition

5. Course Learning Objectives
1. Develop problem solving ability and flexibility in using the tools of multivariable and vector calculus and series in problem solving. This includes appropriate use of technology and the ability to use graphical, numerical, and symbolic techniques in investigating problems. 2. Know and be able to discuss the definition of differentiabiality for functions with domain and range in R,, R2, R3. Be able to write the Jacobian matrix for such functions. 3. Understand the statement of the Chain rule for vector-valued functions of several variables and use the chain rule to calculate derivatives and Jacobian matrices for such functions. 4. Be able to model and solve optimization problems for functions of several variables. This includes optimization with constraints and the use of Lagrange multipliers. 5. Understand the definition of multiple integral for real-valued functions of two and three variables. Be able to set up an iterated integral for evaluation of a multiple integral and be able to evaluate iterated integrals. 6. Know the definition of linear function and be able to show that a function is linear (or that it is not.) 7. Be able to work with matrices, including representation of linear functions and applications involving determinants. 8. Understand and be able to work with lines and planes in three dimensions. 9. Be able to construct Taylor polynomials for simple elementary functions. 10. Understand the meaning and importance of error when dealing with approximations, and be able to work with and provide error estimates for approximation with Taylor polynomials. 11. Determine intervals for convergence for power series and construct power series representations for simple elementary functions. 12. Be able to use comparison, integral, ration, and / or alternating series test to analyze

6. Topics Covered
Geometry and vectors, the derivative in n-Space, the integral in n-Space, vector calculus

7. Class/Laboratory Schedule
Four 50-minute lectures or Three 50-minute lectures, one 50-minute recitations

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing the student with the background in mathematics necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is a component of mathematics computation related learning outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Math 266. Elementary Differential Equations.

Required – all options

1. Course Name: Math 266. Elementary Differential Equations. (Cr. 3)

2. 2005-2007 Catalog Description: Solution methods for ordinary differential equations. First order equations, linear equations, constant coefficient equations. Eigenvalue methods for systems of first order linear equations. Introduction to stability and phase plane analysis.

3. Prerequisites: Grade of C- or better in 166 or 166H

4. Textbook(s) and/or Other Required Material

– "Elementary Differential Equations and Boundary Value Problems" by W. Boyce and R. DiPrima. 8th edition

5. Course Learning Objectives

a. Be able to identify types of differential equations and use appropriate methods to solve them. b. Learn how differential equations are used to model physical systems and other applied problems. c. Gain an elementary understanding of the theory of ordinary differential equations.

6. Topics Covered

a. Solution methods for ordinary differential equations, and their corresponding initial value problems for the following types of equations: 1. scalar first order linear separable exact 2. second order linear constant coefficient ,both homogeneous and nonhomogeneous 3. higher order linear constant coefficient ; both homogeneous and nonhomogeneous 4. first order constant coefficient systems ; both homogeneous and nonhomogeneous b. Use differential equations as models for some simple physical systems and problems, including population dynamics, stirred tank reactors, spring-mass systems, electrical circuits, and compound interest problems. c. Find equilibrium solutions of autonomous first order ordinary differential equations and classify them according to stability. d. Elementary theory of ordinary differential equations, including exposure to existence and uniqueness theorems, linear independence of solutions, general solutions. f. Identify critical points of nonlinear systems in the plane and apply linear stability analysis to them.

7. Class/Laboratory Schedule

266: Three 50-minute lectures per week

8. Contribution of Course to Meeting Professional Component

This is a foundation course, providing the student with the background in mathematics necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

This course is one component of mathematics computation related learning outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Micro 302. Biology of Microorganisms.

Required – FBE option

1. Course Name: Micro 302. Biology of Microorganisms. (Cr. 3)

2. 2005-2007 Catalog Description: Basic cell biology, physiology, metabolism, genetics and ecology of microorganisms, with an emphasis on procaryotes and viruses, as well as the roles of microorganisms in the environment, disease, agriculture, and industry.

3. Prerequisites: Biol 211, credit or enrollment in Biol 212; 1 semester of chemistry

4. Textbook(s) and/or Other Required Material

"Brock Biology of Microorganisms 11th Edition. Madigan and Martinko, Pearson/Prentice Hall, 2006.

5. Course Learning Objectives

This course covers the core concepts and fundamentals of microbiology, while focusing primarily on bacteriology, virology and immunology. The goal of the course is to assist students in developing a sound conceptual foundation of the discipline of microbiology and to adequately prepare them for more advanced microbiology courses as well as other courses in the biological sciences.

6. Topics Covered

The topics covered include: procaryotic cell biology, taxonomy, metabolism, and genetics; the growth and control of microorganisms; microbial interactions with animals and plants; immunology; virology; and the role of microbes in the environment, in animal and plant health, and in food production.

7. Class/Laboratory Schedule

Two 50-minute lectures and one 1 hour lab per week.

8. Contribution of Course to Meeting Professional Component

This is a foundation course providing the student with the background necessary in microbiology for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

This course is one component of the microbiology sciences related learning outcomes.

10. Person(s) who Prepared this Description and Date of Preparation

Janet Putnam - March, 2006

Phys 221. Introduction to Classical Physics I.

Required – all options

1. Course Name: Phys 221. Introduction to Classical Physics I. (Cr. 5)

2. 2005-2007 Catalog Description: For engineering and science majors. 3 hours of lecture each week plus 3 recitations and 1 laboratory every 2 weeks. Elementary mechanics including kinematics and dynamics of particles, work and energy, linear and angular momentum, conservation laws, rotational motion, oscillations, gravitation. Electric forces and fields. Electrical currents; DC circuits.

3. Prerequisites: Credit or enrollment in Math 166

4. Textbook(s) and/or Other Required Material

"Fundamentals of Physics" by Halliday, Resnick, and Walker. In addition, there is a lab manual for the course.

5. Course Learning Objectives

By the end of the course, students will have gained a. Knowledge and understanding of the basic laws of nature developed over the past 400 years, with particular emphasis on mechanics and electrical phenomena; b. The ability to analyze physics problems, to formulate a logical and systematic approach to their solution, and to solve the problems correctly; c. The ability to carry out physics experiments and to determine the significance of the experimental results.

6. Topics Covered

Vectors and scalars; Position, velocity, acceleration vectors; Newton's laws of motion; Force diagrams; One-dimensional motion: free fall; Two-dimensional motion; projectiles; Circular motion: kinematics and dynamics; Work and energy; Power. Potential energy; Mechanical energy. Conservation of energy; Energy diagrams. Energy quantization; Linear momentum and its conservation; Elastic collisions in 1 and 2 dimensions; Systems of particles; Postulates of special relativity; Fission and fusion ; Rotational kinematics; Rotational energy, Torque; Angular momentum; Rigid body rotation; Rigid body rotation; Kepler's laws of planetary motion; The Bohr theory of the hydrogen atom; Simple harmonic oscillation; Pendulums; Damped and forced oscillations; Electrostatics: Coulomb's law; Electric fields. Lines of force; Electric flux. Gauss' law; Electric potential; Electric field and electric potential energy.; Capacitance; Energy storage in capacitors. Dielectrics; Electric current and resistance; Electric energy and electric power; Simple DC circuits; RC circuits.

7. Class/Laboratory Schedule

3 one-hour lectures Monday, Wednesday, Friday mornings. One one-hour recitation (problem-solving) session every Tuesday. In alternate weeks either (1) a second one-hour recitation on Thursday or (2) a two-hour lab that could be on any day of the week.

8. Contribution of Course to Meeting Professional Component

This is a foundation course, providing the student with the background in physics necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the physical -science related learning outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Phys 222. Introduction to Classical Physics II.

Required – PME and AES Options

1. Course Name: Phys 222. Introduction to Classical Physics II. (Cr. 5)

2. 2005-2007 Catalog Description: Magnetic forces and fields: LR, LC, LCR circuits; MaxwellÆs equations; waves and sound; ray optics and image formation; wave optics: heat, thermodynamics, kinetic theory of gases; topics in modern physics.

3. Prerequisites: 221, Math 166. 3 hours of lecture each week plus 1 recitation and 1 laboratory each week

4. Textbook(s) and/or Other Required Material

"University Physics, by H.D. Young and R.A. Freedman, 11th Edition. Pearson/Addison Wesley 2004.(Recommended: "University Physics, Student Solutions Manual", A. Lewis Ford, Pearson/Addison Wesley 2004. "Physics 222 Laboratory Manual" available at ISU bookstore.

5. Course Learning Objectives

By the end of the course, students will have gained a. Knowledge and understanding of the basic laws of nature, with particular emphasis on electromagnetic phenomena and thermodynamics. b. The ability to analyze physics problems, to formulate a logical and systematic approach to their solution, and to solve the problems correctly; c. The ability to carry out physics experiments and to determine the significance of the experimental results.

6. Topics Covered

Magnetic field, force, torque, moment; Ampere's law, Biot-Savart Law, Faraday's law, Lenz's law, ac generator, induced E field, displacement current, Maxwell's Equations, inductors, magnetic field energy, RL circuits, LC and series LRC circuits, phasors, AC circuits, reactance, driven LRC circuit, power in AC circuits, resonance, transformers, waves (mechanical, periodic, equation, speed, energy, standing, electromagnetic, matter) superposition, interference, wind instruments, resonance, Doppler effect, Poynting vector, radiation pressure, polarization, EM spectrum, light (dispersion, polarization, ray optics, reflection, refraction, total internal reflection, Huygens' Principle), geometric optics, images, magnifier, microscope, telescope, wave optics, thin films, diffraction (single- and multiple-slit, X-ray), photons, nuclear atom, Bohr model of H atom, lasers Schrodinger equation, quantum numbers, Pauli exclusion principle, periodic table, temperature, ideal gases, heat, internal energy, heat engines, refrigerators, second Law of Thermodynamics, Carnot cycle, entropy.

7. Class/Laboratory Schedule

Three 50-minute lectures, one 50-minute recitation and 1 2-hour laboratory weekly.

8. Contribution of Course to Meeting Professional Component

This is a foundation course, providing the student with the background in physics necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of the physical-sciences related learning outcomes.

10. Person(s) who Prepared this Description and Date of Preparation
Janet Putnam - March, 2006

Sp Cm 212. Fundamentals of Public Speaking.

Elective

1. Course Name: Sp Cm 212. Fundamentals of Public Speaking. (Cr. 3)

2. 2005-2007 Catalog Description: Theory and practice of basic speech communication principles applied to public speaking. Practice in the preparation and delivery of extemporaneous speeches.

3. Prerequisites:

4. Textbook(s) and/or Other Required Material

"The Art of Public Speaking", by Stephen E. Lucas, 8th Edition. McGraw-Hill, 2003, with CD-ROM. "Speech Communication 212 Workbook", by Amy R. Slagell, 8th Edition. McGraw-Hill/Primis, 2005.

5. Course Learning Objectives

Develop practical skills for success: how to build a speech that people will want to hear, and how to deliver it so they'll want to hear more. Develop skills for life such as rhetorical sensitivity, critical thinking and self-confidence.

6. Topics Covered

Essentials skills for public speaking, ethics, informative speaking, transitions, outlines, developing ideas, strong delivery and visual aids, persuasive speaking, evidence-supporting materials and reasoning, language/style for 'special occasion' speaking,

7. Class/Laboratory Schedule

Three 50-minute lectures alternating weeks. Three 50-minute recitation on the other alternating weeks.

8. Contribution of Course to Meeting Professional Component

This is a foundation course, providing students with the oral communication skills necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives

This course provides one component of oral communication related learning outcomes.

10. Person(s) who Prepared this Description and Date of Preparation

Janet Putnam - March, 2006

Stat 305. Engineering Statistics.

Required – all options

1. Course Name: Stat 305. Engineering Statistics. (Cr. 3)

2. 2005-2007 Catalog Description: Statistics for engineering problem solving. Principles of engineering data collection; descriptive statistics; elementary probability distributions; principles of experimentation; confidence intervals and significance tests; one-, two-, and multi-sample studies; regression analysis; use of statistical software; team project involving engineering experimentation and data analysis. Credit for both 105 and 305 may not be applied for graduation.

3. Prerequisites: Math 165 (or 165H)

4. Textbook(s) and/or Other Required Material
"Basic Engineering Data Collection and Analysis" by Stephen B. Vardeman and J. Marcus Jobe. (Two handouts as supplements to text.) JMP software which is in many on-campus PC labs and can also be purchased. For ChE section: "Probability and Statistics for Engineering and the Sciences", by Devore, 6th Edition (2004).

5. Course Learning Objectives
For ChE majors section: To raise the students' statistical knowledge to the level of competent application of statistical methodologies critical to chemical engineering problem solving. (Other syllabus did not state objectives.

6. Topics Covered
Introduction to engineering statistics, laws of probability. Descriptive statistics, probability distributions: discrete and continuous and single and joint. Linear combinations, propagation of errors, and central limit theorem, data collection. One, two and multi-sample hypothesis testing and confidence intervals. Experimental design. Regression, statistical monitoring charts.

7. Class/Laboratory Schedule
Two 80 minute lectures per week.

8. Contribution of Course to Meeting Professional Component
This is a foundation course, providing students with the background in statistics necessary for further professional development.

9. Relationship of Course to Program Learning Outcomes and Program Educational Objectives
This course is one component of learning outcomes related to the development of engineering analysis and judgement.

10. **Person(s) who Prepared this Description and Date of Preparation**
Janet Putnam - March, 2006

Appendix 1.C. Faculty Curriculum Vitae

Robert P. Anex

Associate Professor of Agricultural and Biosystems Engineering
Member of Faculty:
Biorenewable Resources and Technology Graduate Program
Graduate Program in Sustainable Agriculture
Department of Mechanical Engineering

Education

Ph.D.	University of California, Davis	Civil and Environmental Engineering	9/95
M.S.	University of California, Davis	Mechanical Engineering	6/83
B.S.	University of California, Davis	Mechanical Engineering	9/81

ABE Faculty Service

(3 years of service, original appointment: 08/03)
2003-present Associate Professor

Other Professional Experience

2002-2003	Associate Professor, School of Aerospace and Mechanical Engineering; and Research Fellow, Institute for Science and Public Policy, University of Oklahoma, Norman, OK
1996-2002	Assistant Professor, School of Aerospace and Mechanical Engineering; and Research Fellow, Institute for Science and Public Policy, University of Oklahoma, Norman, OK
1989-1991	Section Head, Propulsion Systems, Systems Control Technology, Inc., Palo Alto, California
1987-1989	Senior Engineer, Systems Control Technology, Inc., Palo Alto, California
1983-1987	Engineer, Systems Control Technology, Inc., Palo Alto, California
1982-1983	Development Engineer and Co-founder, Automatek, Inc., Davis, California

Consulting, Patents, etc.

2004-2005	European Commission, European Science and Technology Observatory (ESTO)
2002	U.S. Environmental Protection Agency
2002-2003	Converse Consultants, Inc., Parsippany, New Jersey
1996-2000	M.Cubed, Inc., Sacramento, California

Principal Publications (2001 – 2005)

Refereed Articles

Anex, R. P. and Ogletree, A. L. "Life Cycle Assessment of Energy-based Impacts of a Biobased Process for Producing 1,3-Propanediol." In J. Bozell and M. Patel (eds.) *ACS Symposium Series: Fuels and Chemicals from Biomass,* Washington, D.C.: American Chemical Society, October 2005.

NRC Committee on Science and Technology in Armenia, *Science and Technology in Armenia: Toward a Knowledge-Based Economy*, Washington, DC: The National Academies Press, 2004.

Anex, R. P. and Focht, W. "Participation in Life-Cycle Assessment and Risk Assessment: A shared need," *Risk Analysis*, 22(5):861-877, October 2002.

Anex, R. P. "Restructuring and Privatizing Electric Industries in the Commonwealth of Independent States," *Energy Policy*, 30(5):397-408, May 2002.

Anex, R.P. and Englehardt, J.D., "Application of the Predictive Bayesian Compound Poisson Model in Environmental Accounting," *J. of Hazardous Materials,* 82(2):99-112, March 2001.

Non-Refereed Articles

Anex, R. P. "Something new under the Sun? The Industrial Ecology of biobased materials." Journal of Industrial Ecology, Special Issue on the Industrial Ecology of Biobased Materials, 7(3/4): 1-4, 2004.

Kanzig, J., R. Anex, O. Jolliet, Conference Report: International workshop on assessing the sustainability of bio-based products, *Int. J. LCA* 8(5): 313-314, 2003.

Conference papers

Anex, R., A. Ogletree, "Life cycle assessment of a bio-based process for producing 1,3-propanediol," *Proceedings of the 227th ACS National Meeting*, Anaheim, CA, March 28-April 1, 2004.

Sharfman, M. P., Shaft, T. M., Anex, R. "Information, Uncertainty and Vertical Environmental Management Cooperation: A Two-Phase Investigation," presented at the 2004 meeting of the Academy of Management, August 2004.

Sharfman, M. P., Shaft, T. M., Anex, R. "Current and Best Practice in Cooperative Environmental Management with Suppliers and Customers," *Proceedings of the 2003 NSF Design & Manufacturing Research Conference*, Vancouver, B.C., January 3-6, 2003.

Professional Society Membership

International Society for Industrial Ecology, American Institute of Chemical Engineers

Honors and Awards

2005-2006	OECD Fellowship, Biological Resource Management for Sustainable Agricultural Systems
2003-2004	Member, National Research Council Committee on Science and Technology in Armenia
1999-2000	National Academy of Sciences Young Investigator Program, "Energy and the Environment in Armenia"
1992-1993	University of California Toxic Substances Research and Teaching Program Fellow

Institutional and Professional Service (2001 – 2005)

2004-present	Director of Graduate Education, Biorenewable Resources and Technology Graduate Program, Iowa State University
2003-present	Science and Engineering Committee, Office of Biorenewables Programs, Iowa State University
2003-present	Area Editor, Industrial Ecology and Public Policy, Journal of Industrial Ecology
2003-present	Editorial Board Member, International Journal of Life Cycle Assessment
2004-2005	Chair, Steering Committee for National Science Foundation Biocomplexity in the Environment Awardees Meeting
2003-2004	Editor, special issue *Journal of Industrial Ecology* on the Industrial Ecology of Biobased Materials, Vol. 7, No. 3-4, 2004

Professional Development Activities (2001 – 2005)

Workshop, Land Grant University Science and Policy: Enhancing the Connections, May 11-13, 2004

US-EC Workshop on Applications of Molecular Biology for Production of Plants for Biobased Products and Bioenergy, USDA, ARS Western Regional Research Center (WRRC), Albany, CA, April 2004

Carl J. Bern

University Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	Iowa State University	Agricultural Engineering, minor Mechanical Engineering	5/73
M.S.	University of Nebraska	Agricultural Engineering	6/64
B.S.	University of Nebraska	Agricultural Engineering	12/63

ABE Faculty Service

(37 years of service, original appointment: 09/68)

2002-present	University Professor
1982-2002	Professor
1976-1982	Associate Professor
1973-1976	Assistant Professor
1968-1973	Instructor

Other Professional Experience

1967-1968	Half-time Grad. Teach. Asst., Iowa State University, Ames, IA
1964-1967	Instructor, Lynam Agricultural College, Stann Creek, Belize
1963-1964	Graduate Research Assistant, University of Nebraska

Consulting, Patents, etc.

2004-05 Consulting on storage of distillers grains

Professional Engineering Registration

Iowa (agricultural)

Principal Publications (2001 – 2005)

Refereed Journal Articles

Chitraker, S., C. J. Bern, D. S. Shrestha. 2006. Quantifying corn deterioration due to fungal growth by use of CO_2 – sensitive gel. Applied Engr. in Ag.

Rukunudin, I. H., C. J. Bern, M. K. Misra, T. B. Bailey. 2004. Carbon dioxide evolution from fresh and preserved soybeans. Transactions of the ASAE 47(3): 827-833.

Rosentrater, K. A., T. L. Richard, C. J. Bern, R. A. Flores. 2003. Economic simulation modeling of reprocessing alternatives for corn masa byproducts. Resources Conservation and Recycling. 39(4):341-367.

Bern, C. J., L. J. Steele, R. V. Morey. 2002. Shelled corn CO2 evolution and storage time for 0.5% dry matter loss. Applied Engr. In Ag. 18(6):703-706.

Steenhoek, L. W., M. K. Misra, C. R. Hurburgh, C. J. Bern. Implementing a computer vision system for corn kernel damage evaluation. Appl. Engr. In Ag. 17(2): 235-240. 2001.

Non-Refereed Articles

Conference papers

Rosentrater, K. A., C. J. Bern. 2002. Framework for a computer simulation model of terminal grain elevators. Paper MC02-104. ASAE: St. Joseph, MI.

Kabomo, Nelson, C. J. Bern. 2002. Effects of long-term, low moisture storage of corn. Paper MC02-109. ASAE: St. Joseph, MI.

Arora, Gaurav, C. J. Bern, Steven Shivvers, Lloyd Lerew. 2002 Paper MC02-102. ASAE: St. Joseph, MI.

Chitracar, Sinora, C. J. Bern. 2002. Quantifying corn storability by use of CO2-sensitive gel. Paper MC02-103. ASAE: St. Joseph, MI.

Rosentrater, K. A., T. L. Richard, C. J. Bern. 2002. Modeling reprocessing costs for corn masa by product streams. Paper MC02-105. ASAE: St. Joseph, MI.

Rosentrater, K. A., T. L. Richard, C. J. Bern, R. A. Flores. 2002. Developing resuse alternatives for corn masa processing byproduct streams. Paper 026056. ASAE: St. Joseph, MI.

Books

Bern, C.J., D. I. Olsen. 2002. Electricity for agricultural applications. 305 p. Iowa State University Press, Ames, IA.

Bern, C.J., C.R. Hurburgh, T. J. Brumm. 2005. Managing grain after harvest. Photoduplicated text, 502 pages. Agricultural and Biosystems Engineering Department, Iowa State University, Ames, IA.

Book Chapters

Bern, C. J., G. R. Quick, F. L. Herum. 2003. Harvesting and postharvest management. p. 107-158 in Corn: Chemistry and technology eds: P. J. White and L. A. Johnson. AACC press, Minneapolis.

Bern, C. J., T. J. Brumm. 2003. Moisture content measurement. p. 671 – 675 in Encyclopedia of Agricultural, Food, and Biological Engineering. Marcel Dekker, Inc., NY.

Professional Society Membership

American Society for Engineering Education
American Society of Agricultural and Biological Engineers
Council for Agricultural Science and Technology

Honors and Awards

2005	National Food and Energy Council Electric Technology Award, ASABE
2005	ISU Foundation Award for Outstanding Achievement in Teaching
2004	Massey-Ferguson Gold Medal Educational Award, Am. Society of Agricultural Engineers
2002	Named a University Professor
2001	ISU Honors Program Award for Excellence in Honors Mentoring and Advising
2001	Member of the Year, Iowa Section, American Society of Agricultural Engineers.

Institutional and Professional Service (2001 – 2005)

2001-present	ABE Promotion and Tenure Committee (chair 2001-02, 2004-05)
2001-present	AE Curriculum Committee (chair 2001-present)

Chair of committee which developed ASABE Std 535 (Shelled corn storage time for 0.5% dry matter loss)

Professional Development Activities (2001 – 2005)

Attended Annual International Meetings of the American Society of Agricultural and Biological Engineers: 2005, 2004, 2003, 2002, 2001

Stuart J. Birrell

Associate Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	University of Illinois, Urbana	Agricultural Engineering	5/95
M.S.	University of Illinois, Urbana	Agricultural Engineering	10/87
B.S.	University of Natal, Pietermaritzburg, RSA	Agricultural Engineering	12/84

ABE Faculty Service

2004-present	Associate Professor
1998-2004	Assistant Professor

Other Professional Experience

1996 - 1998	Visiting Assistant Professor, University of Illinois, Urbana-Champaign, IL.
1992 - 1996	Research Assistant Professor. (Formerly Senior Research Specialist), University of Missouri, Columbia, MO.

Principal Publications (2001 – 2005)

Refereed Journal Articles

Eubanks, J.C. and **S.J. Birrell**. 2005. Determining moisture content of hay and forages using multiple frequency parallel plate capacitors. *Transactions of the ASAE*. (In Review)

Al Mahasneh, M., **S.J. Birrell,** C.J. Bern, and Adam K. 2005. Measurement of Corn Mechanical Damage using Dielectric properties. *Transactions of the ASAE*. (In Review)

Kim, H.J., J. W. Hummel, and **S. J. Birrell**. 2005. Evaluation of Nitrate And Potassium Ion-Selective Membranes for Soil Macronutrient Sensing. . *Transactions of the ASAE*. (In Review)

Yildirim, S. **S.J. Birrell** and J.W. Hummel 2005. Laboratory evaluation of an electro-pneumatic sampling method for real-time soil sensing. *Transactions of the ASAE* (accepted)

Isaac, N.E., G. R. Quick**, S. J. Birrell**, W. M. Edwards, B. A. Coers. 2005. Combine Harvester Econometric Model with Forward Speed Optimization. *Applied Engineering in Agriculture*. (Accepted)

Shrestha, D.S., Steward, B.L., and **S. J. Birrell**. 2004. Video processing algorithms for early stage maize plant detection. *Biosystems Engineering*, 89(2):119-129.

Drummond, S.T., K.A. Sudduth, A. Joshi, **S.J. Birrell,** and N.R. Kitchen. 2003. Statistical and neural methods for site-specific yield prediction. *Transactions of the ASAE*. 46(1): 5–14.

Price R.R., J.W. Hummel, **S.J. Birrell,** and I.S Ahmad. 2003. Rapid nitrate analysis of soil cores using ISFETs. *Transactions of the ASAE*. Vol. 46(3): 601–610.

Birrell S.J. and J.W. Hummel 2001. Real-time multi ISFET/FIA soil analysis system with automatic sample extraction. *Computers and Electronics in Agriculture*, 32(1): 45 – 67.

Non-Refereed Articles Conference papers

Hummel, J.W., **S.J. Birrell**, R.R. Price, and Hak-Jin Kim, 2004. Development of Components of a Real-Time Soil Macronutrient Sensor. *Written for presentation at the 2004 CIGR International Conference, 11- 14 October 2004, Beijing, China*. Sponsored by International Commission of Agricultural Engineering (CIGR), Chinese Society for Agricultural Machinery (CSAM), Chinese Society of Agricultural Engineering (CSAE)

Benning, R.C, **S.J. Birrell**, and R.L. Geiger. 2004, Development of a Multi-Frequency Dielectric Sensing System for Real-time Forage Moisture Measurement, ASAE Paper 04-1100, 2004 ASAE/CSAE Annual International Meeting, August 1-4, 2004. Ottawa, Canada.

Sudduth, K.A., **S.J. Birrell**, G.A. Bollero, D.G. Bullock, J.W. Hummel and N.R. Kitchen. 2004. Site-specific relationships between corn population and yield. In: *Proc. 7th International Conference on Precision Agriculture*. July 25-28, 2004. Minneapolis, MN (in press). ASA, CSSA, and SSSA, Madison, WI.

Kim, Hak-Jin, J.W. Hummel, and **S.J. Birrell**. 2004. Sensing macronutrients in soil extracts using ion selective membranes. In: *Proc. 7th International Conference on Precision Agriculture*. July 25-28, 2004. Minneapolis, MN (in press). ASA, CSSA, and SSSA, Madison, WI.

Samsuzana, A.A, B.L. Steward, **S.J. Birrell**, T.C. Kaspar, and D.S. Shrestha. 2004, Ultrasonic Sensing for Corn Plant Canopy Characterization, ASAE Paper 04-1120, 2004 ASAE/CSAE Annual International Meeting, August 1-4, 2004. Ottawa, Canada.

Kim, Hak-Jin, J.W. Hummel, and **S.J. Birrell**. 2004. Evaluation of Ion-Selective Membranes for Real-Time Soil Macronutrients Sensing. ASAE Paper No. 04-1044, 2004 ASAE/CSAE Annual International Meeting, August 1-4, 2004. Ottawa, Canada.

Yildirim, S., **S.J. Birrell,** and J.W. Hummel. 2003. Development of a real-time electro-pneumatic soil sampler. *In: Proc. itafe'03 – International Congress on Information Technology in Agriculture, Food and Environment*, Oct 7-10, Izmir, Turkey. (In press)

Kim, Hak-Jin, J.W. Hummel, and **S.J. Birrell**. 2003. Evaluation of ion-selective membranes for real-time soil nutrient sensing. ASAE Paper No. 03-1075, Am. Soc. of Agric. Engineers, St. Joseph, MI.

Yildirim, S., **S.J. Birrell,** and J.W. Hummel. 2003. Development of a real-time electro-pneumatic soil sampler. ASAE Paper No. 03-1076, Am. Soc. of Agric. Engineers, St. Joseph, MI.

Shrestha, D. S., B. L. Steward, **S. J. Birrell**, and T. C. Kaspar. 2002. Corn plant height estimation using two sensing systems. ASAE Paper No. 021197. St. Joseph, MI.

Professional Society Membership

American Society for Engineering Education
American Society of Agricultural Engineers
Council for Agricultural Science and Technology

Honors and Awards

2004	Massey-Ferguson Gold Medal Educational Award, Am. Society of Agricultural Engineers
2002	Named a University Professor
2001	ISU Honors Program Award for Excellence in Honors Mentoring and Advising
2001	Member of the Year, Iowa Section, American Society of Agricultural Engineers.

Institutional and Professional Service (2001 – 2005)

2001-present	ABE Promotion and Tenure Committee (2001-02, 2004-05)
2001-present	AE Curriculum Committee (2001-present)

Professional Development Activities (2001 – 2005)

Attended Annual International Meetings of the American Society of Agricultural and Biological Engineers: 2005, 2004, 2003, 2002, 2001

Robert C. Brown

Dr. Brown is the Bergles Professor in Thermal Science at Iowa State University (ISU). He holds academic appointments in the departments of mechanical engineering, chemical and biological engineering, and agricultural and biosystems engineering. He is the director for the Office of Biorenewables Programs and the Center for Sustainable Environmental Technologies at ISU. He recently helped establish the first graduate program in the United States in Biorenewable Resources & Technology and in 2003 he published the textbook "Biorenewable Resources: Engineering New Products from Agriculture." His own research includes the application of gasification and fast pyrolysis to production of bioenergy and biobased products.

Education

Ph.D. Mechanical Engineering, Michigan State University, 1980
M.S. Mechanical Engineering, Michigan State University, 1977
B.A. Mathematics, University of Missouri-Columbia, 1976
B.S. Physics, University of Missouri-Columbia, 1976

Academic Experience

Bergles Professor of Thermal Sciences, Department of Mechanical Engineering, Iowa State University, 2002 – present
Professor of Mechanical Engineering, Iowa State University, 1993-present
Professor of Chemical Engineering, Iowa State University, 1993-present
Professor of Agricultural and Biosystems Engineering, Iowa State University, 2004 - present
Director, Graduate Studies in Mechanical Engineering, Iowa State University, 1991-1997
Associate Professor, Iowa State University, 1987-1993
Assistant Professor, Iowa State University, 1983-1987
Research Assistant, Michigan State University, 1978-1980
Teaching Assistant, Michigan State University, 1976-1978

Industrial And Other Non-Academic Experience

Secretary, Executive Committee, Board of Directors, BIOWA Development Association, 2003-2004.
Director, Office of Biorenewables Programs, Iowa State University, 2002-present.
Director, Biotechnology Byproducts Consortium, Iowa State University, 1998-present.
Director, Center for Sustainable Environmental Technology, Iowa State University, 1996-present
Senior Engineer, Thermodynamics Group, General Dynamics Corporation, Fort Worth, Texas.

Honors and Awards

Fellow, American Society of Mechanical Engineering International, March 2002.
David R. Boylan Eminent Faculty Award for Research, College of Engineering, Iowa State University, Fall 2002.
R&D 100 Award, Off-Line Carbon-in-Ash Monitor, Research & Development Magazine, 1997
Young Engineering Faculty Research Award, ISU College of Engineering, 1991.

Selected Publications (of a total of 90 archival publications)

Xu, M., Brown, R. C., Norton, G., and Smeenk, J., "Comparison of a solvent-free tar quantification method to the International Energy Agency's tar measurement protocol, Energy & Fuels (2005) 19, 2509-2513.

Cummer, K. and Brown, R. C., "Indirectly heated biomass gasification using a latent heat ballast. Part 3: Refinement of the heat transfer model," Biomass and Bioenergy (2005) 28, 321–330.

Zhang, R., Cummer, K., Suby, A., and Brown, R. C., Biomass-derived hydrogen from an air-blown gasifier," Fuel Processing Technology (2005) 86, 861-874.

Norton, G. A. and Brown, R. C., Wet chemical method for determining levels of ammonia in syngas from a biomass gasifier, Energy & Fuels (2005) 19, 618-624.

Khiyami, M. A., Pometto III, A. L., Brown, R. C. , Detoxification of corn stover and corn starch pyrolysis liquors by ligninolytic enzymes of Phanerochaete chrysporium, Journal of Agricultural and Food Chemistry (2005) 53, 2969-2977.

Zhang, R., Brown, R., Suby, A., and Cummer, K., "Catalytic destruction of tar in biomass-derived producer gas," Energy Conversion and Management (2004) 45 (7-8), 995-1014.

Zhang, R., Brown, R. C., and Suby, A., "Thermochemical generation of hydrogen from switchgrass," Energy and Fuels (2004) 18, 251-256.

Mérida, W., Maness, P., Brown, R. C., and Levin, D. B., "Enhanced hydrogen production and removal of carbon dioxide from indirectly heated biomass gasification," International Journal of Hydrogen Energy (2004) 29, 283-290.

E. Sandvig, G. Walling, D. Daugaard, R. Pletka, D. Radlien, W. Johnson, and R.C. Brown, "The Prospects for Integrating Fast Pyrolysis into Biomass Power Systems," International Journal of Power and Energy Systems (2004) 24(3).

Daugaard, D. E. and Brown, R. C., "Enthalpy for pyrolysis for several types of biomass," Energy and Fuels (2003) 17, 934-939.

Cummer, K. and Brown, R. C., "Ancillary equipment for biomass gasification," Biomass and Bioenergy (2002) 23, 113 – 128.

Brown, R. C., Radlein, D., and Piskorz, J., "Pretreatment Processes to Increase Pyrolytic Yield of Levoglucosan from Herbaceous Feedstocks," Chemicals and Materials from Renewable Resources, ACS Symposium Series 784, American Chemical Society, Washington, D.C., 2001, pp. 123 - 132.

Pletka, R., Brown, R. C., and Smeenk, J., "Indirectly heated biomass gasification using a latent heat ballast. Part 1: Experimental evaluations," Biomass and Bioenergy (2001) 20, 297 – 305.

Pletka, R., Brown, R. C., and Smeenk, J., "Indirectly heated biomass gasification using a latent heat ballast. Part 2: Computational model," Biomass and Bioenergy (2001) 20, 307 –315.

Brown, R. C., Liu, Q., and Norton, G., "Catalytic effects observed during the co-gasification of coal and switchgrass," Biomass and Bioenergy (2000)18, 499-506.

Brown, R. C., Smeenk, J., and Wistrom, C., "Design of a moving bed granular filter for biomass gasification," Proceedings of the Progress in Thermochemical Biomass Conversion Conference, Tyrol, Austria, September 17-22, 2000.

So, K. and Brown, R.C., "Economic analysis of selected lignocellulose-to-ethanol conversion technologies," Applied Biochemistry and Biotechnology (1999) Vol. 77-79, pp. 633-640.

Thomas J. Brumm

Associate Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	Iowa State University	Agricultural Engineering (with distinction), minor Chemical Engineering	5/90
M.S.	Purdue University	Agricultural Engineering	12/80
B.S.	Iowa State University	Agricultural Engineering (with distinction)	5/79

ABE Faculty Service

(6 years of service, original appointment: 08/00)

2006-present	Associate Professor
2000-2006	Assistant Professor

Other Professional Experience

1996-2000	Technical Director, MBS Genetics, L.L.C. Story City, IA
1991-1996	Technical Manager, MBS Inc, Ames, IA
1991-1991	Post-Doctoral Research Associate, Department of Agronomy, Iowa State University

Principal Publications (2001 – 2005)

Refereed Journal Articles

Brumm, T.J., L.F. Hanneman and S.K. Mickelson, 2006. Assessing and developing program outcomes through workplace competencies. *International Journal of Engineering Education* 22(1): 123-129.

Brumm, T.J., S.K. Mickelson and P.N. White. Integrating behavioral-based interviewing Into the curricula. *National Association of College Teachers in Agriculture (NACTA) Journal* (accepted for publication August 19, 2005)

Brumm, T.J., S.K. Mickelson, B.L. Steward and A.L. Kaleita-Forbes. Competency-based outcomes assessment for agricultural engineering programs. *International Journal of Engineering Education* (accepted for publication April 26, 2005).

Harms, P.C., S.K. Mickelson and **T.J. Brumm**. Longitudinal study of learning communities in agricultural and biosystems engineering. *International Journal of Engineering Education* (accepted for publication April 26, 2005).

Steward, Brian L., S.K. Mickelson and **T.J. Brumm**, 2005. Continuous engineering course improvement through synergistic use of multiple assessment. *Intl Journal of Engineering Education.* 21(2): 277-287.

Steward, Brian L., S.K. Mickelson and **T.J. Brumm**, 2004. Formative and summative assessment techniques for continuous agricultural technology Classroom Improvement, *National Association of College Teachers in Agriculture (NACTA) Journal* 48(2): 33-41. Jack Everly best journal paper award.

Brumm, T.J., A.P. Ellertson, D.D. Fisher and S.K. Mickelson, 2004. Practicing Omega: addressing learning outcomes in an on-line case simulation. *Proceedings of the Annual Meeting of the American Society for Engineering Education*, Salt Lake City, UT (June, 2004).

Fisher, D., T. Bowers, A. Ellertson, **T.J. Brumm** and S.K. Mickelson, 2003. As the case may be: the potential of electronic cases for interdisciplinary communication instruction. *IEEE Transactions on Professional Communication* 46(4): 313-319. December, 2003.

Brumm, T.J., S.K. Mickelson and A.P. Ellertson, 2003. Using ePortfolios to develop and assess ABET-aligned competencies. *Proceedings of the Annual Meeting of the American Society for Engineering Education*, Nashville, TN (June, 2003).

Professional Society Membership

American Society of Agricultural and Biological Engineers
American Society of Engineering Education
Epsilon Pi Tau, Technology Honorary, Iowa Alpha Chapter Co-Trustee

Honors and Awards

Best Paper Award for "Measuring the Success of Learning Communities" by S.K. Mickelson and **T.J. Brumm**. American Society for Engineering Education. 6/2005

Jack Everly Best Journal Paper Award for "Formative and Summative Assessment Techniques for Continuous Agricultural Technology Classroom Improvement" by B.L. Steward, S.K. Mickelson and **T.J. Brumm**, National Association of College Teachers in Agriculture (NACTA) 6/2005

Outstanding Innovations Award, Center for Excellence in Learning and Teaching, ISU 5/2004

Innovative Excellence in Teaching, Learning and Technology, International Conference on Teaching and Learning, Jacksonville, FL 3/2004

Best Paper Award for "Using Engineering Competency Feedback to Assess Agricultural Engineering Curriculum" by S.K. Mickelson, T.J. Brumm, L.F. Hanneman and B.L. Steward. American Society for Engineering Education. 6/2003

Best Session Award for "Contributions of Cooperative Education and Competency-Based, Formative Assessment Tools to a Systems Approach to Engineering Education" by L.F. Hanneman, S.K. Mickelson, L.K. Pringnitz, P.N. White, T.J. Brumm and D.R. Flugrad. American Society for Engineering Education 2/2002

Institutional and Professional Service (2001 – 2005)

AST/Technology Curriculum Committee, member (Chair: 2002-2004) 2001-present
ABE Advising Committee, member 2001-present
ABE Career Guidance Committee, member (Vice-chair: 2005-2006) 2003-present
ABE Promotion and Tenure Committee, member 2003-2004
Program chair, Biological and Agricultural Eng. Division, ASEE

Professional Development Activities (2001 – 2005)

Attended Annual International Meetings of the American Society of Agricultural and Biological Engineers: 2005, 2004, 2003

Attended American Society for Engineering Educators : 2005, 2004, 2003, 2002, 2001

Robert T. Burns

Associate Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	The University of Tennessee	Civil Engineering	5/95
M.S.	The University of Tennessee	Environmental Engineering	5/92
B.S.	The University of Tennessee	Agricultural Engineering	5/90

ABE Faculty Service

(1 year of service, original appointment: 08/04)
2004-present Associate Professor

Other Professional Experience

2000 - 2004 Associate Professor, The University of Tennessee, Knoxville, TN
1995 - 2000 Assistant Professor, The University of Tennessee, Knoxville, TN
1992 - 1995 Research Associate, The University of Tennessee, Knoxville, TN
1992 Environmental Engineer, Sverdrup Technology Inc., Tullahoma, Tennessee

Consulting, Patents, etc.

2002 – Present. America's Clean Water Foundation. Provide animal waste management and water quality engineering services.
2003 Mopongwe Development Corporation, The Democratic Republic of Zambia. Provided irrigation and grain handling engineering services.

Professional Engineering Registration

Registered Professional Engineer in Tennessee (P.E. # 102322)

Principal Publications (2001 – 2005)

Refereed Journal Articles

Oh, I.H.,R. T. Burns and J. Lee. 2005. Periodic Optimization Of Phosphorus Partitioning In Dairy Manure Using Chemical Additives With A Mechanical Solids Separator. *Transactions of the ASAE*. v48(8) pages 1235-1240.

Mayhew, C. R., D. R. Raman, R. R. Gerhardt, R. T. Burns, and M. S. Younger. 2004. Periodic Draining Reduces Mosquito Emergence from Free-water Surface Constructed Wetlands. *Transactions of the ASAE*. v47(2) pages 567-573.

Raman, D. R., E. L. Williams, A. C. Layton, R. T. Burns, J. P. Easter, A. S. Daugherty, G. S. Sayler, and M. D. Mullen. 2003. Estrogen content of dairy and swine wastes. *Environmental Science & Technology*. v47(2) pages 567-573.

Oh, I.H., J. Lee and R. T. Burns. 2003. Development and Evaluation of a Multi-Hose Slurry Applicator for Rice Paddy Fields. *Applied Engineering in Agriculture.* 20(1): 101-106.

Edens, W. C., L. O. Pordesimo, L. R. Wilhelm, and R. T. Burns. 2003. Energy use analysis of the major milking center components at a dairy experiment station. *Applied Engineering in Agriculture.* 19(6): 711-716.

Burns, R.T., L.B. Moody, I. Celen and J. Buchanan. 2003. Optimization of Phosphorus Precipitation from Swine Manure Slurries to Enhance Recovery. *Water Science & Technology*. 48(1): 138 -146.

Burns, R.T., L.B. Moody, F.R. Walker and D.R. Raman. 2001 Laboratory and In-Situ Reductions of Soluble Phosphorus in Liquid Swine Waste Slurries. *Environmental Technology*. 22(11):1273 - 1278.

Raman, D. R., A. C. Layton, L. B. Moody, J. P. Easter, G. S. Sayler, R. T. Burns, and M. D. Mullen. 2001. Degradation of estrogens in dairy waste solids: storage methods and temperature effects. *Transactions of the ASAE*. 44(6):1881-1888.

Hawkins, G. L., D. R. Raman, R. T. Burns, R. E. Yoder, and T. L. Cross. 2001. Enhancing Dairy Lagoon Performance with High-Rate Anaerobic Digesters. *Transactions of the ASAE* . 44(6):1825-1831.

Non-Refereed Articles (18 publications, details available upon request)

Professional Society Membership

American Society for Engineering Education
American Society of Agricultural Engineers
Air & Waste Management Association

Honors and Awards

2003	Nolan Mitchell Young Extension Worker Award, Am. Society of Agricultural Engineers
2003	Learning Module National Winner Award, National Assoc. of County Ag. Agents
2002	ASAE Blue Ribbon Award. Awarded by the American Society of Agricultural Engineers
2001	Outstanding Young Agent Award, TN Association of Agricultural Agents and Specialists

Institutional and Professional Service (2001 – 2005)

2004-present	ABE Program Committee (member), ABE Awards Committee (chair 2005-present)
2004-2005	ABE Graduate Faculty Committee (member)
2002-2005	ASAE T-09 Environmental Quality Committee member.
2000- Present	ASAE SE - 412 Structures & Environment committee member (Chair 2004 / 05 Vice Chair 2003 / 04, Secretary 2003 / 04, Session Chair - 2001 ASAE International Meeting)
2000- Present	ASAE P - 414 *Professional Engineering Licensure* member (Chair for 2003 / 2005; Vice-Chair 2001 – 2003).
2003	Proceedings Chair - ISAAFPW 2003, The Ninth International Symposium on Animal, Agricultural and Food Processing Wastes held in Raleigh, NC on October 11-14, 2003.

2005 Chair - Iowa Section of the ASAE
2002 Chair - Tennessee Section of the ASAE
2001- 2002Southern Region Chair - National Animal Waste Initiative

Professional Development Activities (2001 – 2005)

Attended Annual International Meetings of the American Society of Agricultural Engineers:
2005, 2004, 2003, 2002, 2001

Joseph C. Chen

Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	Auburn University	Industrial Engineering	12/94
M.S.	Auburn University	Industrial Engineering	8/90
B.S.	Tunghai University	Industrial Engineering	6/82

Faculty Service (11 years of service, original appointment: 08/94)

2002-present	Professor
1999-2002	Associate Professor
1994-1999	Assistant Professor

Other Professional Experiences

Manufacturing Engineer	Lummus Industries, Inc., Columbus, Georgia	6/90 – 9/92
Part-time Consultant	The Ministry of Economic Affairs, Taipei, Taiwan	7/87 – 8/88
Production Control Specialist	Tung-Long Metal Co., Taipei, Taiwan	7/84 – 2/87

Professional Engineering Registration

Iowa (Manufacturing Engineering)

Principle publications (2001-2005)

Refereed Journal Articles

Zhu, J., Chen, J.C., & Kirby, D. (2005) Tensile Strength and Optimization of Injection Molding Processing Parameters Using the Taguchi Parameter Design, *International Journal of Modern Engineering, Vol 4, No. 2, pp. 1-6.*

Chen, J.C. & Chen, J.C. (2005) An artificial-neural-networks-based in-process tool wear prediction system in milling operations. *International Journal of Advanced Manufacturing Technology,* Vol. 25, pp. 427-434.

Zhang, Z., Chen, J.C., & Zhu, J. (2005) Development of in-process gap caused monitoring system in injection molding processes. *International Journal of Advanced Manufacturing Technology*

Yang, J.L. & Chen, J.C. (2004). A multiple linear regression based on-line surface roughness recognition system in end milling operations using dynamometer. *Journal of Technology Studies.*Vol. XXX, No. 2, pp. 98-103.

Kirby, E. D., Zhang, Z. & Chen, J. C. (2004). Development of an Accelerometer-Based Surface Roughness Prediction System in Turning Operations Using Multiple Regression Techniques. *Journal of Industrial Technology* Vol. 20, No. 4, pp. 2-7.

Huang, B.P., Chen, J.C. & Chen, J.C., (2004) Testing a New Curriculum of Design for Manufacturability (DFM) in Technical Education. *Journal of Industrial Technology.* Vol. 20, No. 4, pp. 2-7.

Chen, J. & Chen, J.C. (2004) Testing a New Approach to Learning Teamwork Knowledge and Skills in Technical Programs, *Journal of Industrial Technology, Vol. 20, No. 2, 2-10.*

Chen, J.C. & Chen, J.C. (2003) Statistics-assisted fuzzy-nets-based in-process tool wear prediction system in milling operations. *International Journal of Manufacturing Science and Technology* Vol.4 No. 2, pp. 84-101.

Lee, S. & Chen, J.C. (2003) An in-process surface roughness recognition system using an accelerometer sensor in turning operations. *Journal of Engineering Technology.* Pp. 12-18.

Huang, B. P. & Chen, J.C. (2003). A senior course in Design for Manufacturability. *Journal of Technology Studies.* Vol. XXIX, no. 2, pp. 98-102.

Lee, S. & Chen, J. C. (2003). On-line surface roughness recognition system using artificial neural networks system in turning operations. *International Journal of Advanced Manufacturing Technology, Vol 22,* pp. 498-509.
Yang J. L. & Chen, J.C. (2003) Statistical assisted fuzzy-nets based in-process surface roughness prediction (S-FN-IPSRP) system in end milling operations. *Journal of Chinese Institution of Industrial Engineering,* Vol. 20, No. 5, pp. 494-510.
Huang, B.P. & Chen, J.C. (2003). An in-process neural network-based surface roughness prediction system using a dynamometer in end milling operations. *International Journal of Advanced Manufacturing Technology*, 21, pp. 339-347.
Susanto, Victor & Chen, J.C. (2003). Fuzzy logic based in process tool wear monitoring system in face milling operations. *International Journal of Advanced Manufacturing Technology,* 3, pp186-192.
Savage, M. & Chen, J. C. (2002). Multiple regression-based multi-level in-process surface roughness recognition system in milling operations. *Journal of Technology Studies,* XXVIII(1), pp 47-53.
Chen, J. C., Dugger, J. C. & Hammer, R. (2001). Kaizen-based-approach for cellular manufacturing systems design: a case study. *Journal of Technology Studies,* 27(1), pp 19-27.
Chen, J. & Chen, J.C. (2001). QFD-based technical textbook evaluation – Procedure and a case study. *Journal of Industrial Technology,* 18(1), pp. 1-8.
Chen, J. C. & Savage, M. (2001). Fuzzy-net-based multi-level in-process surface roughness recognition system in milling operations. *Journal of Advanced Manufacturing Technology,* 17, pp. 670-676.
Chang, T. C. & Chen, J. C. (2001). Cost-effective CNC part program verification development for laboratory instruction. *Journal of Technology Studies, XXVI*(2), pp. 56-63.
Yang, J. & Chen, J. C. (2001). A systematic approach for identifying optimum surface roughness performance in end-milling operations. *Journal of Industrial Technology,* 17(2), pp. 1-8.
Huang, L. & Chen, J.C. (2001). A multiple regression model to predict in-process surface roughness in turning operation via accelerometer. *Journal of Industrial Technology,* 17(2), pp. 1-8.

Honors and Awards

- Outstanding professor in ABE Dept, College of Engineering, Engineering student council, April 2005.
- Early Achievement in Research Award, recipient, Iowa State University, 2000.
- Early Achievement in Teaching Award, recipient, Iowa State University, 1998.
- Outstanding Early Research Commendation, Recipient, College of Education, ISU, 1998.
- Outstanding Early Teaching Commendation, Recipient, College of Education, ISU, 1997.

Institutional and Professional Service

- Review panel member, National Science Foundation, SBIR, 2005.
- Proposal Reviewer, United States Civilian Research and Development Foundation, for the independent states of the former Soviet Union, 2001.
- Review panel member, National Science Foundation, Advanced Technological Tech. program, 2001.
- Member, Faculty Search Committee, ABE, 2004-present.
- Co-DOGE, IEDT, College of Education, 2002-2004.
- Member, Promotion and Tenure Committee, College of Education, 2002-2004.
- Chair, Promotion and Tenure Committee, IEDT, 2002-2004.
- Faculty advisor, SME student chapter, 2003-present

Professional Development Activities

- Attended Annual International Meetings of the National Association of Industrial Technology (NAIT) 2005, 2003, 2002, 2001
- Visiting at least one industrial related company for lean manufacturing system design every year for the last 10 years

Steven A. Freeman

Associate Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	Purdue University	Agricultural Engineering	5/93
M.S.	Texas A&M University	Agricultural Engineering	8/90
B.S.	Colorado State University	Agricultural Engineering	5/88

ABE Faculty Service

2004-present	Associate Professor
2003-2004	Associate Professor (Courtesy Appointment)
1998-2003	Assistant Professor (Courtesy Appointment)

Other Professional Experience

2004-present	Assistant Director, Center for Excellence in Learning and Teaching, Iowa State University
2003-2004	Associate Professor, Industrial Education and Technology, Iowa State University
1997-2003	Assistant Professor, Industrial Education and Technology, Iowa State University
1994-1997	Agricultural Safety Specialist, Agricultural and Biological Engineering, Purdue University
1993-1994	Visiting Instructor, Agricultural and Biological Engineering, Purdue University
1990-1993	Graduate Research Fellow/Assistant, Agricultural Engineering, Purdue University
1988-1990	Graduate Research Fellow/Assistant, Agricultural Engineering, Texas A&M University

Consulting, patents, etc.

Expert witness for personal injuries and safety training/education.

Professional Registration

- Certified Safety Professional (CSP). Board of Certified Safety Professionals. Certificate No: 16984.
- Certified Senior Industrial Technologist (CSIT). National Association of Industrial Technology. Certificate No: 2015.
- Engineer-in-Training (EIT). 1987. State of Colorado, Board of Registration for Professional Engineers and Professional Land Surveyors. Registration No: 15294.

Principal Publications (2001-2005; partial listing)

Refereed Journal Articles

- Field, D.W., S.A. Freeman, and M.J. Dyrenfurth. Holistic assessment of students in undergraduate industrial technology programs. *Journal of Technology Studies* (in press).
- Freeman, S.A. and D.W. Field. Student perceptions of Web-based supplemental instruction. *Journal of Technology Studies* (in press).
- Freeman, S.A. and M.J. Dyrenfurth. 2003. Using peer assessments in team activities. *Journal of Industrial Technology* 20(1), http://www.nait.org/jit/Articles/freeman102903.pdf.
- Freeman, S.A., C.V. Schwab, and T. Pollard. 2003. Assessment of Iowa farmers' perceptions about auger safety. *Journal of Agricultural Safety and Health* 9(1):61-74.

- Freeman, S.A., D.W. Field, and M.J. Dyrenfurth. 2001. Using contextual learning to build cross-functional skills in industrial technology curricula. *Journal of Industrial Teacher Education* 38(3): 62-75.
- Freeman, S.A., D.W. Field, and M.J. Dyrenfurth. 2001. Enriching the undergraduate experience through a technology learning community. *Journal of Technology Studies* 27(1):53-58.

Professional Society Membership

American Society of Agricultural Engineers (ASAE)
American Society for Engineering Education (ASEE)
National Institute for Farm Safety, Inc. (NIFS)
American Society of Safety Engineers (ASSE)
National Association of Industrial Technology (NAIT)
Iowa Farm Safety Council (1997 -)

Honors and Awards (2001-2005)

Miller Faculty Fellow (2005-2006), Iowa State University.
President's Award (2004), National Institute for Farm Safety, Inc.
Wakonse Fellow (2002), Wakonse Foundation on College Teaching, Iowa State University Center for Teaching Excellence.
Miller Faculty Fellow (2001-2002), Iowa State University.
College of Education Outstanding Early Achievement in Outreach Commendation (2001), Iowa State University.

Institutional and Professional Service (2001-2005; partial listing)

2005-present	Vice Chair Awards, Iowa American Society of Agricultural Engineers Section.
2002-present	Executive Board, National Association of Industrial Technology (Safety Division Past President, 2004-present; Safety Division President, 2002-2004)
2002-present	ABE/IEDT Graduate Programs Committee
2002-present	Co-Trustee Alpha Xi Chapter of Epsilon Pi Tau.
2002-present	ISU Faculty Senate Appeals Committee
1998-present.	Board of Directors, Iowa Farm Safety Council (President, 2001-2003; Vice President, 1999-2001)
1997-present	Faculty advisor; Cyclone Student Chapter of the American Society of Safety Engineers
1997-present	ABE/IEDT Technology Curriculum Committee
2004-2005	ABE Promotion, Tenure, and Review Committee
1999-2005	ABE/IEDT Coordinator of the Technology Learning Community
2003-2004	National Institute for Farm Safety Chair for the 2004 National Symposium on Agricultural Health and Safety

Professional Development Activities (2001-2005; partial listing)

Attended Annual International Meeting of the National Institute for Farm Safety: (2001, 2002, 2003, 2004, 2005)
Attended Annual Convention/Conference of the National Association of Industrial Technology: (2001, 2002, 2003, 2004, 2005)
Attended 2002 Wakonse Conference on College Teaching
Attended 22nd Annual Lily Conference on College Teaching (2002)

Thomas D. Glanville

Associate Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	Iowa State University	Civil Engineering	1987
M.S.	Iowa State University	Civil Engineering	1975
B.S.	Iowa State University	Engineering Operations	1972

ABE Faculty Service

1996- present	Associate Professor
1988-1996	Assistant Professor
1977 - 1988	Extension Agricultural Engineer

Other Professional Experience

1975-1977	Project Engineer, Anderson Engineering, Des Moines, IA
1974-1975	Graduate Research Assistant, Iowa State University
1973-1974	Sales Engineering, Caterpillar Tractor Co, Peoria, IL

Consulting, Patents, etc.

Compost utilization, environmental impacts and bio-security considerations of emergency poultry/livestock mortality disposal

Professional Engineering Registration

Iowa - Engineer-in-training

Principal Publications (2001 – 2005)

Refereed Journal Articles

- Persyn, R.A., **T.D. Glanville**, T.L. Richard, J.M. Laflen, and P.M. Dixon. 2005. Environmental Effects of Applying Composted Organic to New Highway Embankments: Part 3 – Rill Erosion, Transactions of the ASAE 48(?): (reviewed & accepted for publication).
- **Glanville**, T.D., R.A. Persyn, T.L. Richard, J.M. Laflen, and P.M. Dixon. 2004. Environmental Effects of Applying Composted Organic to New Highway Embankments: Part 2 - Water Quality, Transactions of the ASAE 47(2): 471-478.
- Persyn, R.A., T.D. **Glanville**, T.L. Richard, J.M. Laflen, and P.M. Dixon. 2004. Environmental Effects of Applying Composted Organic to New Highway Embankments: Part 1 - Interrill Runoff and Erosion, Transactions of the ASAE 47(2):463-469.
- **Glanville**, T.D., J.L. Baker, S.W. Melvin, and M.M Agua. 2001. Measurement of Leakage from Earthen Manure Structures in Iowa, Transactions of the ASAE 44(6) 1609-16. (Winner of 2001 ASAE Honorable Mention Paper Award)

Non-refereed – Conference Papers, Major Reports, Abstracts

(19 publications, details available upon request)

Professional Society Membership

- American Society of Agricultural Engineers
- Gamma Sigma Delta
- Iowa Groundwater Association
- Phi Kappa Phi

Honors and Awards

- 2005, *Engineer of the Year*, Mid-Central Conference of ASAE
- 2004 Editorial Board, *Compost Science & Utilization*
- 2004 Iowa Section ASAE Appreciation award , for service as Iowa section 2003-2004 chairman.
- 2003 Blue Ribbon Award Winner, 2003 National Educational Aids Competition, sponsored by American Society of Agricultural Engineers. For *Using Compost for a Safer Environment, new* website www.abe.iastate.edu/compost
- 2003-04 Section Chairman, Iowa Section-American Society of Agricultural Engineers
- 2002-03 Program Chairman, Iowa Section-American Society of Agricultural Engineers
- 2002, *Swine Mortality Disposal* website (www.abe.iastate.edu/pigsgone) , selected by the Natural Resources and Environmental Management (NREM) Division of the USDA Cooperative Extension System as year 2002 state "Flagship Program" for Iowa.
- 2002, ASAE Honorable Mention Award for research paper (top 5% of papers judged) *Measurement of Leakage From Earthen Manure Structures in Iowa*, Transactions of ASAE, Vol. 44, No. 6 by T.D. Glanville, J.L. Baker, S.W. Melvin, and M.M. Agua.
- 2001 Blue Ribbon Award Winner, 2001 National Educational Aids Competition, sponsored by American Society of Agricultural Engineers. (for new web site www.ae.iastate.edu/pigsgone/)
- 2001 Letter of commendation for outstanding Technical Paper Review services, Soil & Water Division, American Society of Agricultural Engineers, June 2001.
- 2001 USDA Certificate of Appreciation for participation in *2001 National Integrated Water Quality Program Review Panel*, June 2001.

Institutional and Professional Service in Past Five Years (partial list)

- 2004 - Chairman, ASAE National Standards Development Committee, Standards Project S-585, *Standards for Poultry/Livestock Mortality Composting*
- 2004-05 Chair, Nominations Committee, Iowa Section – American Society of Agricultural Engineers
- 2003-04 Section Chairman, Iowa Section-American Society of Agricultural Engineers
- Vice Chair - ABE Graduate Programs Committee
- COE Professional Development Committee
- COA Technology Advancement Committee
- Extension Environmental Sustainability Program Committee (POW 150)
- Consultant to IDNR on environmentally sound disposal of livestock mortalities

Professional Development Activities in the Past Five Years

- Attended Annual International Meetings of the American Society of Agricultural Engineers: 2005, 2004, 2003, 2002, 2001
- Program site visit to Technologico de Monterrey, Monterrey, NL, Mexico. March 15-18, 2005.

David A. Grewell

Assistant Professor, Agricultural and Biosystems Engineering

Education

Ph.D. Welding Engineering, The Ohio State University	2005
M.S.Welding Engineering, The Ohio State University	2002
B.S. Welding Engineering, The Ohio State University	1989

Academic Experience

- Teaching Assistant, Welding Engineering 620-Engineering Analysis for Design and Simulations Laboratory setup with ANSYS
- Instructor, Welding Engineering 694-Communications for Engineers
- Teaching Assistant, WE 706-Welding of Plastics and Composites
- Instructor, Seminar on Plastics Welding. The Madison Group and Rauwendaal Extrusion Engineering
- Instructor, Seminar on Plastics Welding, including exams and certification. Techtrax LLC
- Instructor, Seminar on Plastics Welding. Society of Manufacturing Engineers

Industrial/Consulting

- EWI/Materials Joining Technology, Research Engineer (II), Columbus, Ohio. Areas of focus were automotive, aerospace, ultrasonics and medical industries.
- Branson Ultrasonics Corporation, Research Project Manager Infrared Welding, Danbury, Connecticut. Responsibilities include project management for the development of novel laser welding product line. This work resulted in a new product line for the company with annual sales of more than several million dollars and five patents.
- Grewell Engineering Consultants Inc., President, Columbus, Ohio. Clients include: Emerson Electric, Eastman Kodak, Waddington North America Inc., Edison Welding Institute and Numonics Corp.

Selected Patents

- *Apparatus and Method for Ultrasonic Debulking of Composite Laminates,* US Patent Application 0837RF-H591-PCT, D. Grewell, A. Benatar, E. Lee
- *Laser beam shaping using liquid crystals*, US Patent 6,867,388, D. Grewell
- *Light guide for laser welding*, US Patent 6,528,755, D. Grewell, J. Bickford D. Lovett, P. Rooney
- *Transparent pressure bladder*, US Patent 6,486,433, D. Grewell, D. Lovett
- *Distance mode control for laser welding*, US Patent 6,329,629, D. Grewell
- *Laser Diode Array,* US Patent 6,205,16, D. Grewell
- *Welding Method and Apparatus,* US Patent 6,064,798, D. Lovett, D. Grewell
- *Welding Method and Apparatus,* US Patent 5,949,959, D. Lovett, D. Grewell

- *Simultaneous Amplitude and Force Profiling During Ultrasonic Welding of Thermoplastic Workpieces,* U.S. Patent 5,855,706, D. Grewell
- *Method for Processing Workpieces by Ultrasonic Energy,* U.S. Patent 5,846,377, J. Frantz, D. Grewell

Selected Publications (TOTAL PUBLICATIONS>50)

Plastic and Composite Welding Handbook, Editors; D. Grewell, A. Benatar, J. Park
Welding-Plastics Pocket Power, A. Benatar, C. Bonten, D. Grewell, C. Tuechert
Plastic and Composite Welding Handbook, Munich Germany, 2003

Chapter 8 *Ultrasonic Welding,* D. Grewell; Chapter 10 *Spin Welding,* Paul Rooney, D.Grewell; Chapter 11 *Radio Frequency Welding,* J. Dixon, D. Grewell; Chapter 12 *Infrared and Laser Welding*, D. Grewell; Chapter 14 *Process Selection,* J.Park, D. Grewell.

Part Design for Assembly, Chapter on *Laser Welding*, Hanser Publications, Munich Germany, 2003
Welding Handbook, Volume 3, Chapter 11, *Welding and Fusion Bonding of Plastics*, Co-Author, American Welding Society, Miami FL., 1996

- V. Kagan, D. Grewell, Relationship Between Optical Properties and Optimized Processing Parameters for Through-transmission Laser Welding of Thermoplastics, Journal of Reinforced Plastics and Composites
- D. Grewell, A. Benatar, *Comparison of Orbital and Linear Frictions Welding*, Submitted March 2006 Polymer Engineering and Science'
- D. Grewell, C. Lu, J. Lee, A. Benatar, *Experiments with Infrared Micro-Embossing of Thermoplastics,* Submitted November 2005 to Polymer Engineering and Science
- C. Lu, D. Grewell J. Lee, A. Benatar, *Analysis of Laser/IR-Assisted Microembossing,* Polymer Engineering and Science, May 2005 661-666, 45.6, Society of Plastic Engineers

Honors and Awards

- Best Paper Award, ANTEC 2004 and 1997 Society Plastics Engineers,
- Phi Kappa Phi OSU Honors Society
- Procter and Gamble Graduate Research Award
- Significant Contribution Award, Branson Ultrasonics Corporation

Professional Activities

- Society of Plastic Engineers Chair to SIG Joining of Plastics and Composites
- Society of Plastic Engineers Technical Chair to SIG Joining of Plastics and Composites
- Society of Plastic Engineers Vice-Chair to SIG Joining of Plastics and Composites
- Society of Plastic Engineers Secretary to SIG Joining of Plastics and Composites
- Program Organizer and Chairman for Materials Week '95 ASM and '91 ASM
- AWS member on plastics G1 committee

Invented/Guest Speaker

- Controlling Amplitude During the Ultrasonic Welding of Thermoplastics, The Polymer Processing Society, Akron OH
- TTIr Welding of Aliphatic Polyketone, Society of Plastic Engineers, IIW Annual Assembly, Florence, Italy

Shufneg Han

Collaborator/Associate Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	University of Illinois at Urbana-Champaign	Agricultural Engineering	12/92
M.S.	Zhejiang University, China	Agricultural Engineering	07/85
B.S.	Zhejiang University, China	Agricultural Engineering	02/82

ABE Faculty Service

2004-present Collaborator/Associate Professor

Other Professional Experience

2002-present	Staff Engineer / Scientist, John Deere, Urbandale, IA
2000-2002	Assistant Professor, University of Illinois at Urbana-Champaign, Champaign, IL
1997-2000	Senior Engineer, Case Corporation, Burr Ridge, IL
1993-1997	Agricultural Engineer / Research Associate, Washington State University, Prosser, WA

Consulting, Patents, etc.

United States Patent No. 6,178,253, 2001. Method of determining and treating the health of a crop.
United States Patent No. 6,278,918, 2001. Region of interest selection for a vision guidance system.
United States Patent No. 6,285,930, 2001. Tracking improvement for a vision guidance system.
United States Patent No. 6,385,515, 2002. Trajectory path planner for a vision guidance system.
United States Patent No. 6,490,539, 2002. Region of interest selection for varying distances between crop rows for a vision guidance system.
United States Patent No. 6,529,615, 2003. Method of determining and treating the health of a crop.
United States Patent No. 6,686,951, 2004. Crop row segmentation by K-means clustering for a vision guidance system.

Professional Engineering Registration

Washington (agricultural)

Principal Publications (2001 – 2005)

Refereed Journal Articles (15 total)

Han, S. and Y. He. 2002. Remote sensing of crop nitrogen needs and variable-rate nitrogen application technology. Transactions of the CSAE 18(5): 28-33.

Han, S., S. M. Schneider, and R. G. Evans. 2003. Evaluating cokriging for improving soil nutrient sampling efficiency. Transaction of the ASAE 46(3): 845-849.

Han, S., S. M. Schneider, R. G. Evans, and J. R. Davenport. 2004. Blocking estimating of spatial yield data and its uncertainty. Precision Agriculture 5, 73-84.

Han. S., Q. Zhang, B. Ni, and J. F. Reid. 2004. A guidance directrix approach to vision-based vehicle guidance systems. Computers and Electronics in Agriculture 43: 179-195.

Han .S., Q. Zhang, H. Noh, and B. Shin. 2004. A dynamic performance evaluation method for DGPS receivers under linear parallel-tracking applications. Transactions of the ASAE 47(1): 321-329.

Westphalen, M. L., B. L. Steward, and S. Han. 2004. Topographic mapping through measurement of vehicle attitude and elevation. Transactions of the ASAE 47(5): 1841-1849.

Noh, H., Q. Zhang, S. Han, B. Shin, and D. Reum. 2005. Dynamic calibration and image segmentation methods for multispectral imaging crop nitrogen deficiency sensors. Transactions of the ASAE 48(1): 393-401.

Wei, J., F. Rovira-Mas, J. F. Reid, and S. Han. 2005. Obstacle detection using stereo vision to enhance safety of autonomous machines. Transactions of the ASAE 48(6): 2389-2397.

Non-Refereed Articles

Li, B., B. Steward, and S. Han. 2004. Integration of digital elevation models with vehicle dynamics for vehicle pitch and roll angle estimation. ASAE Paper No. 041057. ASAE Annual Meeting (2004). Ottawa, Canada, August 1 – August 4, 2004.

Noh, H., Q. Zhang, and S. Han. 2004. A neural network model of nitrogen stress assessment using a multispectral corn nitrogen deficiency sensor. ASAE Paper No. 041132. ASAE Annual Meeting (2004). Ottawa, Canada, August 1 – August 4, 2004.

Wei, J., S. Han, F. Rovira-Mas, and J.F. Reid. 2005. A method to obtain vehicle guidance parameters from crop row images. ASAE Paper No. 051155. ASAE Annual Meeting (2005). Tampa, Florida, July 17 – July 20, 2005.

Rovira-Mas, S. Han, J. Wei, and J.F. Reid. 2005. Fuzzy logic model for sensor fusion of machine vision and GPS in autonomous navigation. ASAE Paper No. 051156. ASAE Annual Meeting (2005). Tampa, Florida, July 17 – July 20, 2005.

Wei, J., F. Rovira-Mas, J.F. Reid, and S. Han. 2005. Obstacle detection using stereo vision to enhance safety of autonomous machines. ASAE Paper No. 055006. ASAE Annual Meeting (2005). Tampa, Florida, July 17 – July 20, 2005.

Book Chapters

Han, S., and F. W. Simmons. 2000. Soil management and tillage systems. In Illinois Agronomy Handbook 2001-2002, ed. J. Atkinson, ch. 13, 135-146. University of Illinois Extension, Circular 1360.

Han, S., and F. W. Simmons. 2000. No tillage. In Illinois Agronomy Handbook 2001-2002, ed. J. Atkinson, ch. 14, 147-153. University of Illinois Extension, Circular 1360.

Professional Society Membership

American Society of Agricultural and Biological Engineers (ASABE)
Society of Automotive Engineers (SAE)

Institutional and Professional Service (2001 – 2005)

2001-2002	Chair, Farm Committee, ABE Department, University of Illinois.
2002-2003	Chair, PM-58 Committee, ASABE.
2002-present	Associate Editor, IET Division, ASABE.
2005-present	Vice Chair, ASABE Iowa Section.
2006	Program Chair, AMC Conference.

Professional Development Activities (2001 – 2005)

Attended Annual International Meetings of the American Society of Agricultural and Biological Engineers: 2005, 2004, 2003, 2002, 2001

H. Mark Hanna

Extension Agricultural Engineer (Professional & Scientific staff)

Education

Ph.D.	Iowa State University	Agricultural Engineering	1991
M.S.	Iowa State University	Agricultural Engineering	1975
B.S.	Iowa State University	Agricultural Engineering	1973

ABE Service

5/87 - Extension Agricultural Engineer, Ames

Other Professional Experience

9/75 - 4/87	Extension Soil, Water and Waste Management Specialist, Atlantic and Council Bluffs
11/73 - 8/75	Teaching and research assistant, Ames
5/73 - 8/73	Summer Design Trainee, Caterpillar Tractor Co, Peoria, IL

Consulting, patent

Agrichemical equipment education
Anhydrous ammonia manifold patent

Professional Engineering Registration

Iowa, Nebraska

Publications Within Past Five Years

Referred Articles

Hanna, H.M., P.M. Boyd, J.L. Baker, and T.S. Colvin. 2005. Anhydrous ammonia application losses using single-disc and knife fertilizer injectors. Applied Engineering in Agriculture 21(4):573-578.

Boyd, P. M., H. M. Hanna, J. L. Baker, and T. S. Colvin. 2004. Field evaluation of anhydrous ammonia manifold performance. Applied Engineering in Agriculture 20(6):745-756.

Hanna, H. M. 2004. Farm implements. In Encyclopedia of the Great Plains, D. J. Wishart ed. Univ. of Nebraska Press, Lincoln. pp 417-418.

Hanna, H. M. 2003. Grain production systems. In Encyclopedia of Agricultural, Food, and Biological Engineering, D. R. Heldman, ed. Marcel Dekker, New York. pp 451-453.

Hanna, H. M., K. D. Kohl, and D. Haden. 2002. Machine losses from conventional vs. narrow row corn harvest. Applied Engineering in Agriculture 18(4)405-409.

Hanna, H. M., M. L. White, T. S. Colvin, and J. L. Baker. 2002. Anhydrous ammonia distribution during field application. Applied Engineering in Agriculture 18(4)443-451.

Stone, J. F., H. M. Hanna, C. Guo, and P. Imerman. 2001. Protective headgear for Midwestern agriculture: a limited wear study. Journal of Environmental Health 63(7):13-19.

Professional Society Membership

American Society of Agricultural Engineers
American Association for the Advancement of Science

American Society of Heating, Refrigerating and Air Conditioning Engineers
National Institute for Farm Safety

Honors and Awards

American Society of Agricultural Engineers AE 50 Design Award
Superior Engineering Extension Award
Mission Award for Extension (Gamma Sigma Delta)
American Society of Agricultural Engineers Honorable Mention Paper Award
Achievement Award (Iowa State University Extension) (4)
American Society of Agricultural Engineers Educational Aids Blue Ribbon Award (6)
American Society of Agronomy Educational Materials Award (4)

Institutional and Professional Service in Past Five Years

2001-	Cultural Practices Equipment Committee, ASAE PM-42 (chair)
2001-	Pest Control and Fertilizer Application Committee, ASAE PM 23/6/1
2001-	Soil Dynamics Research Committee, ASAE PM-45
2004-	Grain Harvesting Committee, ASAE PM 23/7/1
2003-	ASAE Iowa Section (chair, program vice-chair)
2003-	Extension ABE departmental liaison

Professional Development Activities Past Five Years

Attended Annual International Meeting of the American Society of Agricultural Engineers:
Tampa, FL July 17-20, 2005;
Ottawa, ON, August 1-5, 2004;
Las Vegas, NV, July 27-30, 2003;
Chicago, IL, July 28-31, 2002;
Sacramento, CA, July 29-August 1, 2001
Attended ASAE Agricultural Equipment Technology Conference:
Louisville, KY, February 13-15, 2005;
Louisville, KY, February 8-10, 2004;
Louisville, KY, February 9-11, 2003;
Kansas City, MO, February 20-23, 2002;

Areas of Expertise

Tillage and seeding equipment.
Chemical application equipment.
Harvest equipment.
Safety of agricultural field equipment.
Technology transfer to equipment operators and crop producers

Jay D. Harmon

Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	Virginia Tech	Agricultural Engineering	1989
M.S.	University of Minnesota	Agricultural Engineering	1986
B.S.	Purdue University	Agricultural Engineering	1984

ABE Faculty Service (12 years of service, original appointment: 12/93)

2005- present	Professor
1998- 2005	Associate Professor
1993-1998	Assistant Professor

Other Professional Experience

1989-1993	Assistant Professor, Clemson University
1986-1989	Graduate Research Assistant, VPI&SU
1984-1986	Graduate Research Assistant, University of Minnesota

Consulting, Patents, etc.

2004-05 Consulting on ventilation remodeling for swine buildings

Method and Means for Automated Variable Heater Control for Agricultural Unit Heaters. 2002. S.J. Hoff, J.D. Harmon, and D. Van Utrecht. US Patent No. 6,360,955

Professional Registration

South Carolina (agricultural)

Principal Publications (2001-2005)

Refereed Journal Articles

Larson, M.E., M.S. Honeyman, and J.D. Harmon. 2003. Performance and behavior of early-weaned pigs in hoop structures. *Applied Engineering in Agriculture* 19(5):591-599.

Honeyman, M.S. and J.D. Harmon. 2003. Performance of finishing pigs in hoop structures and confinement during winter and summer. *Journal of Animal Science* 81:1663-1670.

Stender, D., J.D. Harmon, J. Weiss and D. Cox. 2003. Comparison of different styles of swine finishing facilities within a uniform production system. *Applied Engineering in Agriculture* 19(1): 79-82.

Van Utrecht, D.M., S.J. Hoff and J.D. Harmon. 2002. Variable rate heater control for livestock space heating. *Applied Engineering in Agriculture* 18(2):245-253.

Honeyman, M.S. J.D. Harmon, J.B. Kliebenstein, and T. L. Richard. 2001. Feasibility of hoop structures for market swine in Iowa: pig performance, pig environment, and budget analysis. *Applied Engineering in Agriculture* 17(6):869-874.

Non-Refereed Articles

Powers, W., S.B. Bastyr, J. Harmon, R. Wheat, and M. Schilling. 2005. Construction of a laboratory to measure gaseous emissions. ASABE paper 054025. 2005 ASAE Annual International Meeting, Tampa, Florida, July 17-20.

Davis, J.D., M.J. Darr, H. Xin, J.D. Harmon, T.M. Brown-Brandl. 2005. Development of a Low-Cost GPS Herd Activity and Welfare Kit (HAWK) for Livestock Monitoring. Livestock Environment VII: Proceedings of the Seventh International Symposium. Beijing, China. May 18-20.

Harmon, J.D., M.S. Honeyman, and M.Boggess. 2005. Educational Programs: Alternative Swine Housing Educational Programs. In: Certification and Education Programs: Current Status of Farm Animal Welfare. Future Trends in Animal Agriculture. USDA. pp. 43-48.

Harmon, J.D., D.S. Bundy, T.L. Richard, S.J. Hoff and A. Beatty. 2003. Survey monitoring of environmental factors from bedded swine systems. In *International Symposium on Gaseous and Odour Emissions from Animal Production Facilities*. Horsens, Denmark. p 105-113.

Shouse, S., M. Honeyman, and J. Harmon. 2004. Hoop barns for beef cattle. AED-50. Midwest Plan Service, Ames, IA.

Harmon, J.D., M.S. Honeyman, and F.W. Koenig. 2004. Hoop barns for horses, sheep, ratites and multiple utilization. AED-52. Midwest Plan Service. Ames, IA.

Lawrence, J., J.D. Harmon, J. Lorimor, W. Edwards, D. Loy, W. Klein and W. Miller. 2001. Beef Feedlot Systems Manual. Pm-1867. Iowa State University Extension, Ames, IA.

Wheeler, E. B. Koenig, J. Harmon, P. Murphy and D. Freeman. 2004. Horse Facilities Handbook. MWPS, Ames, IA. 232 pp.

ASAE P-414. 2004. A Guide to Professional Licensure for Agricultural, Food and Biological Systems Engineers. (contributing author)

Harmon, J.D., D. Levis, J. Zulovich, S. Hoff, and G. Bodman. 2001. *Swine Breeding and Gestation Handbook*. MWPS-43. Midwest Plan Service, Ames, IA. 103 pages.

Professional Society Membership

American Society of Agricultural Engineers, Member 1980-present
Professional Engineering Institute, member 2004-present
National Frame Builders Association, member 1992-present

Honors and Awards

2005 College of Engineering Superior Extension Award. Iowa State University.
2005 ASAE Blue Ribbon Award for Educational Aids. Horse Facilities Handbook. MWPS-60.
2004 Iowa State University Extension Team
2004 National Pork Board Swine Innovation Award, Education Category
2003 Inducted into the Rural Builders Hall of Fame.
2002 ISU College of Agriculture Team Award. 2002.

Institutional and Professional Service (2001-2005)

2005 – present ABE Promotion and Tenure Committee, (chair)
2004 – present ASABE ED-414 Professional Licensure (vice chair)
2003 - present Scholarship Committee (chair)
2001-2005 Awards Committee
2002 – present AST Student Branch Advisor

Professional Development Activities (2001-2005)

Attended Annual International Meeting of the ASAE: 2005, 2004, ILES VII (Beijing) and others.
Participated in PE question writing sessions 2004 (2), 2005 (2)

Matthew J. Helmers

Assistant Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	Engineering, Specialization: Agricultural and Biological Systems Engineering	University of Nebraska-Lincoln	5/03
M.S.	Civil Engineering	Virginia Polytechnic Institute and State University	8/97
B.S.	Civil Engineering	Iowa State University	5/95

ABE Faculty Service (2 years of service, original appointment: 08/03)

2003-present	Assistant Professor

Other Professional Experience

1999-2003	**USDA National Needs Graduate Fellow, Agricultural and Biological Systems Engineering Department, University of Nebraska-Lincoln**
1997-1999	Staff Engineer, URS Greiner Woodward-Clyde, Santa Ana, CA and Denver, CO
1995-1997	Eisenhower Graduate Research Fellow, Civil Engineering Department, Virginia Polytechnic Institute and State University

Professional Engineering Registration

EIT in Iowa (1995)

Principal Publications (2001 – 2005)

Refereed Journal Articles

Helmers, M. J., D. E. Eisenhauer, M. G. Dosskey, T. G. Franti, J. Brothers, and M. C. McCullough. 2005. Flow pathways and sediment trapping in a field-scale vegetative filter. *Trans. of ASAE* 48(3): 955-968.

Helmers, M. J., D. E. Eisenhauer, T. G. Franti, and M.G. Dosskey. 2005. Modeling sediment trapping in a vegetative filter accounting for converging overland flow. *Trans. of ASAE* 48(2): 541-555.

Helmers, M. J. and D. E. Eisenhauer. Overland flow modeling in a vegetative filter considering non-planar topography and spatial variability of soil hydraulic properties and vegetation density. Submitted to the *Journal of Hydrology.*

Dosskey, M. G., M. J. Helmers, D. E. Eisenhauer, T. G. Franti, and K. D. Hoagland. 2002. Assessment of concentrated flow through riparian buffers. *Journal of Soil and Water Conservation*, 57(6): 336–343.

Non-Refereed Articles

Baker, J. L., S. W. Melvin, D. W. Lemke, P. A. Lawler, W. G. Crumpton, and M. J. Helmers. 2004. Subsurface drainage in Iowa and the water quality benefits and problem. In *Drainage*

VIII, edited by Richard Cooke, Proceedings of the Eight International Symposium. ASAE Publication Number 701P0304, St. Joseph, MI: ASAE. pp. 39-50.

Melvin, S.W., J. L. Baker, D.W. Lemke, M. J. Helmers, and P.A. Lawlor. 2004. Subsurface drainage water quality as impacted by agricultural cultural practices. In *Proceedings of the International Conference on Hydro-Science and Engineering* (May 30-June 4, Brisbane, Australia), pp. 53-54.

Dosskey, M. G., M. J. Helmers, D. E. Eisenhauer, T. G. Franti and K. D. Hoagland. 2003. Hydrologic routing of farm runoff and implications for riparian buffers. In *Agricultural Hydrology and Water Quality*, edited by Dana Kolpin and John D. Williams. AWRA's 2003 Spring Specialty Conference Proceedings. TPS-03-1, CD-ROM. Middleburg, VA: American Water Resources Association.

Lawlor, P. A., M. J. Helmers, J. L. Baker, S. W. Melvin, and D. W. Lemke. 2005. Nitrogen application rate effects on corn yield and nitrate-nitrogen concentration and loss in subsurface drainage. ASAE Meeting Paper No. 05-2025. St. Joseph, MI: ASAE.

M. J. Helmers, P. A. Lawlor, J. L. Baker, S. W. Melvin, and D. W. Lemke. 2005. Temporal subsurface flow patterns from fifteen years in north-central Iowa. ASAE Meeting Paper No. 05-2234. St. Joseph, MI: ASAE.

Professional Society Membership

American Society of Agricultural Engineers (ASAE), Soil and Water Conservation Society (SWCS), American Society of Civil Engineers (ASCE), Environmental and Water Resources Institute of ASCE, and American Water Resources Association (AWRA)

Honors and Awards

2002	ASAE Mid-Central Region Graduate Student of the Year

Institutional and Professional Service (2001 – 2005)

2004-present	Member of NCR-207 Committee (regional Research Committee)
2004-present	Department representative on Environmental Science (graduate program) coordinating committee
2004-2005	Technical Reviewer for Applied Engineering in Agriculture (one manuscript), Transactions of ASAE (four manuscripts), Soil Science Society of America (one manuscript), Soil Science (one manuscript), and USDA-ARS Peer Review (one manuscript)
2004	Moderator of Session at Eighth International Drainage Symposium, 2004 ASAE International Meeting, and 2004 ASAE Mid-Central Meeting
2004	Judge of student paper competition at the 2004 ASAE Mid-Central Meeting
2003-present	Member of ASAE committee SW-224 Pollution by Sediment and ASAE committee SW-23 Drainage Group, and P-208 Extension (since 2004)
2003-present	Agricultural Engineering representative on the Graduate Program for Sustainable Agriculture Coordinating Committee

Professional Development Activities (2001 – 2005)

Attended Annual International Meetings of the American Society of Agricultural Engineers: 2005, 2004, 2003, 2002, 2001

Steven J. Hoff

Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	University of Minnesota	Agricultural Engineering	12/90
M.S.	University of Minnesota	Agricultural Engineering	6/87
B.S.	University of Minnesota	Agricultural Engineering	6/85
B.S.	University of Wisconsin-River Falls	Agricultural Engineering Technology	6/83

ABE Faculty Service (15 years of service, original appointment: 11/90)

2005-present	Professor
1995-2005	Associate Professor
1990-1995	Assistant Professor

Other Professional Experience

1988-1990 Graduate Research Assistant, University of Minnesota

Consulting, Patents, etc.

1995-2005 Consulting on livestock housing ventilation systems, controllers, energy efficiency

U.S. Patent Number	Patent Title	Inventors
6,360,955	*Method and Means for Automated Variable Heater Control for Agricultural Unit Heaters*	***Hoff**, S.J, J.D. Harmon, and D. VanUtrecht*
5,813,599	*Automated Controller for Naturally Ventilated Livestock and Poultry Facilities*	***Hoff**, S.J.*
5,767,385	*Automated Forced-Choice Dynamic-Dilution Olfactometer and Method of Operating the Same*	*Bundy,D.S., W. Huang, S.J. **Hoff**, Q. Liu, and X. Li*
5,707,283	*Dual Baffle System in Automatic Air Inlets for Livestock Facilities*	*Oberreuter, M.E., S.J. **Hoff**, and F. Perez-Munoz*
5,579,719	*Method and Means for Quasi Ad-Libitum Feeding for Gestation Sows in Loose Housing*	***Hoff**, S.J., M.S. Honeyman, J.D. McKean, E.J. Stevermer, D.S. Bundy, F. Perez-Munoz, S.E. Bryce, and W.E. Backhaus*

Professional Engineering Registration

Iowa (agricultural)

Principal Publications (2001 – 2005)

Refereed Journal Articles

Jerez, S.B., Y. Zhang, J.M. McClure, L.D. Jacobson, A.J. Heber, S.J. **Hoff**, J. Koziel, D. Beasley. 2005. Comparison of Measured Total Suspended Particulate Matter Concentration Using Tapered Element Oscillating Microbalance and a TSP Sampler. *J Air & Waste Management Association, accepted for publication.*

Hoff, S.J., D.S. Bundy, M.A. Huebner, B.C. Zelle, L.D. Jacobson, A.J. Heber, J. Ni, Y. Zhang, J. Koziel, D. Beasley. 2005. Emissions of Ammonia, Hydrogen Sulfide, and Odor Before, During and After Slurry Removal from a Deep-Pit Swine Finisher. *J Air & Waste Management Association, accepted for publication.*

Cai, L., J.A. Koziel, Y.C. Lo, and S.J. **Hoff**. 2005. Characterization of volatile organic compounds and odorants associated with swine barn particulate matter using solid-phase microextraction and gas chromatography-mass spectrometry-olfactometry. J of Chromatography A, 1102(Issues1-2):60-72.

Alimardani, R. and S.J. **Hoff**. 2005. Development of Multiple Velocity and Temperature Probe Sets for Ventilation Spaces. International *Agrophysics Journal*, 19(1): 1-6.

Hoff, S.J. and B.C. Zelle. 2005. Hydrogen Sulfide and Ammonia Concentrations in the Community of Multiple Agricultural Sources. (*accepted, Atmospheric Environment*).

Hoff, S.J. 2004. Automated Control Logic for Naturally Ventilated Agricultural Structures. *Applied Engineering in Agriculture, 20(1): 47-56*.

Liang, Y., H. Xin, S.J. **Hoff**, T.L. Richard, and B.J. Kerr. 2004. Performance of Single Point Monitor in Measuring Ammonia and Hydrogen Sulfide Gases. *Applied Engineering in Agriculture*, 20(6):863-872.

Yu, H. and S.J. **Hoff**. 2002. Criteria for Ceiling Slot-Ventilated Agricultural Enclosures: Non-Isothermal. *Transactions of the ASAE, 45(1): 201-214*.

Van Utrecht, D.M., S.J. **Hoff**, and J.D. Harmon. 2002. Variable Rate Heater Control for Livestock Space Heating. *Applied Engineering in Agriculture, 18(2): 245-253*.

Hoff, S.J. 2001. Assessing Air Infiltration Rates of Agricultural-Use Ventilation Curtains. *Applied Engineering in Agriculture, 17(4): 527-531*.

Professional Society Membership

American Society of Agricultural and Biological Engineers
Air & Waste Management Association

Honors and Awards

2005 Superior Engineering Teaching Award, College of Engineering, Iowa State University
2003 Leadership Award, Engineering Student Council, Iowa State University
2003 Outstanding ABE Professor, E-Week, Iowa State University
2002 Exceptional Support Recognition, Iowa State University Student Scholars
2001 Honorary Researcher, National Livestock Research Institute, Seoul National University, Korea

Institutional and Professional Service (2001 – 2005)

2005-present ABE Promotion and Tenure Committee
2001-present AE Curriculum Committee
2001-present ABE Awards Committee (chair 2001-02)

Professional Development Activities (2001 – 2005)

Attended Annual International Meetings of the American Society of Agricultural Engineers: 2005, 2004, 2003, 2002, 2001

Attended Annual International Meeting of the Air & Waste Management Association: 2005

Charles R. Hurburgh, Jr.

Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	Iowa State University	Agricultural Engineering, minor Economics	12/81
M.S.	Iowa State University	Agricultural Engineering	02/80
B.S.	Iowa State University	Agricultural Engineering	02/73

ABE Faculty Service

1991-present	Professor
1985-1991	Associate Professor
1982-1985	Assistant Professor
1976-1982	Instructor

Other Professional Experience

1998-Present	Faculty Coordinator, Iowa Grain Quality Initiative
1972-1976	Managed and operated cash grain farm

Principal Publications (2001 – 2005)

Refereed Journal Articles

Ye, W., J.C. Lorimor, C.R. Hurburgh, Jr., H. Zhang, and J. Hattery. 2004. Transfer of beef cattle feedlot manure calibrations between near-infrared spectrophotometers using three standardization techniques. Trans ASAE (sub).

Ye,W, J.C. Lorimor, C.R. Hurburgh, Jr. H. Zhang, and J. Hattery. 2004. Application of near-infrared reflectance spectroscopy for determination of nutrient contents in liquid and solid manures. Trans ASAE (sub.)

Chang, Cheng Wen, David A. Laird*, and Charles R. Hurburgh, Jr. 2004. Influence of Soil Moisture on Near-Infrared Reflectance Spectroscopic Measurement of Soil Properties. Soil Science 170(4):244-255

Siska, J., C.R. Hurburgh, Jr. and P. Siska. 2001. The standardization of near-infrared instruments using master selection and Wiener filter methods. J. Near Infrared Spectrosc. **9,** 97-105.

Siska, J., C.R. Hurburgh, Jr. and P. Siska. 2001. The impact of engineering parameters on the accuracy of calibration transfer. J. Near Infrared Sprectrosc. **9,** 107-116.

Chang, Ching-Wen, D. Laird, M.J. Mausbach, and C.R. Hurburgh, Jr. 2001. Near-Infrared Reflectance Spectroscopy – Principal Component Regression Analysis of Soil Properties. Soil Sci. Soc. Am. J. 65:480-490.

Steenhoek, L.A., M.K. Misra, C.R. Hurburgh, Jr., and C.J. Bern. 2001. Implementing a computer vision system for corn kernel damage evaluation. Trans. ASAE 17(2):235-240.

Roussel, S.A., C.L. Hardy, C.R. Hurburgh, Jr., G.R. Rippke. 2001. Detection of Roundup Ready™ soybeans by near-infrared spectroscopy. Applied Spectroscopy 55(10):1425-1430.

Cogdill, R. P., P. Dardenne, and C.R. Hurburgh, Jr. 2005. Support vector machines for NIR calibration. JNIRS (in-press).

Cogdill, R. P. and C. R. Hurburgh, Jr. 2004. Photometric standardization of a near-infrared hyperspectral imaging spectrometer. J. N.I.R.S (in-press).

Codgill, R.P., C.R. Hurburgh, Jr., G.R. Rippke, R.W. Jones, T.C. Jensen, and J.R. McClelland. 2004. Single kernel maize analysis by near-infrared hyperspectral imaging. Trans. ASAE 47(1): 150

Hurburgh, C. R., Jr. 2002. Quality of the US 2001 soybean crop. American Oil Chemists Society, Inform 13(5):394.

Singh, S., L.A. Johnson, L.M. Pollak, and C.R. Hurburgh, Jr. 2001. Heterosis in compositional, physical and wet milling properties of adapted X exotic corn crosses. Cereal Chemistry 78(3): 336-341.

Singh, S., L.A. Johnson, L.M. Pollak and C.R. Hurburgh, Jr. 2001. Compositional, physical and wet milling properties of accessions used in the germplasm of maize project. Cereal Chemistry 78(3): 330-335.

Roussel, S.A., G.R. Rippke and C.R. Hurburgh, Jr. 2001. Comparison of PLS, locally weighted regression and artificial neural networks for grain quality assessment using NIR spectrometers. Applied Spectroscopy (submitted).

Professional Society Membership

American Society of Agricultural Engineers (ASAE)
American Society of Cereal Chemists (AACC)
Iowa Academy of Science (IAS)
Grain Elevator and Processing Society (GEAPS)
American Oil Chemists Society (AOCS)
Society for Applied Spectroscopy (SAS)
International Diffuse Reflectance Council (IRDC)
Council on Near-Infrared Spectroscopy (CNIRS)

Honors and Awards

Grain Elevator and Processing Society Industry Leader Award (2002)
Andersen Research Award (2000)
Best Paper Award, ASAE (2000)

Institutional and Professional Service (2001 – 2005)

Faculty Coordinator, Iowa Grain Quality Initiative

Professional Development Activities (2001 – 2005)

- EPA Science Advisory Panel, food safety (2000-2002)
- Innovative Growers, LLC, Board of Directors (2000-present)
- U.S. Technical Advisory Group, ISO Technical Committee TC34, working group 7 (biotechnology testing) and working group 12 (traceability) (2001-present)
- College of Agriculture/Extension Ag Quality Initiative (2001- present, co-chair)
- Council on Near Infrared Spectroscopy Associate Editor (2003 – present)
- Ag9000 proposed ISO agricultural standards, working group chair (2004 – present)
- KEMA Registrars, Inc. Corporate Advisory Committee 2004 -

Lawrence A. Johnson

Professor of Food Science & Human Nutrition
Courtesy Professor of Agricultural and Biosystems Engineering
Director of the Center for Crops Utilization Research

Education

Ph.D.	Kansas State University	Food Science (emphases Grain Science and Engineering Technology)	6/78
M.S.	North Carolina State University	Food Science	6/71
B.S.	The Ohio State University	Food Technology	6/69

ABE Faculty Service (20 years of service, original appointment: 06/85)

1988-present	Professor, Food Science & Human Nutrition
1999-present	Director, Center for Crops Utilization Research
1997-present	Courtesy Professor, Agricultural & Biosystems Engineering
1985-1999	Professor in Charge, Center for Cops Utilization Research
1985-1988	Associate Professor, Food Science & Human Nutrition
1985-1973	Professor in Charge, Food Crops Processing Center

Other Professional Experience

1982-1985	Associate Research Chemist, Texas A&M University, College Station, TX
1978-1982	Assistant Research Chemist, Texas A&M University, College Station, TX
1973-1975	Project Leader/Research Chemist, Durkee Foods, SCM Corp, Strongsville, OH
1971-1973	First Lieutenant, Food Advisor, Quartermaster Corps, U.S. Army

Consulting, Patents, etc. (2001-2005)

2002 Shuttleworth & Ingersol, PLC, Cedar Rapids, IA (assisted development of architecture design proposal for Value-added Center, Kansas State University).

2002 South Dakota State University Board of Regents, Pierre, SD (evaluated value-added center plans).

2001 Kuwait University, College for Women, Department of Family Sciences, Food Science and Nutrition Programs, Safat, Kuwait (evaluated Food Science and Nutrition academic programs).

2001 Keith Smith and Associates, Farmington, MO (developed soy meal quality database and Website for United Soybean Board).

Deak, N., and L. Johnson. 2004. Novel Vegetable Protein Fractionization Process and Compositions. U.S. Provisional Patent.

Selected Principal Publications (2001-2005)

Refereed Articles

Wang, H., T. Wang, and L. Johnson. 2005. Effect of Alkali on the Refunctionalization of Soy Protein by Hydrothermal Cooking. J. Am. Oil Chem. Soc. 82(6):451-456.

Jung, S., P. Murphy, and L. Johnson. 2005. Physicochemical and Functional Properties of Soy Protein Substrates Modified by Low Levels of Protease Hydrolysis. J. Food Sci. 70(2):C180-187.

Rickert, D., L. Johnson, and P. Murphy. 2004. Improved Fractionation of Glycinin and β-Conglycinin and Partitioning of Phytochemicals. J. Food Ag. Chem. 52(6):1726-1734.

Rickert, D., L. Johnson, and P. Murphy. 2004. Functional Properties of Improved Glycinin and β-Conglycinin Fractions. J. Food Sci. 69(4):FCT303-311.

Wang, H., T. Wang and L. Johnson. 2004. Preparation of Soy Protein Concentrate and Isolate from Extruded-Expelled Soybean Meals. J. Am. Oil Chem. Soc. 81(7):713-717.

Wang, H., T. Wang and L. Johnson. 2004. Refunctionalization of Extruded-Expelled Soybean Meals. J. Am. Oil Chem. Soc. 81(8):789-794.

Jung, S., C. Rousel-Philippe, J. Briggs, P.A. Murphy, and L. Johnson. 2004. Limited Hydrolysis of Soy Proteins with Endo- and Exo-proteases. J. Am. Oil Chem. Soc. 81:(10):953-960.

Hojilla-Evangelista, M., and L. Johnson. 2003. Optimizing Extraction of Zein and Glutelin-rich Fraction during Sequential Extraction Processing of Corn. Cereal Chem. 80(4):481-484.

Books

White, P., and L. Johnson. 2003. Editors. Corn Chemistry and Technology. AACC Monograph Series. American Association of Cereal Chemists, St. Paul, MN.

Book Chapters

Hammond, E., L. Johnson, C. Su, T. Wang, and P. White. 2005. Soybean Oil. In Bailey's Industrial Oil and Fat Products, edited by F. Shahidi, Academic Press, London.

Wang, T., L. Johnson, and W. Wijeratne. 2004. Low-cost Oil-processing Techniques. In Nutritionally Enhanced Edible Oil Processing, edited by N. Dunford and H. Dunford, AOCS Press, American Oil Chemists Society, Champaign, IL, pp.219-238.

Professional Society Membership

American Oil Chemists' Society: Immediate Past President, 2005-present; President, 2004-2005; Vice President, 2003-2004; Member at Large to the Governing Board, 1996-1998 Associate Editor, JAOCS, 1989-2001; Senior Associate Editor, JAOCS, 2001-2003; Interim Editor-in-Chief, INFORM, 1996-1997.

American Association of Cereal Chemists: AACC Board of Directors, Director at Large, 2002-2004; Finance Committee, member, 2002-2004; Associate Editor, Cereal Chemistry, 1982-1985; Technical Program Committee for 1990 annual meeting, 1989-1990; AACC Foundation Board of Directors, member, 1993-1998. Scholarship Committee, member, 1997-2000.

Institute of Food Technologists, American Society of Agricultural Engineers.

Honors and Awards (2001-2005)

2003 Regents Faculty Excellence Award, Iowa Board of Regents.
2002 ADM/AOCS Award for best research paper in processing and engineering.
2001 ADM/AOCS Award for best research paper in processing and engineering.

Institutional and Professional Service (2001-2005)

1993-2002 Iowa Corn Promotion Board, Peer Review and Research Advisory Team, member.
1998-present Iowa Grain Quality Initiative, Management Committee, member.
1999-present Plant Sciences Institute Council, member.
1999-2001 Biotechnology Byproducts Consortium, Iowa State University, co-director.
2001-present Biorenewable Resources and Technology Steering Committee, member.

Professional Development Activities (2001-2005)

Attended Annual Meetings of the American Oil Chemists Society 2005, 2004, 2003, 2002, 2001; American Association of Cereal Chemists 2004, 2003, 2002, 2001; International Society for Fat Research 2004, 2005; Corn Utilization and Technology Conference 2004, 2002.

Amy L. Kaleita

Assistant Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	University of Illinois at Urbana-Champaign	Agricultural Engineering	7/2003
M.S.	University of Illinois at Urbana-Champaign	Civil Engineering	8/1999
B.S.	The Pennsylvania State University	Agricultural Engineering	5/1997

ABE Faculty Service (2 years of service, original appointment: 08/03)

2003-present Assistant Professor

Other Professional Experience

1999	Summer Research Fellow, NASA Goddard Space Flight Center
1996-1997	Research Assistant, USDA ARS Pasture Systems & Watershed Management Research Laboratory, University Park PA

Professional Engineering Registration

Certified as Engineer-In-Training, Commonwealth of Pennsylvania

Principal Publications (2001 – 2005)

Refereed Journal Articles and Conference Papers

Kaleita, A. L., L. F. Tian and M. C. Hirschi. 2005. Relationship between soil moisture content and soil surface reflectance. Transactions of the ASAE. 48(5): 1979-1986.

Kaleita, A. L., J. L. Heitman, S. D. Logsdon. 2005. Field calibration of the Theta Probe for Des Moines Lobe soils. Applied Engineering in Agriculture. 21(5): 865-870.

Kumar, P. and A. L. Kaleita. 2003. Assimilation of near-surface temperature using extended Kalman Filter. Advances in Water Resources. 26:79-93.

Brumm, T.J., S.K. Mickelson, B.L. Steward, A.L. Kaleita-Forbes and C.J. Bern, 2005. ABET is Coming! Getting Faculty Involved. Proceedings of the Annual Meeting of the American Society for Engineering Education, Portland, OR (June 2005).

Steward, B. L., R. P. Ewing, D. A. Ashlock, A. L. Kaleita, S. M. Shaner. 2004. Range operator enabled genetic algorithms for hyperspectral analysis. In Intelligent Engineering Systems Through Artificial Neural Networks: Smart Engineering Systems Design: Neural Networks, Fuzzy Logic, Evolutionary Programming, Complex Systems and Artificial Life, Vol. 14. eds. C. H. Dagli, A. L. Buczak, D. L. Enke, M. J. Embrechts, and O. Ersoy, 295-300. New York. ASME Press.

Yao, H., L. Tian, and A. Kaleita. 2003. Hyperspectral image feature extraction and classification for soil nutrient mapping. Proceedings of the 4th European Conference on Precision Agriculture, eds. J. Stafford, A. Werner, and J Zaske.

Kumar, P., and A. L. Kaleita. 2001. Assimilation of surface temperature in a land-surface model. In: Remote Sensing and Hydrology 2000: Proceedings of a symposium held at Santa Fe, New Mexico, USA, April 2000. IAHS Publ. No. 267, pp. 197-202

Non-Reviewed

B. L. Steward, A. L. Kaleita, R. P. Ewing, D. A. Ashlock. 2005. Genetic algorithms for hyperspectral range and operator selection. ASAE Paper No. 053063. St Joseph, MI.

Esteve, L., A. Kaleita, M. Helmers. 2005. Leaching of a veterinary antibiotic through soil columns. ASAE Paper No. MC05-303. St. Joseph, MI.
Kaleita, A.L., M. Hirschi, and L. Tian. 2004. Relationship of near-surface moisture variability to topographic variability. Proceedings of the 7th Int'l. Conf. on Precision Agriculture, eds. R. H. Rust and W. E. Larson, Madison WI: ASA- CSSA-SSSA.
Yao, H., L. Tian, and A. Kaleita. 2003. Hyperspectral image feature extraction and classification for soil nutrient mapping. Proceedings of the 4th European Conference on Precision Agriculture, eds. J. Stafford, A. Werner, and J Zaske.
Kaleita, A. L., L. F. Tian, and M. C. Hirschi. 2004. Identification of optimal sampling locations and grid size for soil moisture mapping. ASAE Paper No. 041146. St. Joseph, MI.
Kaleita, A. L., L. F. Tian, and H. Yao. 2003. Soil moisture estimation from remotely sensed hyperspectral data. ASAE Paper No. 031047. St. Joseph, MI.
Kaleita, A. L. and L. F. Tian. 2002. Remote sensing of site-specific soil characteristics for precision farming. ASAE Paper No. 021078. St. Joseph, MI.
Yao, H., L. Tian, M. Paulsen, A. Kaleita, and M. Singh. 2002. Hyperspectral imagery for various crop growth information extraction. ASAE Paper No. 021076. St. Joseph, MI.

Professional Society Membership

American Society for Engineering Education, American Society of Agricultural Engineers, International Association of Hydrological Sciences

Honors and Awards

2006 Outstanding Early Achievement in Teaching Award, Iowa State University College of Agriculture
2006 Outstanding ABE Faculty Award, Iowa State University Engineering Student Council
2005 Newcomer of the Year, Iowa Section, American Society of Agricultural Engineers.
2004 Outstanding ABE Faculty Award, Iowa State University Engineering Student Council
2003 Karl. A. Snyder Teaching Excellence Award, Dept. of Agricultural Engineering, Univ. of Illinois
2000 Best Student Presentation Award, Remote Sensing & Hydrology Symposium, sponsored by International Association of Hydrological Sciences (IAHS)
1998 NSF Graduate Fellowship

Institutional and Professional Service (2001 – 2005)

2004-2005 ABE Promotion, Tenure, and Review Committee
2004-2005 ISU College of Engineering International Task Team
2003-present AE Curriculum Committee
2003-2006 ISU ASAE Student Branch Advisor
2003-present ISU Tau Beta Pi Iowa Alpha Chapter Advisor (Chief Advisor 2004-present)
2003-2004 ISU ASAE Fountain Wars Team Advisor
2004-present ASABE SW-21 (Hydrology) Committee Member
2003-present ASABE P-203 (Undergraduate & Graduate Education) Committee Member
2005-present ASABE PM-54 (Precision Agriculture) Committee Member

Professional Development Activities (2001 – 2005)

Attended Annual International Meetings of the ASAE: 2005, 2004, 2003, 2002
Attended National Council on Science and the Environment Conference, Washington DC, 2/3-4/2005
Attended 7th Annual International Conference on Precision Agriculture, Minneapolis, MN, 7/25-28/2004
Participated in ISU Outcomes Assessment Workshop Series, Ames, IA, Fall 2003
Attended 4th European Conference on Precision Agriculture, Berlin, Germany, 6/2003

Ramesh S. Kanwar

Professor of Agricultural and Biosystems Engineering
Department Chair

Education

Ph.D.	Iowa State University	Agricultural Engineering	12/81
M.S.	G.B. Pant University of Ag.& Tech, India	Agricultural Engineering	1/75
B.S.	Punjab Agricultural University, India	Agricultural Engineering	6/69

ABE Faculty Service (25 years of service, original appointment: 07/81)

2001-present	Professor and Chair
1999-2002	Director, Iowa State Water Resources Research Institute
1997-2001	Assistant Director, Iowa Agriculture Experiment Station
1981-present	Professor
1986-1981	Associate Professor
1983-1986	Assistant Professor
1981-1983	Instructor

Other Professional Experience

1976-1981	Graduate Teaching/Research Assistant, Iowa State University
1969-1976	Lecturer/Assistant Professor, Pb. Agric. Univ., Ludhiana, India

Consulting, patents, etc.

DeWild Grant Reckert & Assoc. Co., Grand Rapids, SD; Faegre & Benson, Des Moines, Iowa
Bush & Co., Wall Lake Drainage Project, Iowa; GEOTECHNICA, Zagreb, Yugoslavia.

European Commission, The World Bank, NATO, UNDP, FAO, USAID – Austria, Belgium, China, Ethopia, Georgia, Ghana, India, Israel, Kenya, Maldova, Pakistan, Poland, Portugal, Romania, Serbia, and Turkey.

Professional Registration

Institute of Engineers (India); American Institute of Hydrology - Professional Hydrologist

Selected Principal Publications – 22 Refereed J. Articles Published in 5 yrs (2001 – 2005):

Bakhsh, A.*, R.S. Kanwar, and D. Karlen. 2005. Effects of liquid swine manure applications on NO_3-N –N leaching losses to subsurface drainage water. Agric., Ecosystems and Environment 109(1-2):118-128.

Bakhsh, A.* and R.S. Kanwar. 2005. Mapping Clusters of NO_3-N Leaching Losses with Subsurface Drainage Water. Journal of American Water Resources Association 41(2):333-341.

Kanwar, R.S., R. Cruse, M. Ghaffarzadeh, A. Bakhsh, D. Karlen, and T. Bailey. 2005. Corn-soybean and alternate farming systems effects on water quality. Applied Engineering in Agric. 21(2):181-188.

Bakhsh, A.* and R.S. Kanwar. 2004. Spatio-temporal analysis of trends in subsurface drainage flow rates from agricultural fields in the Midwest. TRANSACTIONS of the ASABE 47(5): 1427-1436

Bakhsh, A.*, L. Ma, L.R. Ahuja, J. L. Hatfield, and R.S. Kanwar. 2004. Using RZWQM to predict herbicide leaching losses in drainage water. TRANSACTIONS of the ASABE 47(5): 1415-1426

Bakhsh, A.* and R.S. Kanwar. 2004. Using discriminating analysis and GIS to delineate subsurface drainage patterns. TRANSACTIONS of the ASABE 47(3):689-699.

Karlen, D.L., C. A. Cambardella, R. S. Kanwar. 2004. Challenges of Managing Liquid Swine Manure. Applied Engineering in Agriculture 20(5): 693-699.

Bakhsh, A.*, J. Hatfield, R.S. Kanwar, L. Ma, and L.R. Ahuja. 2004. Simulating nitrate drainage losses from a Walnut Creek watershed field. Journal of Environmental Quality 33(1): 114-123.

Professional Society Membership

American Society of Agricultural Engineers, Life Member
American Water Resources Association, Member
Foundation Member, Asian Association for Agricultural Engineering
Life Member, International Commission on Irrigation and Drainage
Life Member, Pakistan Society of Agricultural Engineers
Life Member, Indian Science Congress Association
Honorary Member of Association of Overseas Chinese Agricultural, Biological, and Food Engineers
Alpha Epsilon
Gamma Sigma Delta
Sigma XI

Honors and Awards

2006-present	**Chief Editor**, International Journal of Agricultural Engineering, AAAE
2005	**Fellow** of American Society of Agricultural and Biological Engineers
2004-2005	**Editor**, Special Issue of International Journal of Agricultural Engineering, AAAE
2004	**International Service Award** by Iowa State University
2003-present	**Editorial Board,** International Journal of Biotronics, Kyushu University, Japan.
2003	**Honorary Professor** of the Ningxia University, Yinchuan City, China
2002	College of Agriculture Excellence in International Agriculture Award, Iowa State Univ.
2001	**Fellow** of the National Academy of Agricultural Sciences, India
2000	**Distinguished Service Award**, Asian Association of Agricultural Engineers (AAAE)
2000	**Honorary Doctorate Degree** by the Agrarian State University of Georgia
1999-2007	Member of the Research Advisory Committee of the World Bank Project, India **Honorary**
1996	**Professor**, China Agric.Univ. & Tashkent Inst. Mech and Irrig Engr Uzbek.
1991-2005	**Editorial Advisory Board,** Journal of Agricultural Engineering, AAAE
1994, 1995	**Engineer of the Year Awards**, Iowa-Section of ASAE; Mid-Central Conf. of ASAE
1993	**Margaret E. White Graduate Faculty** Award by Iowa State University
1991	**Outstanding Young Engineering Faculty Research Award** by Iowa State University

Professional Development Activities (2001 – 2005)

Attended Annual International Meetings of the ASABE and Other Professional Societies: 2002-2005

Nir Keren

Assistant Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	Texas A&M University	Interdisciplinary Engineering	12/2003
M.S.	Ben Gurion University - Israel	Management and Safety Engineering	7/98
B.S.	Ben Gurion University - Israel	Mechanical Engineering	7/90

ABE Faculty Service

2005-present Assistant Professor

Other Professional Experience

2004-2005 Assistant Research Scientists, Chemical Engineering Department, Texas A&M University
2001-2003 Graduate Research Assistant, Chemical Engineering Department, Texas A&M University
1996-1998 Graduate Student, Management and Safety Engineering, Ben Gurion University - Israel

Industrial Experience

1999-2000 Maintenance Manager, Sulfuric Acid Plant, Rotem Amfert Group, Negev, Israel
1998-1999 Maintenance Manager, Fine Chemical Division, Dead Sea Bromine Compounds Group, Israel
1995-1998 Project Manager and Division Safety Engineer, N.R.C.N., Israel
1992-1995 Maintenance Manager, N.R.C.N., Israel
1990-1992 Maintenance Engineer, N.R.C.N., Israel

Principal Publications (Partial List)

Refereed Journal Articles

1. K. Park, M.S. Mannan, Y-D. Jo, J-Y. Kim, N. Keren, Y. Wang. *Incident Analysis of Bucheon LPG Filling Station - Pool Fire and BLEVE*. Journal of Hazardous Material. In Press.
2. Sumit Anand, Nir Keren, Marietta J. Tretter, Yanjun Wang, T. Michael O'Connor, M. Sam Mannan. *Harnessing Data Mining to Explore Incident Databases*. Journal of Hazardous Material. 130(2006).
3. Mannan, M.S., H.H. West, K. Krishna, A.A. Aldeeb, N. Keren, S.R. Saraf, Y.-S. Liu, M. Gentile. *The Legacy of Bhopal: The Impact Over the Last 20 Years and Future Direction*. Journal of Loss Prevention in the Process Industries. vol. 18, no. 4-6, July-November 2005, pp. 218-224.
4. Keren, N., H.H. West, and M.S. Mannan, Benchmarking of Emergency Preparedness and Response Practices in the Process Industry, Journal of Emergency Management. vol. 3, no. 3, May/June 2005, pp. 25-32.
5. N. Keren, H. H. West, W. J. Rogers, J.P. Gupta, M.S. Mannan. *Use of Failure Rate Databases and Process Safety Performance Measurements to Improve Process Safety*. Journal of Hazardous Material. 104(2003).
6. N. Keren, H.H. West, M.S. Mannan. *Benchmarking MOC Practices in the Process Industry*. Process Safety Progress. (6/2002).

Book Chapters

Emergency Planning chapter for the 3rd edition of *Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control*. (Frank Lees) Butterworth Heinemann Pub.

Professional Society Membership

1.	National Association of Industrial Technology	2005-Present
2.	American Society of Safety Engineers	2004-Present
3.	American Institute of Chemical Engineers	2002-Present

Institutional and Professional Service (2001-2005; partial listing)

Agricultural and Biosystems Engineering, Iowa State University

1. Graduate Program Committee (2005-present)
2. Facilities Safety Committee (2005-present)
3. International Diversity Committee (2005-present)
4. Webpage Committee (2005-present)
5. Advisor to the American Society of Safety Engineers Student Chapter at Iowa State University (2005 – Present)

Chemical Engineering, Texas A&M University

1. Established the American Society of Safety Engineers Student Chapter and served as advisor, (2005)

Professional Development Activities

1. Attended Annual Conference of the American Institute of Chemical Engineers
2. Attended Annual Convention/Conference of the National Association of Industrial Technology
3. Attended Annual Conference of the Mary Key O'Connor Process Safety Center

Jacek A. Koziel

Assistant Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	University of Texas at Austin	Civil Engineering, Air Resources Engineering	5/98
M.S.	University of Alaska Anchorage	Environmental Quality Engineering	12/93
B.S./M.S.	Warsaw University of Technology	Mechanical Engineering	4/89

ABE Faculty Service (1 year of service, original appointment: 08/04)

2004-present Assistant Professor

Other Professional Experience

2000-2004	Assistant Professor, Texas Agricultural Experiment Station, Texas A&M University System, Amarillo, TX
2001-2003	Adjunct Professor, West Texas A&M University
1998-2000	Postdoctoral Research Fellow, Department of Chemistry, University of Waterloo, Canada
1994-1998	Graduate Research Assistant, University of Texas at Austin
1992-1993	Graduate Research Assistant, University of Alaska Anchorage

Principal Publications (2001 – 2005)

Refereed Journal Articles

Wright, D., L. Nielsen, D. Eaton, F. Kuhrt, J.A. Koziel, J.P. Spinhirne, D.B. Parker. 2005. Multidimensional GC-MS-olfactometry for identification and prioritization of malodors from confined animal feeding operations. Journal of Agricultural and Food Chemistry, accepted.

Baek, B.H., J.A. Koziel, and V.P. Aneja. 2005. Gas to particle conversion of ammonia, acid gases, and fine particulate matter: implications for ammonia emissions from agriculture. International Journal of Global Environmental Issues, accepted.

Heber, A.J., J.Q. Ni, T.T. Lim, P.C. Tao, A.M. Schmidt, J.A. Koziel, S.J. Hoff, L.D. Jacobson, Y. Zhang, G.B. Baughman. 2005. Quality assured measurements of animal building emissions: part 2 – particulate matter concentrations. JAMWA, accepted.

Heber, A.J., J.Q. Ni, T.T. Lim, A.M. Schmidt, J.A. Koziel, P.C. Tao, D.B. Beasley, S.J. Hoff, R.E. Nicolai, L.D. Jacobson, Y. Zhang. 2005. Quality assured measurements of animal building emissions: part 1 – gas concentrations. JAMWA, accepted.

Koziel, J.A., J.P. Spinhirne, J. Lloyd, D. Parker, D. Wright, F. Kuhrt. 2005. Evaluation of sample recoveries of malodorous gases for odor bags, SPME, air sampling canisters, and sorbent tubes. JAMWA, in press.

Parker, D.B, M.B. Rhoades, G.L. Schuster, J.A. Koziel, Z. Perschbacher. 2005. Odor characterization at open-lot cattle feedyards using forced-choice olfactometry. The Transactions of ASAE, in press.

Parker, D.B., S. Pandrangi, L.W. Greene, L.K. Almas, N.A. Cole, M.B., Rhoades, J.A. Koziel. 2005. Rate and frequency of urease inhibitor application for minimizing ammonia emissions from beef cattle feedyards. 2005. Transactions of ASAE, 48(2):787-793.

Chen, Y., J.A. Koziel, and J. Pawliszyn. 2003. Calibration for rapid on-site analysis of organic compounds and aqueous and gaseous samples using solid phase microextraction. Analytical Chemistry. 75(22), 6485-6493.

Koziel, J.A., J. Noah, and J. Pawliszyn. 2001. Field sampling and determination of formaldehyde in indoor air with solid phase microextraction and on-fiber derivatization. Environmental Science & Technology. 35:1481-1486.

Koziel, J.A., R.L. Corsi, and D.F. Lawler. 2001. Gas-Liquid Mass Transfer Along Small Sewer Reaches. Journal of Environmental Engineering. 127(5):430-437.

Koziel, J.A., M. Odziemkowski, and J. Pawliszyn. 2001. Sampling and analysis of airborne particulate matter and aerosols using in-needle trap and SPME fiber devices. Analytical Chemistry. 73:47-53.

Koziel, J.A. and J. Pawliszyn. 2001. Air sampling and analysis of VOCs with solid phase microextraction. Journal of the Air & Waste Management Association. 51:173-184.

Non-Refereed Articles

Conference papers (More than 50 between 2001-2005)

Book Chapters

Koziel, J.A. 2002. Sampling and sample preparation for indoor air analysis, in J. Pawliszyn (Editor) Sampling and Sample Preparation Techniques for Field and Laboratory. Elsevier, Amsterdam, The Netherlands, pp 1-32.

Koziel, J.A. 2003. Nitrogen Measurement. Encyclopedia of Water Science. Marcel Dekker, New York, NY, pp 625-629.

Professional Society Membership

American Society of Agricultural Engineers
American Chemical Society
Air & Waste Management Association
American Society for Engineering Education

Honors and Awards

2003 Engineer of the Year, Texas Section, American Society of Agricultural Engineers.

Institutional and Professional Service (2001 – 2005)

American Society of Agricultural Engineers (ASAE).
Faculty advisor to the ISU-Student Chapter 2004-present
SW-263 Land Application of Wastes committee –chair 2003-2004.

Air & Waste Management Association
Intercommittee Task Force for Agriculture (ITF-10, chair since 2004).

American Chemical Society (member since 2000)
-Organized and co-chaired the "Advances in Passive/Diffusive Sampling for Indoor and Outdoor Air Quality Monitoring" symposia at the Pittcon 2002 Analytical Chem. & Applied Spectroscopy Conference.

Professional Development Activities (2001 – 2005)

Attended Annual International Meetings of the ASAE and AWMA.
Visited and gave seminars at the Danish Institute of Agricultural Sciences in Horsens, Leibniz Institute of Agricultural Engineering in Potsdam, Germany, and the National Livestock Research Institute, Suwon, South Korea.

Steven K. Mickelson

Associate Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	Iowa State University	Agricultural Engineering	12/91
M.S.	Iowa State University	Agricultural Engineering	5/84
B.S.	Iowa	Agricultural Engineering	5/82

ABE Faculty Service

6/05-present	Director of Assessment, College of Engineering (20%)
8/05-present	Associate Department Chair, ABE (30%)
4/99 – present	Associate Professor
6/92 – 4/99	Assistant Professor
5/84 - 8/92	Assistant Professor

Other Professional Experience

5/82 - 7/84	Adjunct Instructor, Iowa State University
9/81 - 3/82	Research Assistant, Iowa State University
6/84-12/84	Systems Engineer, Sundstrand/Technical

Area of Expertise

Improving teaching techniques for increased student learning and improved student skills for meeting industries needs.

Living/learning community development with communication/engineering link.

Research efforts in the area of surface and ground water quality as related to nutrient and pesticide applications and best management practices (buffer strips, conservation tillage, application methods).

Nondestructive evaluation of soil quality using X-ray tomography and traditional evaluation methods as related to field and nutrient management practices

Professional Engineering Registration

Engineer-in-training

SelectedPublications Within Past Five Years

Steward, Brian L., S.K. Mickelson and T.J. Brumm, 2005. Continuous Engineering Course Improvement through Synergistic use of Multiple Assessment. Int. J. Engng Ed. 21(2): 277-287.

Steward, Brian L., S.K. Mickelson and T.J. Brumm, 2004. Formative and Summative Assessment Techniques for Continuous Agricultural Technology Classroom Improvement, NACTA Journal 48(2): 33-41.

Arora, K., S.K. Mickelson, and J.L. Baker. 2003. Effectiveness of Vegetated Buffer Strips in Reducing Pesticide Transport in Simulated Runoff. Transactions of the ASAE Vol. 46(3):635-644.

Boyd, P. M., J.L. Baker, S.K. Mickelson, and S.I. Ahmed. 2003. Pesticide transport with surface runoff and subsurface drainage through a vegetative filter strip. Transactions of the ASAE 46(3):675-684.

Mickelson, S.K., J.L. Baker, and I.S. Ahmed. 2003. Vegetative Filer Strips for Reducing Atrazine and Sediment Runoff Transport. Journal of Soil and Water Conservation 58(6):359-367.

Hanneman, L.R., Steven K. Mickelson, Loni K. Pringnitz, and Michael Lehman. 2002. Constituent-Created, Competency-Based, ABET-Aligned Assessment Tools for the Engineering Experiential Education Workplace. Proceeding of The 2nd National Conference on Outcomes Assessment for Program Improvement, October 31 - November 1, 2002, Pittsburgh, PA.

S.I. Ahmed, S.K. Mickelson, J. Russell, W. Powers, R. Schultz, and J. Kovar. 2002. Impact of different grazing systems and vegetative filter strips on sediment and nutrient losses with surface runoff. ASAE/CIGR Annual International Meeting, July 29-31, Hyatt Regency, Chicago, IL.

Haan, M., J. Russell, W. Powers, S.K. Mickelson, J. Kovar, and R. Schultz. 2002. Effects of grazing management on sediment and phosphorus runoff. Proceedings/Reports of the American Forage and Grassland Council 11:38.

Mickelson, S. K. , S. Anton, J. L. Baker, and S. I. Ahmed . 2001. Subsurface Herbicide Application with the Modified John Deere Mulch Master. *Transactions of the ASAE* 44(4): 807-812.

Mickelson, S.K., P. Boyd, J.L. Baker, and S.I. Ahmed. 2001. Tillage and herbicide incorporation effects on residue cover, runoff, erosion, and herbicide loss. Soil and Tillage Research 60:55-66.

Lee, K-H., T.M. Isenhart, R.C. Schultz, and S.K. Mickelson. 2000. Multispecies Riparian Buffers Trap Sediment and Nutrients during Rainfall Simulations. Journal of Environmental Quality 29:1200-1205.

Baker, J.L., S.K. Mickelson, K. Arora, and A.K. Misra. 2000. The potential of vegetated filter strips to reduce pesticide transport. Chapter 18, (p. 272-285). In: Agrochemical Fate and Movement: Perspective and Scale of Study, Thomas R. Steinheimer, Lisa J. Ross, and Terry D. Spittler, eds., ACS Symposium Series 751, American Chemical Society, Washington, D.C.

Professional Society Memberships

American Society of Agricultural Engineers (1979-1981, 1990- present);American Society for Engineering Education (1986-present);Soil and Water Conservation Society (1987-1999);Alpha Epsilon (1982);Gamma Sigma Delta (1984)

Honors and Awards

Best Paper Award, BAE Division of ASEE (2005); ISU Advisor of the Year (2005);Chair, BAE Division of ASEE (2005);Program Chair, BAE Division of ASEE (2004);ISU Outstanding Innovation Award in Learning Communities (2004);E-Week Faculty of the Year Award (2004):ASAE Superior Paper Award (2004):Superior Engineering Advisor Award, College of Engineering (2004):John D. Shingleton Award, Midwest Association of Colleges and Employers (2004):ISU Miller Faculty Fellowship (2004);Best Paper Award, BAE Division of ASEE (2003);Midwest Association of Colleges and Employers - John D. Shingleton Award -Best Application of Research (2003);Secretary, BAE Division of ASEE (2003);Best Session: Presenter, ASEE Conference for Industry and Education Collaboration (2002);ISU Wakonse Fellow (2002);Outstanding Faculty Member – ISU Greek Community (2002);Engineers Week - Professor of the Semester (2002);VEISHEA Outstanding Faculty of the Year (2002);VEISHEA Outstanding Engineering Professor (2002);Engineering Student Council Leadership Award (2002);Superior Engineering Teacher Award (2001);Outstanding Innovations Award, Learning Community Institute (2001);Division of Student Affairs Award (2001);Outstanding Professor of ABE – Engineering Student Council (2002, 2000)

Institutional and Professional Service in Past Five Years

American Society of Agricultural Engineers: Chair; SW225 Committee (2006), Program Chair, SW225 (2005, 2004); Member, P204 (2003-Present); Member, P205 (2003-Present); Member, SW222 (2003- Present); Membership Chair, Education Division (2005)

Department, College, and University Committees:
University: Learning Community Advisory Committee**;** Learning Community Faculty/Staff Development Subcommittee**;** Learning Community Mentor Subcommittee**;** ISU University Calendar Committee
College: Student Learning Task Force, Chair; Engineering College Advising Committee, Chair; Cooperative Education Task Force Committee, Chair; Industrial Advisory Coop/Intern Committee; Dean's Task force for Experiential Education; OPAL Management Team; Academic Quality Management Team (AQMT)
Department: Career Guidance Committee, Chair; P & T Committee (S04);CSREES Planning Committee (S04), ABET Planning Committee, Chair; AE Curriculum Committee; many others

Manjit Misra

Director, Institute for Food Safety and Security
Director, Seed Science Center

Professor, Agricultural & Biosystems Engineering

Education

Ph.D.	University Of Missouri, Columbia, MO	Agricultural Engineering, (Food & Process emphasis)	1978
M.S.	Same as above	Agricultural Engineering	1973
B.S.	Orissa University of Agriculture & Technology, Orissa, India	Agricultural Engineering	1971

Professional Experience

1991-present	Director/Professor, Iowa State University
1979-1991	Assistant Professor, Associate Professor
1978-1979	Research Associate, University of Missouri
1971-1978	Graduate Research Assistant, University of Missouri

Consulting, Patents, etc

U.S. patent # 6805014 B1. 2004. Y, Shyy and M. Misra, "Method of measuring flow rate of particulate material under continuous flow conditions, and an in-line continuous flow meter".

Publications Within Past Five Years

Refereed Journal Articles

Adam K, M. Misra and D. Thoreson. Removal of Ergot from Barley by Density Separation, 2004 Applied Engineering in Agriculture Vol. 20(1):39-43

Wolt, JD, Y-Y Shyy, P Christensen, KS Dormin, M Misra. 2004 Quantitative exposure assessment for confinement of maize biogenic systems. Environmental Biosafety Research 3:183-196.

Rukunudin, I. H., Bern C. J, Misra, M., and T.B. Bailey. 2004. Carbon Dioxide Evolution from Fresh and Preserved Soybeans, Transactions of the ASAE, Vol. 47(3): 827-833

Adam K, M. Misra and D. Thoreson. 2004. Removal of Ergot from Barley by Density Separation. Applied Engineering in Agriculture Vol. 20(1):39-43

Steenhoek, L., Misra, M., Batchelor, W., Davidson, J. 2001. Probabilistic Neural Network for Segmentation of Features in Corn Kernel Images. Applied Engineering in Agriculture, Vol. 17(2): 225-234

Steenhoek, L., Misra, M., Hurburgh, C., C. Bern. 2001. Implementing a computer vision System for Corn Kernel Damage Evaluation. Applied Journal in Agriculture, Vol. 17(2): 235-240

Non-Refereed Journal Articles

M. Adam, M. K. Misra, L. M. Shepherd. Removal of off-colored soybean seeds by optical sorting. Mid-Central meeting of the ASAE March 26th, 2004, Paper No. MC04-404.

Adam, K and M.Misra, Effects of various adjustments of a spiral separator for removing splits from soybeans, 2003 Midcentral ASAE meeting , Paper #MC03-101,

Adam, K and M.Misra. Effect of dropping height, flow pattern and landing surface on mechanical damage to soybean seeds, Paper # MC02-101 Midcentral ASAE meeting, 2002

Krueger, Nick, C. Bern, M. Misra, Adam K, Gravity Table Separation of Commodity Corn, paper, presented in 2002 Midcentral ASAE meeting.

Adam, K, M. Misra., Yuh-Yuan Shyy. and Dan Curry. 2001 Regulating seed count and bag weight for seed corn and soybean packaging. ASAE Paper No. MC01-104. St Joseph, MI: ASAE.

Professional Society Membership

American Society of Agricultural Engineering
American Society of Official Seed Analysts
American Seed Trade Association

Professional Honors and Awards

- Appreciation Plaque for contribution to the formation of the National Seed Health System, American Seed Trade Association, 2002
- Editorial Board, Seed World, 2002-present
- Scientific Advisory Council, American Seed Research Foundation, 1991-present.
- Plaque of appreciation and $25,000 for graduate student support in Seed Science for
- Program Chair of Soybean Seed Research Conference, The American Seed Trade Association Convention, 2001 (this is the largest gathering of seed professionals in the world—about 2500)
- Superior Engineering Extension Award, College of Engineering, ISU, 2001

Selected Institutional and Professional Service

- Chair, Strategic Planning Committee, College of Agriculture, ISU, 2003
- Member, Soybean Rust team, College of Agriculture, 2004Chair, Biocontainment task force for plant made pharmaceuticals, ISU, 2002-ongoing
- Member, Biotechnology working group formed by Iowa Secretary of Agriculture, 2003
- Member, Counter Agroterrorism Committee, Iowa State University, 2002
- Board of Directors, Iowa Seed Association, 1991-present.
- Board of Directors, Iowa Crop Improvement Association, 1993-present.

Professional Development Activities in the Past Five Years

Media training by ISU, 2003, 2001

Wendy J. Powers

Associate Professor of Animal Science
Courtesy appointment in Agricultural and Biosystems Engineering

Education

Ph.D.	University of Florida	Animal Science	5/97
M.S.	University of Florida	Dairy Science	8/93
B.S.	Cornell University	Animal Science	5/89

Faculty Service

2003-present	Associate Professor
1997-2003	Assistant Professor

Principal Publications (2001 – 2005)

Refereed Journal Articles

Powers, W.J. and H.H. Van Horn. 2001. Nutritional implications for manure nutrient management planning. Appl. Engng. In Agric. 17(1):27-39.

Gralapp, A.K., W.J. Powers, and D.S. Bundy. 2001. Comparison of olfactometry, gas chromatography and electronic nose technology for measurement of indoor air from swine facilities. Trans of the ASAE 44(5):1283-1290.

Gralapp, A.K., W.J. Powers, M.A. Faust and D.S. Bundy. 2002. Effects of dietary ingredients on manure characteristics and odorous emissions from swine. J. Anim. Sci. 80(6):1512-1519.

Van Kempem, T.A.T.G., W.J. Powers, and A. Sutton. 2002. Technical note: Fourier transform infrared (FTIR) spectroscopy as an optical nose for predicting odor sensation. J. Anim. Sci. 80(6):1524-1527.

Powers, W.J. and L.A. Flatow. 2002. Effects of flocculent and flocculation rates on solids and phosphorus precipitation in dilute swine manure. Appl. Engng. in Agric. 18(5):609-614.

Powers, W.J. 2002. ADSA Foundation Lecture: Keeping science in the environmental regulatory process; the role of the animal scientist. J.Dairy Sci. 86(4): 1045-1051.

Bicudo, J.R., Clanton, C.J., Schmidt, D.R., Jacobson, L.D., Powers, W.J., and Tengman, C.L. 2004. Geotextile Covers To Reduce Odor And Gas Emissions From Swine Manure Storage Ponds. Applied Engineering in Agriculture. Vol. 20(1): 65-75.

Kim, I.B., P.R. Ferket, W.J. Powers, H.H. Stein, and T.A.T.G. Van-Kempen. 2004. Effects of different dietary acidifier sources of calcium and phosphorus on ammonia, methane and odorant emission from growing-finishing pigs. Asian-Australasian journal of animal sciences. 17(8):1131-1138.

Angel, C.R., W.J. Powers, T.J. Applegate, N.M. Tamim, and M.C. Christman. 2005. The influence of dietary phytase on water soluble phosphorus in broiler chickens, turkeys, and growing swine. J. Environ. Qual. 34(2):563-571.

Panetta, D.M., W.J. Powers, and J.C. Lorimor. 2005. Management strategy impacts on ammonia volatilization from swine manure. J. Environ. Qual. 34(4):1119-1130.

Powers, W.J., R.Angel, T. Applegate. 2005. Air emissions in poultry production: current challenges and future directions. Journal of Applied Poultry Research 14:613-621.

Angel, R., W.W. Saylor, A.S. Dhandu, W. Powers, and T.J. Applegate. 2005. Effects of dietary phosphorus, phytase, and 25-hydroxycholecalciferol on performance of broiler chickens grown in floor pens. Poult. Sci. 84:1031-1044.

Powers, W.J., E.R. Fritz, W. Fehr, and R. Angel. 2006. Evaluation of low-phytate soybeans on performance and excretions from swine. J. Anim. Sci. (accepted, in revision).

Panetta, D.M., W.J. Powers, H. Xin, B.J. Kerr, and K.J. Stalder. 2006. Nitrogen excretion and ammonia emissions from pigs fed reduced crude protein diets or yucca extract. J. Environ. Qual. (accepted, in revision).

Angel, R., W.W. Saylor, A. Mitchell, W. Powers, T.J. Applegate and A.S. Dhandu. 2006. Effect of dietary phosphorus concentration, and inclusion of phytase and 25-hydroxycholecalciferol on broiler chicken bone mineralization, litter total and water soluble phosphorus, and processing yields and losses. Poult. Sci. (accepted, in revision).

Book Chapters

Lorimor, J., W. Powers and A. Sutton 2000. Manure characteristics. MWPS-18 Manure Management Systems Series. Midwest Plan Service, Ames, Iowa.

University of Iowa and Iowa State University. 2002. Iowa concentrated animal feeding operations air quality study. A peer-reviewed report submitted to Director Vonk, Iowa Department of Natural Resource. Developed at the request of Gov. Vilsack.

Van Horn, H.H. and W.J. Powers. 2003. In: Perspectives in world food and agriculture 2004, ed. C. G. Scanes and J.A. Miranowski. Iowa State Press, Ames, IA.

IDNR. 2004. Animal feeding operations technical workgroup report on: air emissions characterization, dispersion modeling, and best management practices. http://www.iowadnr.com/air/afo/files/finalaforeport.pdf

ASAE. 2005. Manure production and characteristics standard D384.2. American Society of Agricultural and Biological Engineers; St. Joseph, MI.

Meyer, D., J. Menke, W. Powers, and J. Harner, III. 2005. Dairy cattle: waste management. In: Encyclopedia of animal science. Marcel Dekker, Inc., New York.

Professional Society Membership

American Society of Animal Science
American Dairy Science Association
American Society of Agricultural Engineers
Council for Agricultural Science and Technology

Honors and Awards

2004	Iowa Academy of Science Distinguished Scientist Award
2003	ISU Foundation Young Extension Specialist Award
2003	American Society of Animal Science Midwestern Section Young Extension Specialist Award
2002	American Dairy Science Association Production Foundation Scholar
2001	ASAE Blue Ribbon Award

Institutional and Professional Service (2001 – 2005)

2005-present	Faculty mentor
2004-present	College of Agriculture Awards Committee
2002-2005	Co-chair of committee which revised ASAE Standard D384.2 Manure Characteristics and Production

Professional Development Activities (2001 – 2005)

Attended Annual International Meetings of the American Society of Agricultural and Biological Engineers: 2005, 2004, 2003, 2002, 2001

Attended Annual Meetings of the American Society of Animal Science/American Dairy Science Association: 2005, 2004, 2003, 2002, 2001

D. Raj Raman

Associate Professor of Agricultural and Biosystems Engineering

Education

PhD	Cornell University	Agricultural & Biological Engineering	5/94
BS	Rochester Institute of Technology	Electrical Engineering	5/86

ABE Faculty Service

1/06-present Associate Professor

Other Professional Experience

11/04 – 12/05 Interim Head and Associate Professor, Biosystems Engineering & Environmental Science Department, The University of Tennessee

7/99 – 12/05 Associate Professor, Biosystems Engineering & Environmental Science Department, The University of Tennessee

9/93 – 6/99 Assistant Professor, Agricultural & Biosystems Engineering Department, The University of Tennessee

6/00 – 12/03 Faculty Member, Engage Freshman Engineering Program, The University of Tennessee

3/00 – 12/05 Faculty Member, Center for Environmental Biotechnology Research Center of Excellence, The University of Tennessee

1/93 – 5/93 Graduate Teaching Assistant, Department of Agricultural and Biological Engineering.

Areas of Expertise

Engineering education; sensors and biosensors; environmental bioprocessing
Professional Engineering Registration
Professional Engineer, Tennessee License No. 104996, Active

Publications Within Past Five Years (selected 5 of 11 refereed)

Raman, D. R., E. L. Williams, A. C. Layton, R. T. Burns, J. P. Easter, A. S. Daugherty, M. D. Mullen, and G. S. Sayler. 2004. Estrogen content of dairy and swine wastes. *Environmental Science & Technology* 38(13): 3567 – 3573

Mayhew, C. R., **D. R. Raman**, R. R. Gerhardt, R. T. Burns, and M. S. Younger. 2004. Periodic draining reduces mosquito emergence from free-water surface constructed wetlands. *Transactions of the ASAE* 47(2): 567 – 573

Parsons, J. R., J. E. Seat, R. M. Bennett, J. H. Forrester, F. T. Gilliam, C. D. Pionke, **D. R. Raman**, T. H. Scott, W. R. Schleter, F. E. Weber, and D. C. Yoder. 2002. The Engage Program: Implementing and assessing a new first year experience at the University of Tennessee. *Journal of Engineering Education* 91(4): 441 – 446

Hawkins, G. L., **D. R. Raman**, R. T. Burns, R. E. Yoder, and T. L. Cross. 2001. Enhancing dairy lagoon performance with high-rate anaerobic digesters. *Transactions of the ASAE* 44(6):1825-1831

Moody, L. B., and **D. R. Raman**. 2001. A dual-reactor anaerobic system for complete treatment of a food processing waste. *Journal of Agricultural Engineering Research* 80(3):293-299

Professional Society Memberships

Member – American Society of Agricultural and Biological Engineers
Charter Member – Institute of Biological Engineering

Honors and Awards

- A.W. Farrall Young Educator Award, American Society of Agricultural Engineers (2004)
- College of Engineering Outstanding Teacher Award, Biosystems Engineering & Environmental Science, The University of Tennessee (2004)
- Outstanding Service Faculty Award, Biosystems Engineering & Environmental Science, The University of Tennessee (2004)
- Innovative Technology Center Best Practices Award with Bennett, R. M., and Schleter, W. J. (2002)
- T. J. Whatley Outstanding Distinguished Young Scientist Award, Tennessee Agricultural Experiment Station (2001)
- W. F. & Golda Moss Outstanding Teaching Award for Faculty with Less than Ten Years Service. College of Agricultural Sciences and Natural Resources, The University of Tennessee (2000)
- Neal & Tacie Peacock Teaching/Learning Merit Certificate co-recipient (with Dr. Ronald E. Yoder). College of Agricultural Sciences and Natural Resources, The University of Tennessee (1997)

Institutional and Professional Service in Past Five Years

Institutional (Iowa State University): Departmental: Chair, Biological Systems Engineering Curriculum Committee; Chair, Computer Committee; Chair, Internationalization and Diversity Committee; Chair, Tuition Surcharge Committee; Member, Agricultural Engineering Curriculum Committee; Member, Graduate Committee; Advisor, ASABE Student Branch. College: Member, College of Engineering Tuition Surcharge Advisory Committee; Member, College of Engineering Cluster Hire Committee.
Institutional (University of Tennessee - selected): Chair, Departmental Graduate Committee (2002 – 2004); Judge, CASNR Exhibition of Undergraduate Research and Creative Achievement (2004); Coordinator, CASNR Exhibition of Undergraduate Research and Creative Achievement (1996 – 2003).
Professional: Editorial Board, *Bioresource Technology* (since 2004); Chair ASAE Committee P-121, G.B. Gunlogson Environmental Student Design Competition, (2003 – 2004); Developer, 2002 ASAE Student Environmental Design Competition; Judge, ASAE Student Environmental Design Competition (2001); Judge, IBE Student Poster Competition (2001); External Reviewer, Cornell University Agricultural and Biological Engineering Department Review, Sponsored by Cornell University Faculty Senate (2001); Chair ASAE committee T-09, Environmental Quality Group (2002 – 2003); Associate Editor, Transactions of the ASAE, Applied Engineering in Agriculture, Structures and Environment Division (2001 – 2004); Reviewer, USDA SBIR Program (2003); Reviewer, USDA IFAFS Program (2001); Reviewer, USDA SBIR Program (2001). Author and reviewer for Agricultural Engineering Professional Engineering Licensure Exam (ASAE Committee P-414, since 2003).

Charles V. Schwab

Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	University of Kentucky	Agricultural Engineering	1989
M.S.	University of Kentucky	Agricultural Engineering	1982
B.S.	University of Kentucky	Agricultural Engineering	1979

ABE Faculty Service (15 years of service, original appointment: 08/90)

2005- present	Professor
1995- 2005	Associate Professor
1990-1995	Assistant Professor

Other Professional Experience

1989-1990	Post Doctoral Scholar, University of Kentucky
1983-1989	Research Specialist, University of Kentucky
1979-1983	Research Associate, University of Kentucky

Principal Publications (2001 – 2005)

Refereed Journal Articles

Freeman, S. A., C. V. Schwab, and T. Pollard. 2003. Assessment of Iowa farmers' perceptions about auger safety. ASAE Journal Agricultural Safety and Health 9(1):61-74.

Non-Refereed Articles

Schwab, C. V., and S. A. Freeman. 2003. Pre-professional's perceptions of agricultural hazards and practiced safety behaviors at Iowa State University. National Institute for Farm Safety International Summer Meeting Windsor, Ontario Canada. NIFS Paper No. 2003-11. NIFS Madison, WI 53706.

Harlan, M. R., R. Schmidt, C. V. Schwab, and K. J. Donham. 2002. Farm related injuries 1990-1999: the Iowa experience. Iowa Department of Public Health. Des Moines, IA.

Freeman, S. A., and C. V. Schwab. 2002. The role of volunteer farm safety organizations: a case study of the Iowa Farm Safety Council. National Institute for Farm Safety International Summer Meeting Ponte Vedra Beach, Florida. NIFS Paper No. 2002-04. NIFS Columbia, MO 65211.

Schwab, C. V., and S. A. Freeman. 2002. Agricultural Systems technology pre-professional's perceptions of agricultural hazards and practiced safety behaviors. National Institute for Farm Safety International Summer Meeting Ponte Vedra Beach, Florida. NIFS Paper No. 2002-02. NIFS Columbia, MO 65211.

Books and Book Chapters

Schwab, C. V. 2004. Executive editor and editorial coordinator. Progressive Farmer's Farm Safety Day Camp © Manual 2005. Progressive Agriculture Foundation, Birmingham, AL, 35209. 535 pages.

Schwab, C. V. 2003. Executive editor and editorial coordinator. Progressive Farmer's Farm Safety Day Camp © Manual 2004. Progressive Agriculture Foundation, Birmingham, AL, 35209. 487 pages.

Schwab, C. V. 2002. Executive editor and editorial coordinator. Progressive Farmer's Farm Safety Day Camp © Manual 2003. Progressive Agriculture Foundation, Birmingham, AL, 35209. 475 pages.

Schwab, C. V. 2001. Executive editor and editorial coordinator. Progressive Farmer's Farm Safety Day Camp © Manual 2002. Progressive Farmer - A Southern Progress Company, Birmingham, AL, 35209. 455 pages.

Extension Publications

Schwab, C. V., S. Falb, and G. Harris. 2001. Reducing farm vehicle crashes. Chapter 15 of the Toolbox

of Highway Safety Strategies. Iowa Highway Safety Management System, Department of Transportation, Engineering Division. Iowa Safety Management systems. October, 2001.
North Central Region 197 Committee on Agricultural Safety and Health. 2003. National land grant research and extension agenda for agricultural safety and health. ISU Reference No. EDC-292. 18 pp. Ames, Iowa: Iowa State University.
Schwab, C. V., S. Burgus, and Colleen Jolly. 2004. Rhythm of the Seasons Video Companion. Iowa State University Extension publication Pm-1986. ISU University Extension, Ames, IA 50011-3080.
Schwab, C. V., L., J. Miller, and L. Graham. 2004. Club Misterio: Sigue Las Huellas Del Tractor Por El Camino Seguro. Iowa State University Extension publication Pm-1877as. ISU University Extension, Ames, IA 50011-3080.
Schwab, C. V., L., J. Miller, and L. Graham. 2002. The Mystery Club Series. Iowa State University Extension publication Pm-1877a - f. ISU University Extension, Ames, IA 50011-3080.
Schwab, C. V. 2001. Employers' Instructional Guide: Training Employees Who Operate Agricultural Tractors. Iowa State University Extension publication Pm-632. ISU University Extension, Ames, IA 50011-3080.

Professional Society Membership

American Society of Agricultural Engineers member since 1979 (26 yrs.)
American Society for Engineering Education, member since 1991 (14 yrs.)
American Society of Safety Engineers, member since 1998 (7 yrs.)
Iowa Farm Safety Council, life member since 1990 (15 yrs.)
National Association of Industrial Technology, member, 2004 (2 yrs.)
National Institute for Farm Safety, member since, 1992 (13 yrs.)
National Safety Council, member, 1991 – 2003 (12 yrs.)
Sigma Xi, Scientific Research Society of North America, full member since 1988 (17 yrs.)

Honors and Awards

2004	I-CASH Agricultural Safety Hall of Fame
2002	Meritorious Service Award, ISU Extension
2002	Superior Engineering Extension Award, College of Engineering
2002	Professional Skills Award for Writing, Agricultural Communicators in Education
2001, 2002	Blue Ribbon for ASAE Educational Aids Competition

Institutional and Professional Service in Past Five Years

Editorial Board member for Journal of Agricultural Safety and Health (1999), National Institute for Farm Safety President (2004-2005), National Institute for Farm Safety Board of Directors member (2001 – 2004 and 2004-2007), University committee on Disabilities (1993 present), Agricultural and Industrial Technology Curriculum Committee (2004- present, Chair), CREES Review Committee (2003-2004), ABE & IEDT Merger Committee (2003-2004, Chair), Faculty Search Committee (Chair-2003, and 2004)

Professional Development Activities (2001 – 2005)

Attended National Institute for Farm Safety International Meeting: 2002, 2003, 2004, and 2005
Iowa Food Security Conference: 2003
Fire Safety Emergency Online Training, EHS: 2003
National Association of Extension 4-H Agents 55th Annual Conference: 2001

Shana Shiang-Fong Smith

Associate Professor of Agricultural and Biosystems Engineering

EDUCATION

1997	Ph.D. in Mechanical Engineering, Iowa State University, Ames, Iowa
1993	M.S. in Mechanical Engineering, Iowa State University, Ames, Iowa
1990	B.S. in Mechanical Engineering, National Chiao-Tung University, Hsin-Chu, Taiwan

IOWA STATE FACULTY SERVICE

2005 –	PresentAssociate Professor
2001 –2005	Assistant Professor

OTHER PROFESSIONAL EXPERIENCE

2000 – 2001	Assistant Professor	Tri-State University, Angola, Indiana
1997 – 1999	Assistant Professor	Hong Kong University of Science and Technology
1997	Consultant	Engineering Animation Inc.
1992 – 1997	Research Assistant	Iowa State University
1991 –1992	Research Assistant	National Taiwan University
1992 –1992	Design Engineer	Ehrung Industrial Co., Ltd., Hsin-Chuang, Taiwan
1990 –1991	Design Engineer	Advanced Technology Inc., Taiwan

PRINCIPAL REFERRED PUBLICATIONS (2001 – 2005)

1. Seth, Abhishek, **Smith, S. S-F.,** Shelley, M. C., & Jiang, Q. (accepted). A low-cost virtual reality human-computer interface for CAD model manipulation. *ASEE, The Engineering Design Graphics Journal*.
2. Shen, Z., & **Smith, S. S-F.** (accepted). Optimizing the functional design and life cycle cost of mechanical systems using genetic algorithms. *International Journal of Advanced Manufacturing Technology* (also appeared in the *Transactions of NAMRI/SME*, Volume XXXII, 2004, pp. 295-306).
3. *Seth, A., & **Smith, S. S-F.** (accepted). PC-based virtual reality for CAD model viewing. *The Journal of Technology Studies*.
4. **Smith, S. S-F**., Taylor, K., Green, T., Peterson, N, Garrety C., Kemis, M., & Thompson, A. (Winter 2005). Using virtual reality tools in design and technical graphics curricula: an experience in learning. *ASEE*, *The Engineering Design Graphics Journal, 69*(1), pp. 16-25.
5. Pan, C., **Smith**, **S. S-F**., & Smith, G. C. (March 2005). Determining interference between parts in CAD STEP files for automatic assembly planning. *Transactions of The ASME, Journal of Computing And Information Science in Engineering*, *5*(1), 56-62.
6. **Smith, S. S-F.** (Autumn 2004). Integrating computer-generated stereoscopic models into an introductory design course. *ASEE*, *The Engineering Design Graphics Journal, 68*(3), pp. 6-13.
7. **Smith, S. S-F.,** & Lee, S-L. (Spring 2004). An evaluation of internet-based CAD collaboration. *The Journal of Technology Studies*, *XXX*(2), 79-85.
8. **Smith, S. S-F.**, & Lee, S-L. (2004). A pilot study for integrating virtual reality into an introductory design and graphics course. *Journal of Industrial Technology, 20*(4)*, 1-7*.
9. **Smith, S. S-F.** (2004). Using multiple genetic operators to reduce premature convergence in genetic assembly planning. *Computers in Industry*, *54*(1), 35-49.
10. **Smith, S. S-F**. (Spring 2003). A design-based engineering graphics course for first-year students. *ASEE, The Engineering Design Graphics Journal, 67*(2), 33-42.

11. Smith, G. C., & **Smith, S. S-F.** (April-May, 2003). Automated initial population generation for genetic assembly planning. *International Journal of Computer Integrated Manufacturing*, *16*(3), 219-228.
12. Su, Q., & **Smith, S. S-F.** (February-April, 2003). An integrated framework for assembly oriented product design and optimization. *Journal of Industrial Technology, 19*(2)*, 1-9*.
13. Smith, G. C., & **Smith, S. S-F**. (October-December, 2002). An enhanced genetic algorithm for automated assembly planning. *Robotics and Computer-Integrated Manufacturing, 18/5-6*, 355-364.
14. Wang, C. C. L., **Smith, S. S-F.**, & Yuen, M. M. F. (2002).Surface flattening based on energy model. *Computer-Aided Design, 34*(11), 823-833.
15. **Smith, S. S-F.**, Smith, G. C., & Liao, X-Y. (2001). Automatic stable assembly sequence generation and evaluation. *SME, Journal of Manufacturing Systems*, *20*(4), 225-235.
16. **Smith, S. S-F.,** & Liu, Y-J. (August-October, 2001). The application of multi-level genetic algorithms in assembly planning. *Journal of Industrial Technology*, *17*(4), 1-9.
17. **Chen, S-F.,** & Liu, Y-J. (October, 2001). An adaptive genetic assembly-sequence planner. *International Journal of Computer Integrated Manufacturing*, *14*(5), 489-500.
18. Wang, C. C. L., **Chen, S-F.**, & Yuen, M. M. F. (2001). Fuzzy part family formation based on grey relational analysis. *International Journal of Advanced Manufacturing Technology, 18*(2), 128-132.

PROFESSIONAL MEMBERSHIPS

American Society for Engineering Education (2002 – present); National Association of Industrial Technology (2001 – present); Society of Manufacturing Engineers (2001 – present); Institute of Industrial Engineers (1997 – 2004); American Society of Mechanical Engineers (1993 – present)

HONORS

Outstanding ISU Student Organization Advisor (2002-2003)
Miller Faculty Fellow (2002-2003)
Ray Witt Gift, The Foundry Educational Foundation (2000)
Scholarship of Women in Engineering, Iowa State University (1994)
Phi Kappa Phi Honor Society

INSTITUTIONAL AND PROFESSIONAL SERVICE (2001 – 2005)

College Research Committee (2002 – 2004)
Faculty Professional Development Committee (2003 – 2004)
Honors Program Committee (2001 – 2003)
Faculty Mentor, Honors Program (2002)
Organized and chaired the 2004 and 2005 Virtual Reality Summer Camps (VR4U) for female and minority 9^{th} – 11^{th} grade high school students and high school teachers.
Participated in the 2003 Exploring Education Summer Camp for underrepresented high school students, College of Education.
Organized and chaired the 2002 Summer Academy, Three-dimensional computer-aided design solid modeling, a workshop for the continuing education of high school teachers in the Des Moines area.

PROFESSIONAL DEVELOPMENT ACTIVITIES (2001 – 2005)

Attended 6 national or international professional conferences (NAIT, ASME, ASEE).

Brian L. Steward

Associate Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	University of Illinois at Urbana-Champaign	Agricultural Engineering	7/99
M.S.	South Dakota State University	Electrical Engineering	12/94
B.S.	South Dakota State University	Electrical Engineering	5/89

ABE Faculty Service (6 years of service, original appointment: 08/99)

2005-present	Associate Professor
1999-2005	Assistant Professor

Other Professional Experience

1995-1999	Research Fellow/Assistant, University of Illinois, Urbana, IL
1994-1999	Foreign Expert, Changsha Electric Power University, Changsha, PRC
19991–1993	Teaching Assistant, South Dakota State University, Brookings, SD
1989-1994	Engineer, Raven Ind. Inc., Sioux Falls, SD
1989-1989	Intern Computer Programming, Missouri Basin M. Power Agency, Sioux Falls, SD

Professional Engineering Registration

South Dakota (Engineering-in-training)

Principal Publications (2001 – 2005)

Refereed Journal Articles

Brumm, T. J., S. K. Mickelson, B. L. Steward and A. L. Kaleita-Forbes. In Press. Competency-based outcomes assessment for agricultural engineering programs. International Journal of Engineering Education.

Steward, B. L., S. K. Mickelson, and T. J. Brumm. 2005. Continuous engineering course improvement through synergistic use of multiple assessment. International Journal of Engineering Education. 21(2): 277-287.

Shrestha, D. S. and B. L. Steward. 2005. Shape and size analysis of corn plant canopies for plant population and spacing sensing. Applied Engineering in Agriculture. 21(2): 295-303.

Westphalen, M. L., B.L. Steward, and S.F. Han. 2004. Topographic mapping through measurement of vehicle attitude and elevation. Transactions of ASAE 47(5): 1841-1849.

Shrestha, D. S., B. L. Steward, and S. J. Birrell. 2004. Image processing algorithms for early stage maize plant detection. Biosystems Engineering 89(2): 119-129.

Steward, B. L., S. K. Mickelson, and T. J. Brumm. 2004. Formative and summative assessment techniques for continuous agricultural technology classroom improvement. NACTA Journal. 48(2): 33-41.

Miller, M. A., B. L. Steward, and M. L. Westphalen.¬ 2004. Effects of multi-mode four-wheel steering on sprayer machine performance. Transactions of the ASAE 47(2): 385-395.

Steward, B. L., L. F. Tian, D. Nettleton, and L. Tang. 2004. Reduced-dimension clustering for vegetation segmentation. Transactions of the ASAE 47(2): 609-616.

Shrestha, D. S. and B. L. Steward. 2003. Automatic corn plant population measurement using machine vision. Transactions of the ASAE 46(2): 559–565.

Tang, L., L.F. Tian, and B. L. Steward. 2003. Texture-based real-time broadleaf and grass classification for selective weed control. Transactions of the ASAE 46(4): 1247–1254.

Steward, B. L., L. F. Tian, and Tang L. 2002. Distance-based control system for machine vision-based selective spraying. Transactions of the ASAE 45(5): 1255-1262.

Refereed Conference Proceeding

Steward, B. L., R. P. Ewing, D. A. Ashlock, A. L. Kaleita, and S. M. Shaner. 2004. Range operator enabled genetic algorithms for hyperspectral analysis. In Intelligent Engineering Systems Through Artificial Neural Networks: Smart Engineering Systems Design: Neural Networks, Fuzzy Logic, Evolutionary Programming, Complex Systems and Artificial Life, Vol. 14. eds. C. H. Dagli, A. L. Buczak, D. L. Enke, M. J. Embrechts, and O. Ersoy, 295-300. New York. ASME Press.

Suzhen L., G. Manimaran, B. L. Steward. 2004. Feedback-based Real-time Scheduling in Autonomous Vehicle Systems. Proceedings of the 10th IEEE Real-Time Technology and Applications Symposium (RTAS). Le Royal Meridien, King Edward, Toronto, Canada. 25-28 May.

Mickelson, S. K., Brumm, T. J., Hanneman, L., and B. L. Steward. 2003. Using Engineering Competency Feedback to Assess Agricultural Engineering Curriculum. In Proceedings of the Annual Meeting of the American Society for Engineering Education, Knoxville, TN: ASEE.

Shrestha, D. S., B. L. Steward, and T. C. Kaspar. 2002. Determination of early stage corn plant height using stereo-vision. Proceedings of the 6th Int'l. Conf. on Precision Agriculture, eds. P.C. Robert, R. H. Rust and W. E. Larson, Madison WI: ASA- CSSA-SSSA.

Miller, M. A. and B. L. Steward. 2002. Control and Evaluation Methods for Multi-Mode Steering. Proc. of Automation Technology for Off-road Equipment Conference, ed. Q. Zhang., 357-366. Chicago, IL, 26-27 July.

Shrestha, D. S., B. L. Steward, and E. Bartlett. 2001. Segmentation of plant from background using neural network approach. Proc. of Artificial Neural Networks in Engineering Conference (ANNIE 2001) eds. C. H. Dagli et al., 903-908. St. Louis, MO, 4-7 Nov.

Professional Society Membership

American Society for Engineering Education. American Society of Agricultural Engineers

Honors and Awards

2005 Jack Everly Journal Award, North American Colleges and Teachers of Agriculture (NACTA), Brian Steward, Steve Mickelson, and Tom Brumm. "Formative and Summative Assessment Techniques for Continuous Agricultural Technology Classroom Improvement." Presented at the 51st Annual Conference of NACTA, Wooster, OH.

2005 Young Engineer of the Year, Iowa Section of the ASAE.

2003 Select Paper Award of the Information and Electrical Technologies Division of the American Society of Agricultural Engineers, Dev Shrestha and Brian Steward. "An Object-Oriented Architecture for Field Data Acquisition, Processing and Information Extraction," Presented at the 2003 American Society of Agricultural Engineers Annual Meeting, Las Vegas, NV.

2003 Best Paper Award of the Biological and Agricultural Engineering Division of the American Society for Engineering Education. Steve Mickelson, Tom Brumm, Larry Hanneman, and Brian Steward. "Using Engineering Competency Feedback to Assess Agricultural Engineering Curriculum," Presented at the 2003 American Society for Engineering Education Annual Conference & Exposition, Nashville, TN.

2003 Advisor Recognition Award as faculty advisor of the Nepal Student Association, ISU Student Activities Center.

2003 Newcomer of the Year, Iowa Section of the ASAE.

2002 Exceptional Student Support Recognition, Iowa State University.

Institutional and Professional Service (2001 – 2005)

2002-present ABE Technology Committee
1999-2002 AE Curriculum Committee
2005-present Associate Editor, ASABE technical publications

Professional Development Activities (2001 – 2005)

Attended Annual International Meetings of the American Society of Agricultural Engineers:
2005, 2004, 2003, 2002, 2001

Lie Tang

Assistant Professor, Agricultural and Biosystems Engineering

EDUCATION

Ph.D. University of Illinois at Urbana-Champaign, Agricultural Engineering 2/2002
M.S. Zhejiang University (China), Agricultural Mechanization 7/1994
B.S. Jiangsu University of Science and Technology (China), Electrical Engineering 7/1989

ABE FACULTY SERVICE

2004 – Present Assistant Professor (original appointment: 10/2004)

Other professional Experience

2003.7 - 2004.9	Assistant Professor, Department of Agrotechnology and Food Sciences, Wageningen University, The Netherlands
2002.3 - 2003.7	Assistant Professor, AgroTechnology, Department of Agricultural Sciences, the Royal Veterinary and Agricultural University (KVL), Denmark
1997.8 - 2002.2	Research and Teaching Assistant, Agricultural Engineering Department, University of Illinois at Urbana-Champaign
1995.11-1997.8	Visiting scholar, Agricultural Engineering Department, Katholieke Universiteit Leuven, Belgium.

Principal publications (2001 – 2005)

Refereed Journal Articles

Blackmore, B. S., S. Fountas, L. Tang, H. Have. 2004. System requirements for a small autonomous tractor. The electronic journal of the International Commission of Agricultural Engineering (CIGR).

Tang, L., L.F. Tian, and B. L. Steward. 2003. Texture-based real-time broadleaf and grass classification for selective weed control. Transactions of the ASAE 46(4):1247-1254.

Steward, B. L., L. F. Tian, L. Tang. 2002. Distance-based control system for machine vision-based selective spraying. Transactions of the ASAE. 45(5):1255-1262.

Thorp, K. R., L. Tian, H. Yao, L. Tang. 2004. Narrow-band and derivative-based vegetation indices for hyperspectral data. Transactions of the ASAE. 47(1): 291-299.

Steward, B. L., L. F. Tian, D. Nettleton, L. Tang. 2004. Reduced-dimension clustering for vegetation segmentation. Transactions of the ASAE 47(2): 609-616.

Non-Refereed Articles

Nieuwenhuizen, A. T., J, H. W. van den Oever, L. Tang, J. W. Hofstee, J. Muller. 2005. Color-based in field volunteer potato detection using a Bayesian classification and an adptive neural network. ASAE Paper No. 053064, St. Joseph, MI.

Khot, L., L. Tang, S. Blackmore, M. Nørremark.. 2005. Navigational context recognition using onboard sensory for an autonomous weeding robot in tree plantations. ASAE Paper No. 053092, St. Joseph, MI.

Blackmore, B. S., S. Fountas, S. Vougioukas, L. Tang, C. G. Sørensen, R. Jørgensen. 2004. A method to define agricultural robot behaviours. Automation Technology for Off-Road Equipment Proceedings.

Tang, L., L.F. Tian. 2002. Machine vision for automated corn plant spacing, growth stage and population measurements. Part I: Real-time image sequencing. ASAE Paper No. 023099, St. Joseph, MI.

Tang, L., L.F. Tian. 2002. Machine vision for automated corn plant spacing, growth stage and population measurements. Part II: Plant identification. ASAE Paper No. 023100, St. Joseph, MI.

Tang, L., L. Tian, H. Yao and K. Thorp. 2001. A real-time in-field variability mapping system. ASAE paper 01-1025. St. Joseph, MI:ASAE.

Blackmore B. S., Fountas S., Vougioukas S., Tang L., Sørensen C. G., and Jørgensen R. 2004. A method to define agricultural robot behaviours. Mechatronics & Robotics Conference (MECHROB) 2004, Aachen, Germany, September 13 - 15 , 2004, volume III, page 1197-1200

Vougioukas, S., S. Fountas, S. Blackmore, L. Tang. 2004. Navigation task in agricultural robotics. HAICTA 2004 Intl. Conference, Greece.

Bakker, T., H. Wouters, K. van Asselt, J. Bontsema, J. Müller, G. van Straten, L. Tang. 2004. A vision-based row detection system fro sugar beet. Workshop of Computer-Bildanalyse in der Landwirtschaft in Braunschweig, Germany.

Thorp, K.R., L.F. Tian, H. Yao, L. Tang. 2002. Development of vegetation indices for hyperspectral data. ASAE Paper No. 021077, St. Joseph, MI.

HONORS

1994 Outstanding graduate student, Zhejiang University
1999 Won 1st place in Engineering Open House, University of Illinois

Professional Society Membership

ASABE (American Society of Agricultural and Biological Engineering)

Institutional and Professional Service

2002 - present ABE Curriculum Committee
2002, 2005 Session moderator at the ASAE Annual Meetings
2005 Member of the ASABE IET-312, PM-58 Committee

Professional Development Activities

Attended Annual International Meetings of the ASABE: 2005, 2002, 2001
Attended Annual AETC conference, 2004
Attended the ASABE North Central Nanotechnology Committee meeting, 2004

Udoyara S. Tim

Associate Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	Concordia University, Montreal, Canada	Civil/Environ. Engineering	6/1987
B.S.	Concordia University, Montreal, Canada	Civil/Environ. Engineering	6/1982

ABE Faculty Service (15 years of service, original appointment: 10/1990)

1995-present Associate Professor

Other Professional Experience

1990-1995	Assistant Professor, Iowa State University, Ames, IA
1987-1990	Post-doctoral Research Associate, Virginia Tech, Blacksburg, VA
1983-1987	Instructor, Concordia University, Montreal, Canada

Consulting, Patents, etc.

2000-2001 Irell & Manella LLP (State of California v. Montrose et al.)

Principal Publications (2001 – 2005)

Refereed Journal Articles

Tim, U.S. 2006. Best practices in water quality modeling for decision making: Lessons from TMDL program. Journal of Water Resources Planning and Management.

Tim, U.S. and S. Sharma. 2006. Environmental forensics investigative methods applied to anthropogenic pollution from animal feeling operations (AFOs). International Journal of Environmental Forensics.

Eason, A., U.S. Tim**,** and X. Wang. 2004. Integrated modeling environment for statewide assessment of groundwater vulnerability from pesticide use in agriculture. Pesticide Management Science, March 2004.

Tim, U.S. 2003. Water Quality in Precision Agriculture. Encyclopedia of Agricultural, Food, and Biological Engineering. New York, NY: Marcel Dekker, Inc.

Conference Papers(abbreviated list)

Tim, U.S. 2006. Potentials and Limitations of modeling for pollutant load assessment and targeting: The HSPF Model. meeting of the Upper Mississippi River Sub-basin Hypoxia Nutrient Committee (UMRSHNC) Stakeholder Group, Moline, IL April 11-12.

Doel, D. and U.S. Tim. 2003. Interactive Web-based modeling of pesticide loss in a watershed using GIS.Proceedings of the 24th Annual ESRI International User Conference, San Diego, CA, August 9–13.

Non-refereed Publications

Bajwa, H. and U.S. Tim**.** 2002. Immersive Virtual Environments for GIS-Based Flood Modeling and Visualization. In Proceedings of the 2002 ERSI Users Conference, San Diego, CA., July 6-8.

Tim, U.S. and P.W. Gassman. 2001. Overview of available TMDL models. Proceedings of Conference on Agriculture and the Environment: State and Federal Initiatives, Ames, Iowa, March 5-7.

Tim, U.S. 2001. Narrowing the Digital Divide: Creating opportunities for water resource management in the information age. In Proceedings of the International Specialty Conference on Globalization and Water Management-The Changing Value of Water, West Park Center, Dundee, Scotland, August 6-8.

Wang, X. and Tim, U.S. 2001. An integrated spatial decision support system for precision agriculture. In Proceedings of the Summer Specialty Conference and UCOWR Annual Conference, Snowbird, Utah, pp.279-284.

Professional Society Membership

American Association for the Advancement of Science, American Water Resources Association, Urban and Regional Information Systems Association, International Association of Hydrological Sciences, American Chemical Society, American Society for Agricultural and Biological Engineers

Honors and Awards

2004	Wakonse Faculty Fellow
2002	GITA Best Paper Award (with graduate student Mr. Bajwa)
2001	USDA Geospatial Information Award
1999	Best Student Presentation Award, Urban and Regional Information Systems Association (with graduate student Ms Liao)
1998	Miller Faculty Fellow

Institutional and Professional Service (2001 – 2005)

1990-present	Member Sigma Xi
1990-present	Member, Gamma Sigma Delta
1991-present	AE Curriculum Committee
1991-2005	AE International Programs and Diversity Committee
2002-2005	College of Agriculture Global Programs Committee
2000-present	College of Agriculture Diversity Committee
1992-1994	College of Engineering Curriculum Committee
2001-2006	Faculty Senator (Colleges of Agriculture & Engineering), Senator on several committees such as Handbook Committee, Committee on Committees, Faculty Appeals Board, Traffic & Appeals Committee, Governance Council, and University Conduct Policy Committee
2001-present	ISU Representative on the S-273 and S-1004 Regional Projects
2003-present	AAAS Engineering Committee
2003-present	AAAS Industry Affiliate
2003-present	Chair, AWRA GIS and Watershed Management Technical Committee

Professional Development Activities (2001 – 2005)

Panel Member, NSF Bioengineering and Environmental Systems: 2004
Reviewer, NSF Bioengineering and Environmental Systems: 2003, 2004, 2005
Panel Member, EPA Greater Research Opportunities Program: 2000-2005
Panel Member, EPA STAR Program: 2002-2005
Panel Member, EPA Nanotechnology and the Environment Program: 2003-2005
Panel Member, USDA-CSREES Higher Education Capacity Building Grant Program: 2004, 2005
Attended National Council on Science and the Environment Conference, Washington DC, 2/3-4/2005
Attended Annual International Meetings of the ASAE: 2004, 2002, and 2001
Attended the Annual Meeting of the American Water Resources Association: 2000, 2001, 2002 and 2003

J.(Hans) van Leeuwen

Professor of Civil Engineering
Courtesy appointment in Agricultural and Biosystems Engineering

Education

Degree	Field	Institution	Date
Doctorate of Engineering - *awarded for contribution to the literature on advanced wastewater treatment and reclamation*			1988
GradDip	Tertiary Education	University of Pretoria	1983
MEng	Water Utilization	University of Pretoria	1979
BEng	Chemical Engineering	University of Pretoria	1975

Appointment Date

January, 2000 Professor, Iowa State University

Other Related Experience

1996-1999	Professor, Departmental Chair of Environmental Engineering and Vice-Dean of Engineering, University of New England, Australia
1999 to present	Adjunct Distinguished Professor, San Diego State University,
1993-1995	Deputy Head of School of Environmental Engineering and Director of Water Care, Griffith University, Brisbane, Australia
1982-1992	Associate Professor/Professor of Water Utilization, University of Pretoria
1974-1982	Researcher/Consultant, Council for Scientific & Industrial Research, Pretoria
1965-1974	Industry and own business (food, paper, plastics, agricultural, consulting)

Consulting, Patents, etc.

- 31 consultancies and contract research projects in South Africa
- 17 consultancies and contract research projects in Australia
- 8 consultancies and contract research projects in Namibia, Lesotho, Botswana and USA
- 5 consultancies and contract research projects in the USA
- 5 patents pending in the area of ozonation in ships' ballast water treatment and 7 in the area of ethanol and food processing coproducts into more valuable products through biotechnology

Engineering Registration

Iowa, South Africa, and Australia

Selected Principal Publications

Oemcke, D.J. and van Leeuwen, J (2005) Ozonation of the marine dinoflagellate alga *Amphidi-nium* sp. — implications for ballast water disinfection. *Water Research* 39(20), 5119-5120

Fan, M., Brown, R.C., and van Leeuwen, J. (2005) Heavy metals in fly ashes: potential impact on fly ash derived coagulants. *J. of Solid Waste Techn. & Management* Vol 31, 2

Shi, Y. Fan, M. Brown, R. C., Xu, M. and van Leeuwen J (2005) The Recovery of Lactic Acid with Sulfur Dioxide. *Biochemical Engineering Journal*, 24 (2), 2005, 157-160

Oemcke, D.J. and van Leeuwen, J (2004) Seawater ozonation of Bacillus subtilis spores: implications for the use of ozone in ballast water treatment. *Ozone Sci & Eng* 26(4) 389-401

Butler, A. D., Fan, M., Brown, R.C., van Leeuwen, J., Sung, S and Cooper A. T. (2004) Absorption of dilute SO2 gas stream with conversion to polymeric ferric sulfate for use in water treatment of *Chemical Engineering Journal* 98, 265-273

Butler, A. D., Fan, M., Brown, R.C., van Leeuwen, J., Sung, S and Duff, B. (2004) Pilot scale water treatment study of polymeric ferric sulfate synthesized using SO2. *Chem. Eng. J*, 44(3), 413-419

Van Leeuwen, J, Badriyha, B, and Vaczi, S (2003) Cyanide, thiocyanate and organic removal from coal coking processing wastewater – an evaluation of ozonation *Ozone Sci & Eng* , 25(4), 273-283.

Van Leeuwen*, J. (Hans), Hu, Z., Yi, T., Pometto, A. L. III, Jin, B (2003) Kinetic Model for Selective Cultivation of Microfungi in a Microscreen Process for Food Processing Wastewater Treatment and Biomass Production *Acta Biotechnologica* 23 (2/3)

Fan, M, Brown, R.C., van Leeuwen, J, Nomura, M and Zhuang Y. (2003) The kinetics of producing sulfate-based complex coagulant from fly ash. *Chem. Eng. and Processing* 42(12) 1019-1025

Fan, M, Brown R C., Sung, S-W, Huang C-P, Ong S-K, van Leeuwen, J (2003) Comparisons of polymeric and conventional coagulants in As(V) removal. *Water Envir. Res.* 75(4) 308-313

Jin, B, Yan, XQ, Yu, Q and van Leeuwen, J (2002) A comprehensive pilot plant system for fungal biomass protein production from starch wastewater. *Advances in Environ. Res.* 6, 2 179-189.

Jelmert, A and van Leeuwen, J (2000) Preventing the transfer of exotic species or harming the locals? Possible positive and negative effects of using zinc anodes for corrosion protection of ballast water tanks. *Water Research* 34(6) 1937-40.

Scientific and Professional Societies

- Diplomate, American Academy of Environmental Engineers
- Fellow: Institution of Engineers Australia, Chartered Institute of Water and Environmental Management, Water Institution of South Africa

Honors and Awards

- Engineering Student Council Leadership Award, on recommendation of the ISU ASCE Student Chapter (2003)
- Honorary member, Japan Industrial Water Association (2002)
- Research with student nominated for the Eureka POL prize, Australia, 2000

Institutional and Professional Service

- Chair, Curriculum Committee, Dept of Civil and Construction Engineering, Iowa State University
- Member, University Graduate Curriculum and Catalog Committee, Iowa State University
- Senator, CCEE departmental representative on the Faculty Senate, Iowa State University
- Coordinator, Exchange Programs in Australia, Iowa State University
- Member, Steering Group, Integrated Curriculum, Iowa State University
- Editorial Board of Ozone Science and Engineering (1990 - present)
- Director, International Ozone Association (IOA) (1979 - 1997)

Professional Development Activities

- Led training sessions offered for water and wastewater treatment plant operators through Iowa Water Pollution Control Federation
- Short courses on Financial Management, Project Management, Staff Selection and Supervision, University of New England, 1998-1999
- PowerPoint, Excel, Web page Design, San Diego State University, 1999
- Creative Thinking, offered by De Bono, Central Queensland University, 1998

Hongwei Xin

Professor of Agricultural and Biosystems Engineering

Education

Ph.D.	University of Nebraska	Engineering (Bio-environmental Engr Field)	1989
M.S.	University of Nebraska	Agricultural Engineering	1985
B.S.	Shenyang Ag. Univ., China	Agricultural Engineering	1982

ABE Faculty Service (12 years)

2002 – present	*Professor*
1998 – 2002	*Associate Professor*
1993 – 1998	*Assistant Professor*

Other Professional Experience

2002 – present	*Professor*, courtesy appointment of Animal Science, ISU
1990 – 1993	*Post-doctoral Research Associate*, Department of Biological and Agricultural Engineering, University of Arkansas, Fayetteville, Arkansas
1990 (Jan-May)	*Post-doctoral Research Associate*, Department of Biological Systems Engineering, University of Nebraska-Lincoln (UNL), Lincoln, Nebraska
1984 – 1989	Graduate Research Assistant, Department of Agricultural Engineering, UNL
1982 – 1983	Instructor, Dept of Agricultural Engineering, Shenyang Agr University, China

Selected Publications (2001–2005)

Refereed Journal Articles

Cook, R.N., **H. Xin**, and D. Nettleton. 2005. Effects of cage stocking density on feeding behaviors of group-housed laying hens. *Transactions of the ASAE* (accepted for publication)

Gates, R. S., **H. Xin**, K. D. Casey, Y. Liang, and E.F. Wheeler. 2005. A method for measuring ammonia emissions from poultry houses. *Applied Poultry Res.* (in press)

Li, H., **H. Xin**, Y. Liang, R. S. Gates, E. F. Wheeler, and A.J. Heber. 2005. Comparison of direct vs. indirect ventilation rate determinations in layer barns using manure belts. *Trans of the ASAE* 48(1): 367-372.

Liang, Y., **H. Xin**, E. F. Wheeler, R. S. Gates, J. S. Zajaczkowski, P. Topper, H. Li and K. D. Casey. 2005. Ammonia emissions from U.S. laying hen houses in Iowa and Pennsylvania. *Trans of the ASAE* 48(5): (in press)

Zhang, Q. and **H. Xin**. 2005. Resting behavior of piglets in farrowing crates equipped with heat mats. *Applied Engineering in Agriculture* 48(5): (in press)

Liang, Y., **H. Xin**, H. Li, R.S. Gates, E.F. Wheeler and K.D. Casey. 2005. Effect of measurement interval on estimation of ammonia emission rates for layer houses. *Trans of the ASAE* (accepted)

Brown-Brandl, T.M., J. A. Nienaber, **H. Xin**, and R.S. Gates. 2004. A literature review of swine heat and moisture production. *Trans of the ASAE* 47(1): 259-270. (**Superior Paper Award**)

Chepete, H. J. and **H. Xin**. 2004. Heat and moisture production of poultry and their housing systems*: Molting layers*. *Trans of the ASHRAE* 110(2): 274-285.

Chepete, H. J., **H. Xin**, M.C. Puma, and R.S. Gates. 2004. Heat and moisture production of poultry and their housing systems*: Pullets and layers*. *Trans of the ASHRAE* 110(2): 286-299.

Chepete, H. J. and **H. Xin**. 2004. Ventilation rates of laying hen houses based on new vs. old heat moisture production data. *Applied Engineering in Agriculture* 20(6): 835-842.

Dong, H. X. Tao, **H. Xin**, and Q. He. 2004. Enteric methane emissions in China estimated with different IPCC methods and production schemes. *Transactions of the ASAE* 47(6): 2051-2057.

Gates, R. S., K. D. Casey, **H. Xin**, E. F. Wheeler, and J. D. Simmons. 2004. Fan assessment numeration system (FANS) design and calibration specifications. *Trans of the ASAE* 47(5): 1709-1715.

Liang, Y., **H. Xin**, S. J. Hoff, and T. L. Richard. 2004. Performance of Single Point Monitor in measuring ammonia and hydrogen sulfide gases. *Applied Engineering in Agr.* 20(6): 863-872.

Persyn, K.E., **H. Xin**, D. Nettleton, A. Ikeguchi, and R.S. Gates. 2004. Feeding behaviors of laying hens with or without beak-trimming. *Trans of the ASAE* 47(2): 591-596 (**Superior Paper Award**)

Professional Memberships

American Society of Agricultural Engineers (ASAE) – *Lifetime member*, American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Poultry Science Association, Alpha Epsilon Honor Society of Agricultural Engineers, Association of Overseas Chinese Agricultural, Biological and Food Engineers (AOC), Sigma Xi Scientific Research Society

Honors and Awards

- Chair of United Egg Producers Environmental Scientific Panel on Air Emissions (July 2004 –)
- Honorary Scientist of the Rural Development Administration of Republic of Korea (2004-2006)
- Member of EPA National Air Emission Study Advisory Committee (2003-2004)
- New Holland Young Researcher Award of the ASAE (2001)
- Young Member of the Year Award, Mid-Central Section of the ASAE (2001)
- Young Engineer of the Year Award, Iowa Section of the ASAE (2001)
- Research Award for Foreign Specialist, Ministry of Ag, Forestry and Fisheries, Japan (2000)
- Invited member of USDA delegation to China for assessing environmental issues related to intensive animal production (2000)
- ASAE Paper Awards (9): Superior Paper Award (1997[2], 2000, 2005[2]), Honorable Mention Award (1998, 2001, 2002, 2003)

Institutional and Professional Service (2001-2005)

Institutional Service

- University Graduate Faculty Term Membership Review Committee (2003 – present)
- College of Engineering Graduate Education Task Force Committee (2003 – present)
- College of Engineering Research Proposal Evaluation Committee (1998 – 2002)
- College of Engineering Awards Committee (2004 – 2007)
- College of Agriculture Promotion and Tenure Advisory Committee (2003 – 2006)
- College of Agriculture Diversity Committee (1997 - 2001)
- Leader of ABE focus group "Animal and Plant Production Engineering" (2003 – present)
- ABE Chair Advisory Committee (2004 – present)
- ABE Director of Graduate Education (DOGE) (2003 – 2005)
- ABE Graduate Programs Committee (1994 – present; Chair, 2003 - present)
- ABE New Building Feasibility Study Committee (2004 – present)
- ABE CSREES Academic Review Executive Committee (2003-2004)
- ABE junior faculty mentor (Dr. Stuart Brirell, 1998-; Dr. Jacek Koziel, 2004-)
- ABE Promotion and Tenure Review Committee (1995-1996; Chair 2003 – 2004)

Professional Service

ASAE (American Society of Agricultural Engineers)

- Program Chair of the Structures and Environment (SE) Division (2002 - 2005)
- Member of the Planning Committee and Local Host Co-Chair of the Seventh International Livestock Environment Symposium (ILES VII), held in Beijing China, May 18-20, 2005
- Associate Editor of SE Division (1994-2005)
- SE Representative of the Meetings Council (2003 – 2006)

- International Livestock Environment Symposium VII Planning Committee (member and Local Host Co-chair, 2003-2005)
- Publications Council - SE Representative (1999-2002)

ASHRAE (American Society of Heating, Refrigerating and Air-conditioning Engineers)

- Chair of TC 2.2 Handbook Committee (2000 – 2003)

CIGR (International Commission of Agricultural Engineers)

- Editorial Board Member for CIGR e-Journal (2000-present)

Association of Overseas Chinese Agricultural, Biological and Food Engineers

- Member of Board of Directors (2001-2005)
- Vice President (2002-2003)

Multi-state Research Project: NE127 - Biophysical Models for Poultry Production Systems

- Chair (1998-99); Secretary (1997-1998; 2005-2006), Senior Executive Officer (1997-98; 2003-2004); Junior Executive Officer (1996-97; 2002-2003)

Commodity Groups/Organizations

- Iowa Poultry Association and Iowa Egg Council Board of Directors
- United Egg Producers Environmental Scientific Panel on Air Quality (chair)

Manuscript and Proposal Review

- Regular reviewer of ASAE, ASHRAE, CSAE (Canadian Society of Agricultural Engineers) and USDA-ARS technical papers, averaging 8 to 10 papers per year.

Professional Development Activities

- Attended and presented at the 7th International Livestock Environment Symposium, Beijing, China, 2005
- Attended and presented at the Annual International Meetings of the American Society of Agricultural and Biological Engineers: 2001, 2002, 2003, 2004
- Attended and presented at an invited international SMART conference on sensor-based animal production system, held at the Katholic University of Leuven, Belgium, 2004
- Attended and presented at the Third International Conference on Air Pollution from Agricultural Operations, held in Raleigh, NC, 2003

Appendix I.D. ABE External Advisory Committee Members, 2006

Name	Job Title	Company
Patricia Boddy	Executive Director	Polk County (Iowa) Conservation Board
Roshan Chhabra	General Manager, Engineering Operations	General Electric Company
George Dowdle	6 Sigma Black Belt, Assembly Logistics Tech.	Caterpillar, Inc.
Matthew Frandsen	Project Manager	Weitz Agricultural
Davids Gustafson	Senior Project Engineer	Case Corporation
Philip Hamilton	ACIG Technical Specialist	Rockwell Automation
Klaus Hoehn	VP Advanced Tech & Engr.	Deere & Company
Kevin Igli	VP & Chief Environmental Officer	Tyson Foods, Inc.
Mark Jensen	State Conservation Engineer	USDA NRCS
Anthony Kajewski	Project Engineer	John Deere Product Engineering Center
Travis Kalous	Sr. Mfg. Program Specialist	Rockwell/Collins
Steven Kieffer	Loss Control/Sales Professional	Truenorth
Ronald Leonard	Retired	John Deere
Sam McCord	President/CEO	McCord Consulting Group
Mark Mommsen	Operations Management Asst.	General Mills
Gary Riskowski	Professor & Department Head	Texas A&M
Wendell Saunders	VP Strategic Sourcing and External Quality	Turbine Fuel Technologies
David Sommerlot	Plant Superintendent	Cargill, Inc.
Charles Sukup	President and Owner	Sukup Manufacturing Company
Scott Wilcox	Engineer	John Deere Harvester Works
Liansuo Xie	Manager, Research & Development	Townsend Engineering

Appendix I.E. Background Material on Workplace Competencies and Assessment.

Information included in this section:

1. Brumm, T.J., L.F. Hanneman and S.K. Mickelson (2006). Assessing and developing program outcomes through workplace competencies. *International Journal of Engineering Education* 22(1): 123-129.
2. Brumm, T.J., S.K. Mickelson, B.L. Steward and A.L. Kaleita-Forbes. Competency-based outcomes assessment for agricultural engineering programs. *International Journal of Engineering Education* (accepted for publication April 26, 2005).
3. Definitions of ISU workplace competencies and related key actions.

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Printed in Great Britain.

0949-149X/91 $3.00+0.00

Assessing and Developing Program Outcomes through Workplace Competencies*

THOMAS J. BRUMM, LARRY F. HANNEMAN and STEVEN K. MICKELSON
College of Engineering, Iowa State University, Iowa, USA. E-mail: tbrumm@iastate.edu

The College of Engineering at Iowa State University (ISU) partnered with constituents and assessment professionals to identify and validate 14 observable and measurable competencies necessary and sufficient to measure program outcomes. Constituents identified the engineering and experiential workplaces as settings most likely to develop and demonstrate the competencies, and the traditional classroom as least likely. Engineering students in the experiential workplace are assessed on the competencies by their supervisors, providing feedback for curricular change. These results confirm that we must re-examine how we use the classroom to educate engineers and our belief that experiential education is critical to students' success.

Keywords: assessment; ABET; competencies; workplace assessment; internships

INTRODUCTION

MANY ENGINEERING PROGRAMS are well on their way to adopting the outcomes-based ABET Criteria 3, now well know as the 'ABET (a–k) Outcomes' [1]. Eight of the eleven Outcomes address 'an ability to . . .'; two address 'understanding'; and only one addresses 'knowledge.' The direct measurement of 'an ability to . . .' presents challenges very different from those of measuring knowledge and understanding. George Peterson, ABET Executive Director, stated, '. . . evaluating their outcomes are sophisticated activities with which most engineering educators have had little or no experience' [2].

There is no universal approach to implementing and assessing the ABET outcomes-based criteria. Each program must interpret the criteria as they fit for them. A cursory examination of the literature reveals numerous different approaches to implementing ABET criteria [3–5].

Mentkowski *et al.* [6] state:

- Abilities are complex combinations of motivations, dispositions, attitudes, values, strategies, behaviors, self-perceptions and knowledge of concepts and of procedures.
- A complex ability cannot be observed directly, it must be inferred from performance.

At Iowa State University (ISU), we realized that we did not know how to directly assess 'an ability'. We hypothesized that each of the Outcomes are multi-dimensional and represent some collection of workplace competencies necessary for the practice of engineering at the professional level.

We define workplace competencies as the application of knowledge, skills, attitudes and values, and behaviors, as identified by Ewell [7], in the engineering workplace. They are 'the result of integrative learning experiences in which skills, abilities and knowledge interact' to impact the task at hand [8]. As such, competencies are directly measurable through actions or demonstrations of the existence of those competencies in the individual.

The 2005–2006 ABET Engineering Criteria [1] confirm our hypothesis by stating that the program outcomes 'relate to the skills, knowledge, and behaviors that student acquire in their matriculation through the program.'

A list of such competencies could be endless. Which are the most important for students to become successful engineers? Rogers [9] stated that '. . . faculty must determine what competencies that the student must demonstrate in order to know that they have achieved the outcome.' She also stated that 'key stakeholders need to be involved in determining which competencies should be the focus from all the possible competencies for any given outcome.' We could not agree more.

Employers of Iowa State University graduating engineers are relying on behavioral-based interviewing in the recruitment, screening and selection processes of new hires. They seek to assess whether a student has demonstrated a specific set of competencies, the definition of which is based on the analysis of the successful practice of engineering in specific engineering positions. These screening criteria often contain a minimum set of competencies, such as communication, teamwork and continuous learning.

In Spring 1999, the Iowa State University College of Engineering and Development Dimensions International, Inc. (DDI), a global provider of competency-based performance management

* Accepted 6 July 2005.

tools and services [10], collaborated to identify workplace competencies that were linked to Criterion 3 Outcomes and Assessment.

IDENTIFYING WORKPLACE COMPETENCIES

Our initial objective was to create a set of repeatable and reproducible measurements for the ABET (a–k) Outcomes that could be applied across the broad spectrum of the engineering experiential education workplace. This process was previously reported by Hanneman *et al.*, [11] and is summarized here.

Experiential education can be broadly defined as a philosophy and methodology in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, and clarify values [12]. In the College of Engineering at Iowa State University, we use a much narrower definition for engineering experiential education. For us, it is work experience in an engineering setting, outside of the academic classroom, and before graduation. Iowa State engineering students work in either a cooperative education program (alternating periods of full-time academic college training and full-time work experience of approximately equal length) or an internship (a single work period of institutional supervised full-time employment of a summer or at least one semester) [13]. Thus, the experiential workplace for us is where students are working when on an internship or participating in a cooperative education program. Typically, over 80% of graduates of our accredited engineering programs have participated in engineering experiential education before they graduate. An internship or cooperative education experience is not required at ISU in our engineering programs, but is strongly encourage by faculty and advisors.

It was desired that measurements of the ABET (a–k) Outcomes should be applicable across all ten of our accredited programs and across the two forms of experiential education offered by the college. Additionally, we wanted the measurements to be clearly and independently defined, readily observable, immediately measurable, consistent with the visions and missions of our college and university, and aligned with existing employer assessment, development and performance management practices. The competencies were to be uniquely ISU's.

Over two hundred constituents (stakeholders) were invited in 1999 to participate in a process to create and validate metrics for the experiential education workplace. These constituents included representation from these groups:

- employers (supervisors, managers, practicing engineers, recruiters, and human resource, education, training and development representatives);
- faculty, staff, and administrators; alumnae/i;
- students who participated in experiential education; parents;
- international faculty from partnering institutions.

Significant effort was made to ensure that each accredited program in the college received appropriate representation from each of the stakeholder groups and to ensure a broad, diverse representation from the employer community. The group ultimately consisted of 212 stakeholders.

The constituents participated in DDI-facilitated focus sessions, using a 'Critical Incident' data gathering technique, following the DACUM strategy [14]. In these sessions, constituents provided hundreds of examples of successful and unsuccessful demonstrations of the eleven ABET (a–k) Outcomes by engineering students and graduates. DDI professionals analyzed these 'critical incident' stories and extracted fourteen dimensions or workplace competencies necessary and sufficient for the successful demonstration of the eleven Outcomes:

Engineering Knowledge	General Knowledge	Continuous Learning
Quality Orientation	Initiative	Innovation
Cultural Adaptability	Analysis & Judgment	Planning
Communication	Teamwork	Integrity
Professional Impact	Customer Focus	

Note that these are 'ISU Competencies' that resulted from dialogue with *our* constituents. Other programs or institutions might develop a different set of competencies.

Based on their experience, DDI provided definitions for each competency. Each definition is clear, concise and independent of all others. Specific to each definition is a set of observable and measurable Key Actions that a student may take that demonstrates their development of that ISU Competency. A complete listing of the ISU Competencies and Key Actions can be found at http://learn.ae.iastate.edu/assessment/competency-definitions.pdf. An example of one ISU competency, Continuous Learning, is given in Table 1.

This process resulted in a mapping of the fourteen ISU Competencies to the ABET (a–k) Outcomes. The matrix of this mapping is given in Table 2. In each cell with a number, a competency is mapped to a specific Outcome. The numbers refer to constituent ranking of each competency–outcome combination (see the following section on Validation). There is no mapping of a competency to an Outcome where there were no supportive 'critical incident' stories, despite the temptation to assign such a relationship.

This matrix confirms our hypothesis that the outcomes are multi-dimensional and complex. For example, 'Initiative' is linked to each Outcome with 'an ability'. Outcome (c), 'an ability to design a system . . .', requires the greatest

Table 1. The Continuous Learning workplace competency

Definition	Actively identifying new areas for learning; regularly creating and taking advantage of learning opportunities; using newly gained knowledge and skill on the job, and learning through application.
Key Actions	1. Targets learning needs — Seeks and uses feedback and other sources of information to identify appropriate areas for learning. 2. Seeks learning activities — Identifies and participates in appropriate learning activities (e.g., courses, reading, self-study, coaching, experiential learning) that help fulfill learning needs. 3. Maximizes learning — Actively participates in learning activities in a way that makes the most of the learning experience (e.g., takes notes, asks questions, critically analyzes information, keeps on-the-job application in mind, completes required tasks). 4. Applies knowledge or skill — Puts new knowledge, understanding, or skill to practical use on the job; furthers learning through trial and error. 5. Takes risks in learning — Puts oneself in unfamiliar or uncomfortable situation in order to learn; asks questions at the risk of appearing foolish; takes on challenging or unfamiliar assignments.
Representative Career Activities	• Participating in applied projects that require new knowledge • Designing and/or performing experiments that require new knowledge • Designing products that require engineers to learn new subject areas • Questioning ethical professional responsibility when undertaking sensitive tasks • Engaging in discussions on professional responsibility • Taking courses outside of the 'hard sciences' while in the workplace • Using feedback from 'customers' to learn new material that will improve a product • Reading non-assigned books to learn new topics • Attending conferences and seminars • Learning local, state, and federal laws to understand impact on engineering practices • Learning new software programs to design a product or solve a problem • Participating in experiential education opportunities
Off-Key Actions	• Lets others determine learning goals and needs • Allows barriers and obstacles to interfere with learning • Only targets low-priority or current needs • Ignores own preferences, strengths, or developmental needs • Doesn't practice, reinforce, or apply learning
Over Actions	• Sets unrealistic goals or overextends • Over-emphasizes future needs and excludes current needs • Is overly confident or independent

Table 2. Matrix of ABET (a–k) Outcomes vs. ISU Competencies*

	ISU Competency													
ABET Criterion 3 Outcomes	Engineering Knowledge	General Knowledge	Continuous Learning	Quality Orientation	Initiative	Innovation	Cultural Adaptability	Analysis & Judgment	Planning	Communication	Team-work	Integrity	Professional Impact	Customer Focus
(a) An ability to apply knowledge of mathematics, science, and engineering	4.8		3.8		3.5			4.3						
(b) An ability to design and conduct experiments, as well as to analyze and interpret data	4.4		3.6	4.3	3.7	4.0		4.5	4.1		3.4			3.4
(c) An ability to design a system, component, or process to meet desired needs	4.4		3.8	4.1	3.9	4.3	3.0	4.5	4.2	4.0	3.8			4.2
(d) An ability to function on multidisciplinary teams					4.0		4.3	3.6	3.8	4.7	4.9	4.3	3.9	3.7
(e) An ability to identify, formulate, and solve engineering problems	4.7		3.8	3.9	4.1	4.2		4.4		3.7	3.6			3.6
(f) An understanding of professional and ethical responsibility		3.8	3.6	3.3			3.7	3.5				4.7		
(g) An ability to communicate effectively		3.8			3.7					4.9			4.2	4.0
(h) The broad education necessary to understand the impact of engineering solutions in a global & societal context	3.4	3.9	3.9				4.1	3.5						
(i) A recognition of the need for, and ability to engage in, life-long learning			4.6		4.1									
(j) A knowledge of contemporary issues		3.7	3.8				3.8	3.1						
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	4.3		4.2	3.6	3.7		2.6	4.0						

* Numbers refer to the average rating by constituents of the importance of the competency to demonstrating the outcome (5 = essential; 4 = very important; 3 = important; 2 = useful, but not essential; and 1 = unnecessary.) No rating was made for any competency-outcome combination where there was no 'Critical Incident' story.

Table 3. Constituents' view of the probability (%) that students/graduates will have the opportunity to develop and demonstrate competencies in various settings.

	ISU Competency														
Setting	Engineering Knowledge	General Knowledge	Continuous Learning	Quality Orientation	Initiative	Innovation	Cultural Adaptability	Analysis & Judgment	Planning	Communication	Teamwork	Integrity	Professional Impact	Customer Focus	Average
Engineering Workplace	88	71	87	87	92	78	73	89	87	90	90	90	92	88	86
Co-op/Internship Workplace	73	62	76	76	82	63	63	76	69	80	76	80	83	66	73
Classroom Capstone Design	76	47	69	72	73	63	55	73	75	71	75	72	60	53	67
Extracurricular Activities (Engineering Profession Related)	47	54	67	45	70	52	59	59	55	69	68	68	66	50	59
Classroom (Laboratory)	71	32	60	67	57	43	46	59	63	55	61	65	41	30	54
Extracurricular Activities (Non-engineering profession related)	25	69	56	35	63	44	59	49	51	65	64	66	60	47	54
Classroom (Traditional)	64	40	62	51	51	35	43	51	56	50	42	59	41	27	48

number of ISU Competencies. The 'Continuous Learning' and 'Analysis and Judgment' competencies are the most highly leveraged (associated with the greatest number of Outcomes) to the successful demonstration of the Outcomes.

VALIDATING THE RELATIONSHIP BETWEEN WORKPLACE COMPETENCIES AND ABET OUTCOMES

To validate the ISU Competency Matrix, a survey was sent to each of the original constituents. In this survey, we first asked them to carefully read the competency definitions and Key Actions and then to rate how important each competency is to a student's or a graduate's successful demonstration of each of the ABET Outcomes to which that competency is linked. The rating was on a Likert scale (5 = essential; 4 = very important; 3 = important; 2 = useful, but not essential; and 1 = unnecessary.)

Of the 212 constituents mailed a survey, 67 responded, a 32% return rate. The respondents represented industry and faculty from each of the engineering disciplines in the college. Each accredited program within the college had a minimum of six respondents that identified with the degree. Thirty-six percent represented faculty, fifty-eight percent of whom are Iowa State alumni. Sixty-four percent of respondents represented industry; sixty-nine percent of whom are Iowa State alumni. The results of their ratings are given in Table 2.

All competencies received an average rating of 3 (important) or better, confirming that the associations between the competencies and the Outcomes were valid. The only exception was the rating of Cultural Adaptability in its relationship to Outcome (k): 'an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.' That relationship received an average rating of 2.6. After review by the Employer Advisory Board for the ISU Engineering Cooperative Education, Internship and Summer Programs, the decision was made to keep this association at least through the initial pilot applications and analysis.

Finally, we asked of the constituents the degree to which the 14 ISU Competencies collectively cover ABET Criterion 3 Program Outcomes (a–k) and the degree (from 0 to 100%) to which all of the ISU Competencies cover the practice of engineering at the professional level. Coincidentally, the response average to both questions was 89%, from which we conclude that the ISU Competencies are sufficient for measuring our program outcomes.

This process resulted in a set of constituent-created and -validated, competency-based, ABET-aligned assessment tools for the engineering experiential education workplace. These tools will serve as the foundation for assessing our program outcomes.

CONFIRMING THE IMPORTANCE OF EXPERIENTIAL EDUCATION

As part of the validation survey, we asked that, after considering the Key Actions, constituents offer their assessment of the probability that a student and/or graduate would have the opportunity to take those actions to develop and demonstrate that competency in various settings. The settings were: the full-time engineering workplace, the cooperative education/internship workplace (experiential education); the traditional classroom, the classroom laboratory, the classroom capstone design, extracurricular activities (engineering profession related), and extracurricular activities (non-engineering profession related). The results are given in Table 3. The result for the Communication Competency is illustrated in Fig. 1.

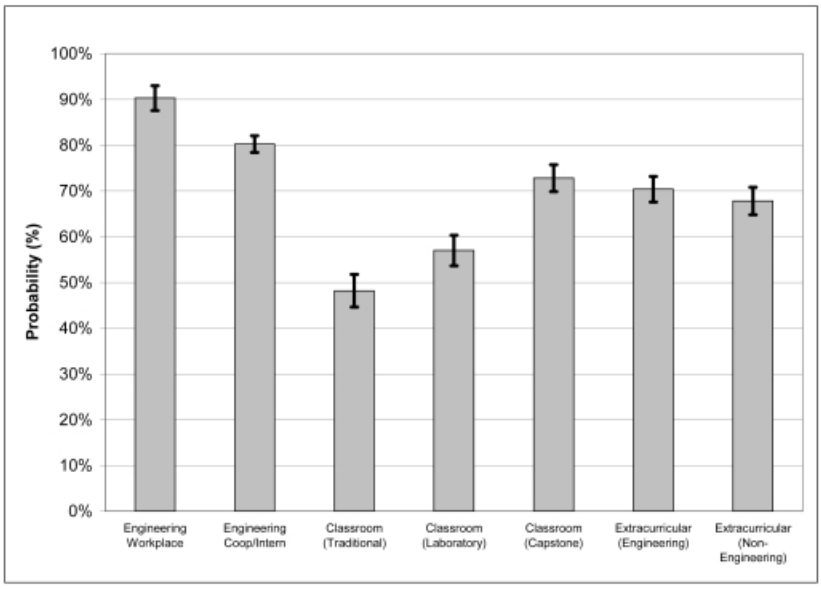

Fig. 1. Constituents' view of the probability (%) that students/graduates will have the opportunity to develop and demonstrate the Communication Competency in various settings.

For most of the competencies essential to the professional practice of engineering, the engineering workplace ranked the highest as the place best to develop and demonstrate the competencies, followed by internships. The classroom consistently ranked last. Engineering students spend a large portion of their academic experiences in the classroom, the least likely place for them to develop the skills, attitudes, values and behaviors necessary to be successful engineers, according to the constituents.

Competency assessment in experiential education

Engineering experiential education programs, such as cooperative education and internships, present the best place to directly observe and measure students developing and demonstrating competencies while engaged in the practice of engineering at the professional level. Measurements made by employers of student competencies present the best opportunity for feedback and curricular change with a cycle time that can address rapidly changing employer needs and expectations. Thus, engineering experiential education can and should be integral to the curricular continuous improvement process.

The ISU College of Engineering, through the office of Engineering Career Services, has implemented competency-based assessment tools for the engineering experiential education workplace, using Online Performance and Learning (OPAL^{TM}) [15]. OPAL^{TM} is DDI's web-based competency development and performance management software that provides assessment, development, coaching and learning tools. OPAL^{TM} was customized to present the ISU Competencies, corresponding Key Actions, and assessment surveys. To receive academic credit for their work experience, each student is required to complete the standard self-assessment and to ensure that their supervisor completes the same assessment of the student. This system has been in place since the fall of 2001. Over 90% of the ISU engineering students in the experiential workplace are evaluated by their supervisors.

A standard assessment survey consists of rating the student on the following question: 'When given the opportunity, how often does this individual perform the action?' The rating for each Key Action is on a Likert scale (1 = never or almost never; 2 = seldom; 3 = sometimes; 4 = often; 5 = always or almost always). A total of 61 Key Actions must be rated in the survey, which takes about 10 minutes to complete.

For each accredited engineering program in the College, the average value of each Key Action is computed from the student's self-assessment and separately from the supervisor's assessment. A ranking of the fourteen competencies (1 = highest mean score value, 14 = lowest mean score value) are made for students in each program. DDI recommends that individual departments look more carefully at patterns than a mean value. The overall results for the college [16] and one program [17] have been reported elsewhere.

The implementation of such an assessment system in a large practice-oriented engineering college presents an outstanding opportunity to collect very large volumes of competency-based assessment data and to study the correlation of these data to curricular processes and to the success of our graduates.

IMPLICATIONS FOR ENGINEERING EDUCATION PROGRAMS

There are number of important implications for engineering educators at Iowa State. Constituents

believe that the classroom is the least likely place to develop competencies necessary for the successful practice of engineering at the professional level. We must re-examine how we use the classroom in educating future engineers, broadening our focus to include competency development. Additionally, these results confirm our belief that experiential education is critical to students becoming successful in the engineering workplace. Finally, the engineering cooperative education and internship workplace provides a superb venue in which to assess student development and demonstration of the ISU Competencies and Criterion 3 Outcomes.

If competencies are the lens through which we view student learning outcomes, competencies must be integral to our engineering education programs. Competency-based learning involves redefining program, classroom, and experiential education objectives as competencies or skills, and focusing coursework on competency development. 'Competencies can have a stronger impact on student learning when they are linked and embedded within specific courses and across both general education and academic majors' [18]. Competencies are transparent; that is, all participants in the learning process can readily understand the learning goals. Competencies provide students with a clear map and the navigational tools needed to move expeditiously toward their goals [19].

At Iowa State University, some engineering programs are implementing competency-based learning and assessment. For example, the Department of Agricultural and Biosystems Engineering is implementing a competency-based education and assessment strategy [20], focused on student attainment of the Competencies, as demonstrated through portfolios and experiential education. They have identified the degree to which all engineering courses they offer address the 14 ISU competencies. The results of these assessments are being used to make curricular changes as part of their continuous improvement process.

CONCLUSIONS

Iowa State University's College of Engineering constituents helped us create and validate the use of workplace competencies to assess ABET Criterion 3 (a–k) Outcomes. Eight of the eleven Outcomes are directly stated as ability-based outcomes. Abilities are highly complex, multi-dimensional variables that cannot be measured directly and must be inferred from performance by direct observation. We re-defined the Outcomes as a collection of independent workplace competencies with measurable Key Actions.

Measuring the Outcomes as single variables can only provide information confirming that the demonstration of an Outcome is at a specified level, or whether the demonstration has improved or declined from a specified level. Measuring the Criterion 3 Outcomes with competencies provides specific information on what needs to be improved to enhance demonstration of specific Outcomes. This provides programs with specific, focused information on where and how to apply resources and, therefore, significantly enhances efficiency and efficacy of the curriculum continuous improvement process.

The experiential workplace (cooperative education and internships) provides a unique setting where the actions that define performance and competencies can be assessed while the student is actually engaged in the practice of engineering at the professional level.

The constituent-created ISU competencies provide the basis for an on-line measurement system that is well aligned with performance management and professional development systems in common practice in the engineering workplace. This system presents minimal burden to supervisors and mentors of engineering students and requires little education and training of the users.

The use of an on-line competency-based assessment system, such as OPAL^{TM}, provides large volumes of data to each program and to the college each semester, with little or no demand on faculty resources. A broad and representative sampling of student competency development is assured because of the high degree of student participation in experiential education and resulting supervisor assessment. Faculty can focus on data analysis, design and implementation of curricular changes, and analysis of the results of those changes.

Understanding the importance of developing workplace competencies in students provides an opportunity to re-invigorate and re-invent the engineering education process. Competencies provide students with a clear map and the navigational tools needed to become successful engineers and have a strong impact on student learning.

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Competency-based outcomes assessment for agricultural engineering programs

Competency-based outcomes assessment for agricultural engineering programs

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ABSTRACT

The ABET 2000 criteria have provided the impetus for the Agricultural and Biosystems Engineering Department at Iowa State University to completely re-structure how it assesses its undergraduate academic program in agricultural engineering. Previous assessment focused on indirect measures of student achievement such as student exit surveys, placement rates, and alumni surveys. We are now focusing on direct measures of student achievement. Because desired student outcomes of the program (e.g., "an ability to …") are multi-faceted, complex and difficult to measure, we have linked these outcomes to a set of validated work-place competencies. Key actions inherent to these competencies are measurable in both academic and experiential education environments. Two key tools used to assess competencies in these environments are (1) an on-line assessment program and (2) electronic portfolio developed by each student as a requirement for graduation. This paper discusses the overall philosophy of our assessment program, how the assessment tools are being implemented, and the implications for change in the curriculum.

BACKGROUND

ABET Outcomes and Competencies

Engineering education programs in the United States are moving from an "input" to an "outcomes" paradigm. Success is now focused on how well students achieve desired learning outcomes, not simply whether they've completed required coursework. The ABET 2000 Engineering Criteria 3 Program Outcomes and Assessment [1] have provided engineering programs with the impetus and opportunity to re-craft how they educate students (Table 1). There are a variety of ways in which engineering departments can respond to the new ABET Criteria. Felder and Brent [2] give an excellent overview of ways to redesign courses and curricula for meeting ABET engineering criteria.

The College of Engineering (COE) at Iowa State University (ISU) has taken the unique approach of addressing the ABET Outcomes criteria as workplace competencies [3, 4]. In the technologically and structurally expanding workplace, employers need different measures to use when recruiting and retraining employees [5]. Competencies fulfill this need by focusing on what people can do with what they learn, not solely on the acquisition of skill or knowledge [6].

Employers of the graduates of our agricultural engineering (AE) program are increasingly focusing on workplace competencies in their hiring practices (e.g., USDA National Resource and Conservation Service, John Deere, ConAgra Foods, Caterpillar), and student development of competencies are, therefore, critical to career success after graduation.

Competencies are the application of behavior and motivation to knowledge, understanding, and skill. They are "the result of integrative learning experiences in which skills, abilities and knowledge interact" to impact the task at hand [7]. As such, competencies are directly measurable through key actions or through demonstrations of the existence of those competencies in the individual.

In the Fall of 1999, a constituency of over 200 ISU faculty, partnering international faculty, co-op and intern students, employers, and alumni were asked to assist the ISU College of Engineering Cooperative Education and Internship Program in developing a next generation of performance assessment tools, ones that would be aligned with the new ABET Engineering Criteria 2000. Specifically, we set out to create a set of assessment metrics for the co-op and intern workplace that would be sufficient to document our students' development and demonstration of the ABET (a-k) Outcomes. Our hypotheses were that each the Outcomes are too complex to measure directly and that each Outcome represented some collection of workplace competencies necessary for the practice of engineering at the professional level. To support our efforts, the College collaborated with Development Dimensions International, Inc. (DDI), a global provider of competency-based performance management tools and services [8].

Constituents participated in DDI-facilitated focus sessions, using a "Critical Incident" data gathering technique, following a DACUM strategy [9]. In these sessions, they provided hundreds of examples of successful and unsuccessful demonstrations of the eleven ABET (a-k) Outcomes by engineering students and graduates. DDI professionals analyzed these "Critical Incident" stories and extracted fourteen dimensions or "ISU Competencies" (Table 2).

The definition of each ISU competency was written clearly, concisely, and independently. Specific to each definition is a set of observable and measurable key actions. For example, the definition of the Communication competency and its key actions are given in Table 3. A complete set of competency definitions and key actions can be found at *http://learn.ae.iastate.edu/assessment/CompetencyDefinitions.pdf.*

COE faculty involved in the constituency dialogue then mapped the competencies to the ABET (a-k) Outcomes. Further constituent dialogue using a survey tool validated these competencies as necessary and sufficient to demonstrate the Outcomes. Figure 1 shows this mapping in the form of a matrix.

Competency-based Learning

A conceptual model of learning based on competencies does not work solely at the level of skill, abilities, and knowledge (the conventional approach to engineering education), but seeks to formulate curriculum and assessment at the competency level which embodies integration of skills, abilities, and knowledge needed to become part of the disciplinary community of practice [10]. Such a model is illustrated in Figure 2.

Competency-based learning (CBL) involves redefining program, classroom, and experiential education objectives as competencies or skills, and focusing coursework on competency development. The advantage to CBL is that competencies are transparent; that is, all participants in the learning process understand the learning goals and outcomes. Competencies provide students with a clear map and the navigational tools needed to move expeditiously toward their goals [7]. Competencies have a stronger impact on student learning when they are linked to and embedded within specific courses and across the curriculum [9]. CBL models rely on both the judgment of those external to the learning process and on measurable assessment [7].

Other institutions have linked competencies to the learning process with some success [9]. King's College in London, UK, Alverno College, Wisconsin, U.S., and Northwest Missouri State University, U.S., have all used competency-based learning as an integral part of student development and learning assessment. However, few engineering programs have embraced CBL across the entire curriculum.

ePortfolios

Portfolios provide a broad assessment tool for student intellectual development and for technical expertise. They are powerful vehicles for both pedagogy and assessment, demonstrating a student's learning as an organic process involving three key factors: collection, reflection, and selection [11].

Portfolios can be a powerful learning experience. Using portfolios allows students to revisit their accomplishments over a given period of time, select various artifacts for the collection, and reflect on their growth and development through the creation of those artifacts: "Revisiting past work, students often improve the earlier work but also comment in a way that demonstrates their thinking around that work. In such a reflective text, students make their thinking visible" [12]. Through students' reflections and choice of artifacts, assessors and instructors have the opportunity to see explicitly how instruction is being interpreted and evaluated long after the class has ended [11].

Although there are many types of portfolios (e.g. professional, classroom, and learning portfolios), generally they can be broken down into two categories: summative and formative [13]. Summative portfolios center themselves on learning outcomes and seek to demonstrate the student's knowledge through the presentation of artifacts. In contrast, formative portfolios emphasize the process of learning and seek to show how students arrive at various artifacts. Moreover, formative portfolios provide feedback to students throughout the learning process.

In the last five years, portfolios have been moving increasingly online. Online electronic portfolios (ePortfolios) are useful pedagogical tools for providing both efficiency and effectiveness for assessment [13]. Because ePortfolios are online, the portfolio process can be streamlined through intelligent database control, electronic guides, and web design templates. All of these procedures can increase the effectiveness of the assessment process for students, faculty, and programs. ePortfolio systems range from the generic tool/template approach (GT) to the customized systems/free design approach (CS) of development [14]. GT systems rely on databases and templates, which give students little individual expression in their portfolio while

CS systems rely on free design which gives students flexibility and personal creativity. CS systems, however, do not lend themselves to competency-based portfolios.

Competency driven portfolios hosted within writing programs have been successfully used at a variety of institutions [15, 16]. For example, Rose-Hulman Institute of Technology, Indiana U.S., has developed an ePortfolio system that allows students to archive multimedia artifacts. Their faculty can rate the artifacts based on learning outcome goals and performance criteria [17]. A slightly different model is the Learning Record Online at the University of Texas at Austin, U.S., which includes both formative and summative assessment in its reading and writing portfolio system [18]. Similarly, the University of Wisconsin-Superior, U.S., piloted a portfolio system for assessment in their general education program [19]. More recently, Alverno College, Wisconsin, U.S., has developed the Diagnostic Digital Portfolio system where students display key performances in a GT environment, linked to abilities and educational standards across the entire college [20].

OUR ASSESSMENT PLAN

Through the integration of ABET Outcomes and ISU Competencies, the Agricultural and Biosystems Engineering (ABE) department developed the outcomes assessment plan for the Agricultural Engineering (AE) undergraduate degree program, as illustrated in Figure 3.

The mission, goals, and objectives of the program are reviewed (and changed as necessary) every three years in consultation with stakeholders and our industrial advisory board, concurrent with the ABET accreditation cycle. From this process, the desired student learning outcomes are developed, taking into account ABET accreditation and ASAE recognition criteria.

Each class in the curriculum is examined to determine which of the outcomes it addresses. Then curriculum as a whole is examined to ensure adequate coverage of the outcomes. Should there be gaps in coverage, the curriculum is re-examined to determine if different classes are needed, or if courses within the department need to be changed or added to ensure all the outcomes are adequately addressed.

Once the outcomes are mapped to the individual classes, we determine from the outcomes-competency matrix which competencies are addressed in each of the classes taught in our department. We thus know which competencies should be focused on in each class. Finally, the faculty designate key assignments in each class that students can use to demonstrate these competencies.

The primary evidence of students achieving the outcomes (or in our case, achieving the fourteen ISU competencies) is direct evidence of performance: student portfolios, workplace evaluations of students on internships and alumni five years post-graduation, and the results of the Fundamentals of Engineering (FE) exam. Indirect measures (e.g., senior exit surveys, student evaluation of instruction, post graduate surveys, program reviews, advisor evaluations and placement statistics) are reviewed as background information but are not the basis of judgment for the attainment of outcomes.

The direct and indirect measures are reviewed annually by the AE Curriculum Committee to identify strengths and weaknesses of the program, and in consultation with the ABE External Advisory Committee, makes recommendations for change. The faculty as a whole (e.g., curriculum changes) or individual faculty (specific classes) implement the recommendations.

This outcomes assessment plan is identical for the other undergraduate degree offered by our department, agricultural systems technology. The outcomes for this program were modeled after the ABET technology criteria [21], with a similar set of competencies mapped to the outcomes, although the program is not accredited by ABET. Thus all undergraduate students in our department, both engineers and technologists, will be creating electronic portfolios, and will be evaluated in internship experiences and in the workplace post-graduation.

Direct and Indirect Measures

Before implementing this new assessment plan, we relied on "indirect" measures of student performance, i.e., student exit surveys, placement rates, and alumni surveys. While these instruments, especially surveys, can provide some useful information, they are ultimately just opinions and not direct evidence of student performance. With the new ABET accreditation guidelines, credence is given to direct measures, i.e., evaluations of student work and performance [22].

Our assessment plan uses these direct measures to evaluate student performance: electronic portfolios created and owned by students, online competency assessments (evaluations by supervisors of students on internships and alumni practicing in the field of engineering), and the results of the Fundamentals of Engineering examination, the first step towards professional licensure.

Connecting Competencies to Outcomes

The direct measures result in numerical evaluations of student performances. Workplace and ePortfolios competency assessments are charted on a Likert Scale, allowing us to rank the weakest and strongest competencies. The aggregate results of the FE exam provide evidence for the attainment of the "engineering knowledge" competency by our students.

We apply a numerical rating to each of the outcomes, given that all the competencies are mapped to outcomes, and we can then rank how well each outcome is achieved. A system which weighs each competency within an outcome could also be developed to determine how each outcome is being met. However, since we are only now working to complete our first cycle of assessment, we don't have the experience with our plan to implement such a system.

ePortfolios

Incorporating a portfolio program into our curriculum allows us to continually renegotiate what our program is teaching and what our students are learning, and also provides us with a strong qualitative methodology for continual program assessment.

Our electronic portfolio system is a compromise between the generic template and the customized system approaches. The foundation of the system is a proprietary database system that we developed to hold the artifacts. This system is based on Macromedia's Rich Internet Application (RIA) model using Dreamweaver, Flash, and Cold Fusion [23]. The system (Figure 4) can be accessed at *http://learn.ae.iastate.edu/portfolio/* (username = guest, password = guest). Built into the database system is an assessment component.

Students upload artifacts that demonstrate achievement of one or more competencies. These artifacts can be papers they have written, examinations, laboratory reports, videos of presentations, design projects, or any form of evidence the student chooses that can be stored electronically. Artifacts, however, are not restricted to formal class settings. They can include internship experiences, student club activities, service learning projects, volunteer work, or any extra-curricular experiences that help demonstrate the competencies. Students must attach a reflection to the artifact by explaining its significance and impact. They must also self-assess the artifact, rating it on a Likert Scale for each of the key actions associated with the competency.

Using Dreamweaver and Flash, students then develop an interface which accesses the database to display the artifacts in whatever fashion they deem appropriate. For assessment purposes, artifacts are presented around a competency theme. They can also develop electronic resumes and portfolios for prospective employers in the same interface.

Students own the artifacts they place in the database. They decide to make the artifacts public (available for viewing by faculty and assessors) or private. They also control, outside of the classroom and assessment settings, who has access to their portfolios.

Faculty and assessors, in the context of class assignments and assessment, can access the "public" student artifacts and their ePortfolios. Just as the students self-assess the artifacts based on competencies, faculty and assessors assess the artifacts, resulting in a numerical evaluation of the students' achievement of the competencies.

On-line Competency Assessment

OPAL™ is DDI's online competency development and performance management software that provides assessment, development, coaching, and learning tools [24]. Following customization of OPAL™ to present the ISU Competencies, key actions, and assessment surveys, the system is now used by all Iowa State engineering cooperative education and internship (semester long only) students and their supervisors. To receive academic credit for the work term, each student is required to complete the standard self-assessment and to ensure that the supervisor completes the same assessment of the student.

The standard assessment survey consists of sixty-one key actions associated with the fourteen ISU Competencies. Using a Likert Scale, each student and each supervisor provides an assessment of the student's demonstration of each key action. The average value of each key action is computed from the student's self assessment and from the supervisor's assessment. A value for student development and demonstration of each ISU Competency is computed as the

average of the averages of the associated Key Actions (Figure 2). These assessments are anonymous to the ABE faculty, in that we can see aggregate results, but cannot identify individual evaluations. Mickelson et al. [25] summarize the results of such assessments for students in the AE program.

The same standard assessment survey is given to alumni (two years post-graduation) and their supervisors. While their participation is voluntary, we are finding that we have approximately the same response rate as the alumni surveys we previously administered.

While not part of our assessment plan, we are using OPAL™ in the classroom and having students evaluate themselves and others in team projects and capstone design experiences. The evaluations of an individual competency within the OPAL™ assessment surveys are identical to the assessments they make on artifacts within the ABE portfolio system.

IMPLEMENTING THE PLAN IN OUR CURRICULUM

Changes in the Curriculum

Upon entering the program, agricultural engineering (AE) students are exposed to workplace competencies. All freshmen are placed in a learning community for the first two semesters of their academic program [26]. In these learning communities, the students take three linked courses each semester as a cohort group. The first semester link includes Engineering Orientation (Engr 101, R credit), First-Year Composition I (English 104, 3 credits), and Engineering Graphics and Design (Engr 170, 3 credits). The second semester includes a link between Engineering Problems Solving (AE 160, 3 credits), First-Year Composition II (Engl 105, 3 credits), and a hands-on laboratory course, Experiencing Agricultural and Biosystems Engineering (AE 110, 1 credit).

AE students are introduced to the 14 ISU competencies in these course linkages through several assignments. For example, in Engr 101 and AE 110, students prepare behavior-based answers to workplace related questions for each of the 14 competencies. Upper-class mentors conduct behavior-based interviews in our college interview rooms to help prepare the students for coop/internship interviews. Assignments in the First-Year Composition courses tie in with the competency theme, where the students write papers related to competencies in engineering, technology, agriculture, and biological systems. From these classes, and the freshman engineering courses, students also start collecting artifacts that demonstrate their proficiency for each ISU competency. An example that demonstrates the teamwork competency would be an open-ended team design report in Engr 170 describing the design of a robot to collect contaminated materials. Another example would be documenting the solution to an engineering economics problem in AE 160, thus demonstrating "engineering knowledge." OPAL™ is used in each of these courses. Education materials that correlate with each competency are available within OPAL™. Faculty and students can access these materials for course or personal development.

Two required one-credit seminar classes for the sophomore and junior years have been created. These seminars focus on three areas: competency development, ePortfolio creation, and service learning. The seminars help ensure that work on competency development and on ePortfolios is a continuous process rather that something that students can delay until the semester in which the portfolio is required.

Portfolios are summatively evaluated as part of the senior seminar. While there is some discussion of competencies and ePortfolios in the class, much of the student work will already have been completed. If the student doesn't submit a satisfactory ePortfolio, she/he will not pass the seminar class, which is required for graduation. Using the assessment tools imbedded in the database system, a team of three engineering professionals, two faculty members and one external reviewer, evaluate portfolios and their artifacts. External reviewers come from the Iowa Section of the American Society of Agricultural Engineers. The local section of our professional society has over 400 members and has been actively involved in student professional development in our department for many years. We anticipate evaluating 35 to 40 portfolios each year. With approximately 17 teaching faculty, each faculty will review four portfolios, which is a reasonable workload.

Changes for Faculty

Implementing an assessment plan based on competencies requires faculty to engage in competency-based learning. Faculty must think, teach and assess in terms of competencies. In short, we must formulate our learning objectives in terms of competencies. This requires us to change how we approach the educational process in our department.

We are at the beginning stages of this process. Faculty know which outcomes their classes address, and the Outcomes-Competency matrix (Figure 2) lets them know the competencies they need to address in their classes. We are providing faculty with workshops and graduate student assistance to help them to include competencies as part of course foundations. Our faculty, through the unanimous adoption of the assessment plan, are committed to the process of implementing competency based learning in our curriculum.

As a first step, faculty designate key assignments for inclusion into student ePortfolios. These designations spring from a recognition of the competencies that the assignment addresses. Sharing these designations with students provides opportunities outside the seminars to discuss competencies.

We recognize that faculty time is always at a premium. As such, we worked hard to create a system that does not place undue burdens on the faculty. The only additional workload involved for individual faculty is evaluating four ePortfolios each year. Incorporating competencies into classes, with guidance and access to resources, can be part of the normal class development and evolution process.

CURRENT STATUS

To date, we have accomplished these aspects of our outcomes assessment plan:

- The ABE portfolio system has been constructed and tested. Students are uploading artifacts. A cohort of students has created ePortfolios which will be assessed in the fall of 2004.
- Competency-based learning has been incorporated into the ABE Learning Communities (coursework) at the freshman and sophomore level.
- The curriculum has been revised to include sophomore and junior seminars. The first offerings will be in the spring of 2005.
- Outcomes have been mapped to individual classes.
- Faculty are currently (summer of 2004) identifying competencies addressed in individual classes and key assignments to be included in student portfolios.

There are some important things we have yet to accomplish:

- The whole ABE undergraduate student body needs to be engaged in ePortfolio creation, not just a small cohort. While we have tested the ABE portfolio system, we need experience managing the system with approximately 300 students from the two undergraduate degree programs in the department.
- We need to train the faculty and external evaluators on assessing ePortfolios.
- Faculty need to fully integrate competency-based learning into their courses.
- We must complete an entire assessment cycle, with students completing their ePortfolios in the senior seminar class. The data needs to be analyzed, with recommendations for change developed and implemented.

The first complete assessment cycle is scheduled for the 2005-2006 academic year, in preparation for the ABET accreditation visit in the fall of 2006. We will learn a great deal in the process – we understand that we cannot fully anticipate all the ramifications of our plan. However, we are willing to adjust and modify are plan as needed to obtain a thorough and on-going outcomes assessment of the students in our degree program.

SUMMARY AND CONCLUSIONS

The Agricultural and Biosystems Engineering Department at Iowa State University has embarked on a process of outcomes assessment that requires us to radically change how we think about the education process. By interpreting the ABET (a-k) Criterion 3 Program Outcomes in terms of competencies, we are committing ourselves to transforming our curriculum into one built on competency-based learning.

While change is often difficult, the ABE faculty view this change as an opportunity to re-craft our curriculum to more effectively prepare students for the professional practice of engineering. Students will benefit by developing competencies that are necessary for success in the engineering workplace. Competencies and ePortfolios will allow them to make connections across the entire curriculum and see their academic experience as an integrated whole rather than just a series of classroom requirements. Faculty will design their classes in ways that address competencies and long-term student success.

Admittedly, we are in the early stages of this process. Even so, we have constructed the pieces of an assessment system radically different from anything we've done before. As we gain experience, we will make the necessary adjustments, refinements, and changes to the process. We believe, however, that our assessment plan is based on sound learning and assessment theory, resulting in a stronger and more successful academic program.

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Table 1. ABET Engineering Criteria 3 Program Outcomes and Assessment for 2003-2004 [1].

Although institutions may use different terminology, for purposes of Criterion 3, program outcomes are intended to be statements that describe what students are expected to know or be able to do by the time of graduation from the program.

Engineering programs must demonstrate that their graduates have:

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs (d) an ability to function on multi-disciplinary teams

(d) an ability to identify, formulate, and solve engineering problems

(e) an understanding of professional and ethical responsibility

(f) an ability to communicate effectively

(g) the broad education necessary to understand the impact of engineering solutions in a global and societal context

(h) a recognition of the need for, and an ability to engage in life-long learning

(i) a knowledge of contemporary issues

(j) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Each program must have an assessment process with documented results. Evidence must be given that the results are applied to the further development and improvement of the program. The assessment process must demonstrate that the outcomes of the program, including those listed above, are being measured.

Table 2. Iowa State University College of Engineering competencies identified in collaboration with over 200 constituents.

• Engineering Knowledge	• General Knowledge
• Continuous Learning	• Quality Orientation
• Initiative	• Innovation
• Cultural Adaptability	• Analysis & Judgment
• Planning	• Communication
• Teamwork	• Integrity
• Professional Impact	• Customer Focus

Table 3. ISU Communication Competency Definition and Key Actions

Communication:
Clearly conveying information and ideas through a variety of media to individuals or groups in a manner that engages the audience and helps them understand and retain the message**.**

Key Actions

- Organizes the communication—Clarifies purpose and importance; stresses major points; follows a logical sequence.
- Maintains audience attention—Keeps the audience engaged through use of techniques such as analogies, illustrations, body language, and voice inflection.
- Adjusts to the audience—Frames message in line with audience experience, background, and expectations; uses terms, examples, and analogies that are meaningful to the audience.
- Ensures understanding—Seeks input from audience; checks understanding; presents message in different ways to enhance understanding.
- Adheres to accepted conventions—Uses syntax, pace, volume, diction, and mechanics appropriate to the media being used.
- Comprehends communication from others—Attends to messages from others; correctly interprets messages and responds appropriately.

Figure 1. ABET Outcomes – ISU Competencies Matrix.

Engineering 2003-2004 Criterion 3 Program Outcomes and Assessment		ISU Competency													
		Engineering Knowledge	General Knowledge	Continuous Learning	Quality Orientation	Initiative	Innovation	Cultural Adaptability	Analysis and Judgment	Planning	Communication	Teamwork	Integrity	Professional Impact	Customer Focus
(a)	an ability to apply knowledge of mathematics, science and engineering	✖		✖		✖			✖						
(b)	an ability to design and conduct experiments, as well as to analyze and interpret data	✖		✖	✖	✖	✖		✖	✖		✖			✖
(c)	an ability to design a system, component, or process to meet desired needs	✖		✖	✖	✖	✖	✖	✖	✖	✖	✖			✖
(d)	an ability to function on interdisciplinary teams					✖		✖	✖	✖	✖	✖	✖	✖	✖
(e)	an ability to identify, formulate and solve engineering problems	✖		✖	✖	✖	✖		✖		✖	✖			✖
(f)	an understanding of professional and ethical responsibility		✖	✖	✖			✖	✖				✖		
(g)	an ability to communicate effectively		✖			✖					✖			✖	✖
(h)	the broad education necessary to understand the impact of engineering solutions is a global and societal context	✖	✖	✖				✖	✖						
(i)	a recognition of the need for, and the ability to engage in, life-long learning			✖			✖								
(j)	a knowledge of contemporary issues		✖	✖				✖	✖						
(k)	an ability to use the techniques, skills and modern engineering tools necessary for engineering practice	✖		✖	✖	✖		✖	✖						

Figure 2. A conceptual learning model based on competencies [10].

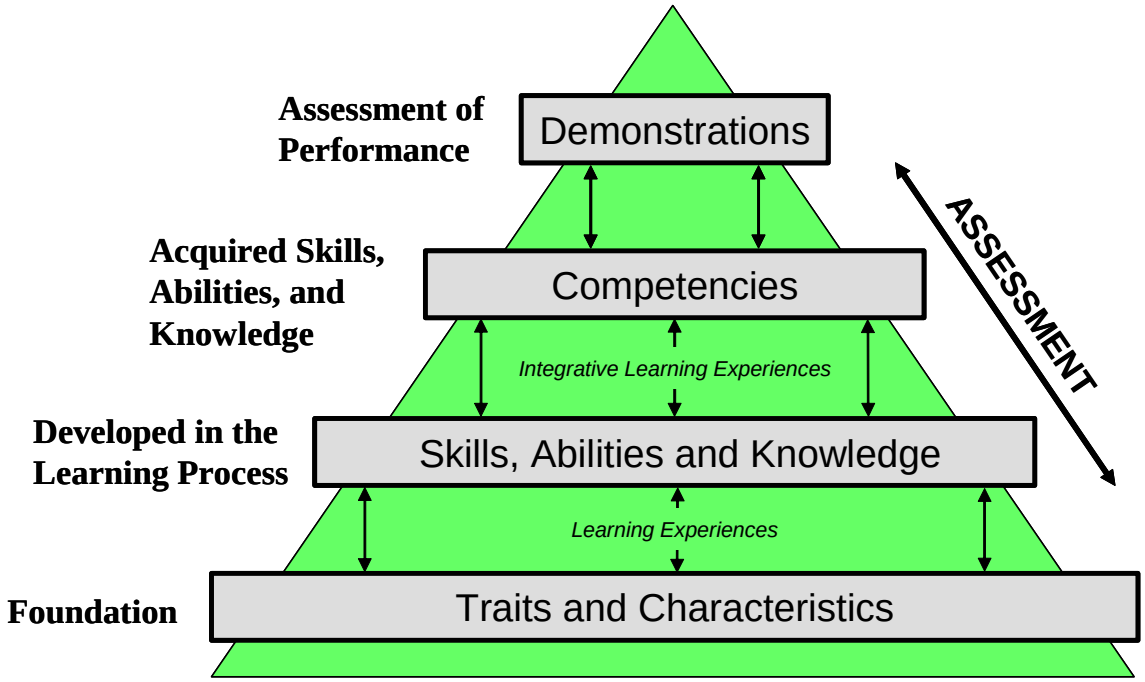


Figure 3. The ABE outcomes assessment plan.

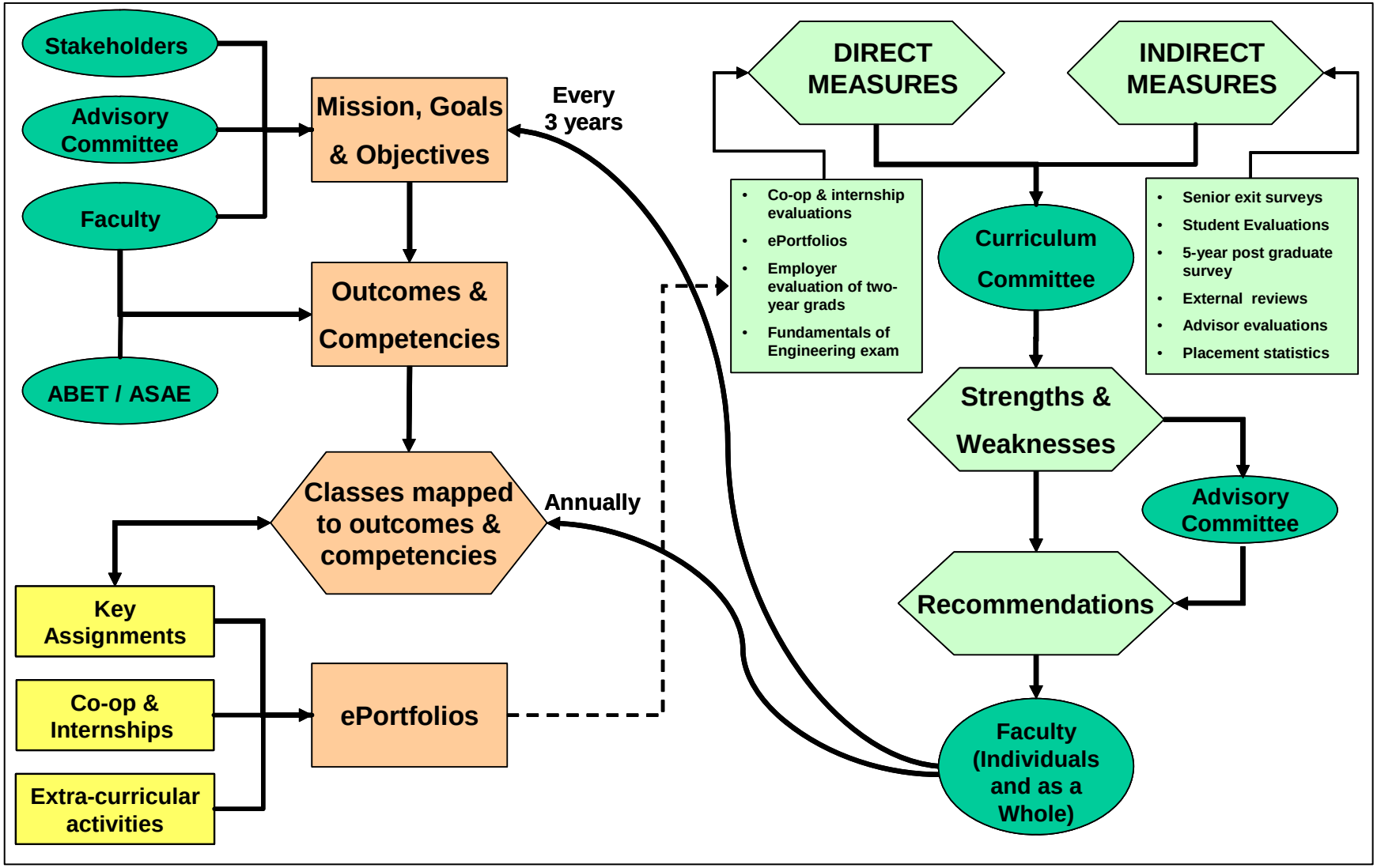
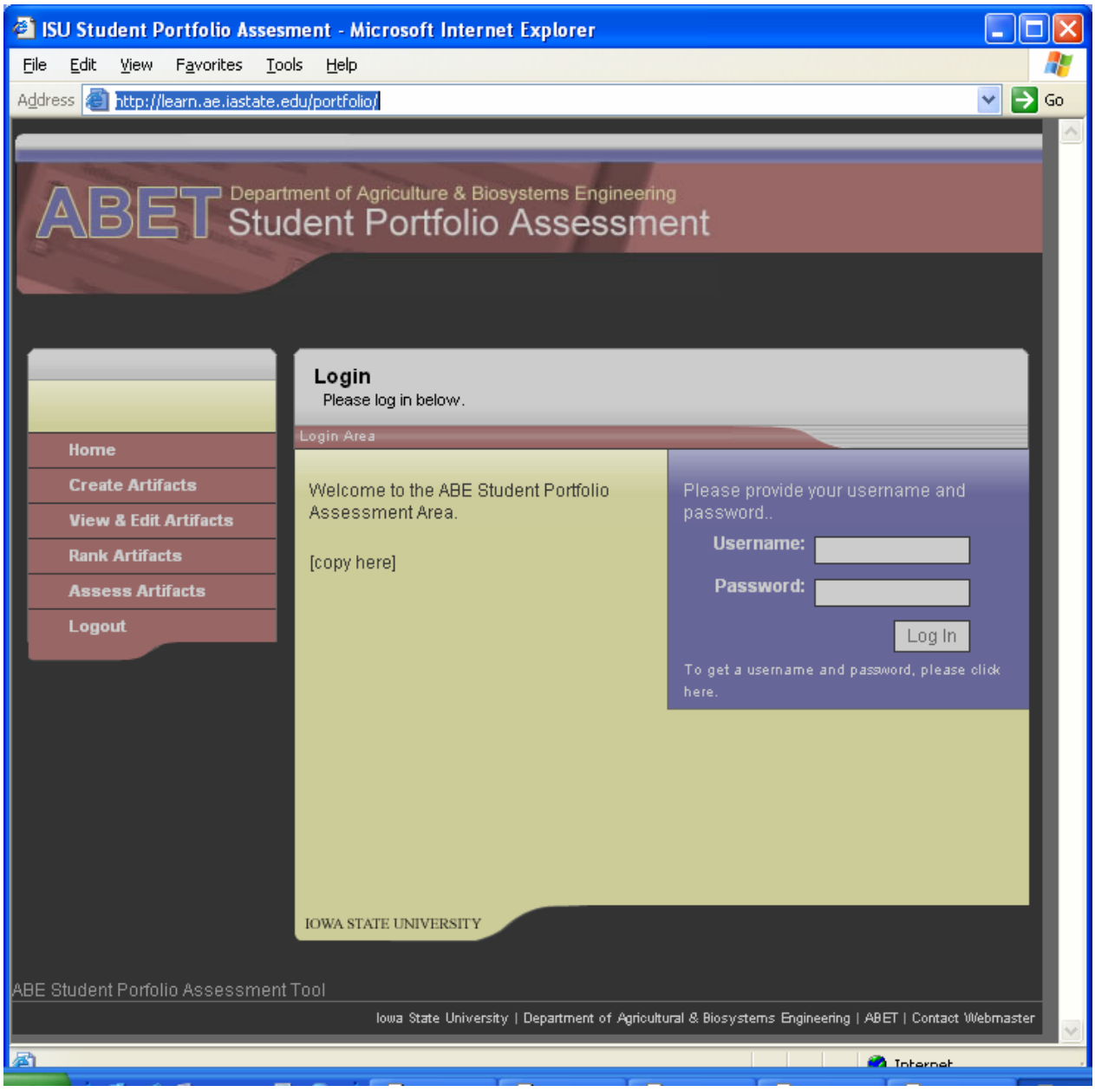


Figure 4. The ABE ePortfolio System introduction screen.



Iowa State University
Engineering & Technology Workplace Competencies*

Definition: A competency is a grouping of similar knowledge, skills, behaviors and motivations. A "core" competency is one that is regularly mentioned by many of our employers.

Competency	Core?	Definition
Analysis and Judgment	✓	Identifying and understanding issues, problems and opportunities; developing the relevant criteria and comparing data from different sources to draw conclusions; using effective approaches for choosing a course of action or developing appropriate solutions; taking action that is consistent with available facts, constraints, and probable consequences.
Communication	✓	Clearly conveying information and ideas through a variety of media to individuals or groups in a manner that engages the audience and helps them understand and retain the message.
Continuous Learning	✓	Actively identifying new areas for learning; regularly creating and taking advantage of learning opportunities; using newly gained knowledge and skill on the job, and learning through application.
Cultural Adaptability		Being open to and making changes to accommodate the differences found in other cultures in order to interact effectively with individuals and groups from a different cultural background.
Customer Focus		Making customers and their needs a primary focus of one's actions; developing and sustaining productive customer relationships.
Engineering/Technical Knowledge	✓	Having achieved a satisfactory level of knowledge in the relevant specialty areas of engineering/technology, science and mathematics.
General Knowledge	✓	Having achieved a satisfactory level of knowledge outside the areas of engineering, technology, science and mathematics
Initiative	✓	Taking prompt action to accomplish objectives; taking action to achieve goals beyond what is required; being proactive
Innovation		Generating creative, non-traditional technical solutions in work situations; trying different and novel ways to deal with work problems and opportunities.
Integrity		Maintaining social, ethical, and organization norms; firmly adhering to codes of conduct and professional ethical principles.
Planning		Effectively managing one's time and resources to ensure that work is completed efficiently.
Professional Impact		Creating a good first impression, commanding attention and respect, showing an air of confidence.
Quality Orientation		Accomplishing tasks by considering all areas involved, no matter how small; showing concern for all aspects of the job; accurately checking processes and tasks; being watchful over a period of time.
Safety Awareness		Identifying and correcting conditions that affect employee safety; upholding safety standards.
Teamwork	✓	Effectively participating as a member of a team to move the team toward the completion of goals.

1. Analysis and judgment

- **Definition:** Identifying and understanding issues, problems, and opportunities; comparing data from different sources to draw conclusions; using effective approaches for choosing a course of action or developing appropriate solutions; taking action that is consistent with available facts, constraints, and probable consequences.
- **Key Actions**
  - **Identifies issues, problems and opportunities.** Recognizes issues, problems, or opportunities and determines whether action is needed.
  - **Gathers information.** Identifies the need for and collects information to better understand issues, problems, and opportunities.
  - **Interprets information.** Integrates information from a variety of sources; detects trends, associations, and cause-effect relationships.
  - **Generates alternatives.** Creates relevant options for addressing problems/opportunities and achieving desired outcomes
  - **Commits to action.** Implements decisions or initiates action within a reasonable time.
  - **Chooses appropriate actions.** Formulates clear decision criteria; evaluates options by considering implications and consequences; chooses an effective option.
  - **Involves others.** Includes others in the decision-making process as warranted to obtain good information, make the most appropriate decisions, and ensure buy-in and understanding of the resulting decisions.
  - **Values diversity.** Embraces and values diverse collection of inputs, values, perspectives, and thought paradigms in approaching the application of engineering and technology to products and processes.

2. Communication

- **Definition:** Clearly conveying information and ideas through a variety of media to individuals or groups in a manner that engages the audience and helps them understand and retain the message.
- **Key Actions**
  - **Organizes the communication.** Clarifies purpose and importance; stresses major points; follows a logical sequence.
  - **Maintains audience attention.** Keeps the audience engaged through use of techniques such as analogies, illustrations, body language, and voice inflection.
  - **Adjusts to the audience.** Frames message in line with audience experience, background, and expectations; uses terms, examples, and analogies that are meaningful to the audience.
  - **Ensures understanding.** Seeks input from audience; checks understanding; presents message in different ways to enhance understanding.
  - **Adheres to accepted conventions.** Uses syntax, pace, volume, diction, and mechanics appropriate to the media being used.
  - **Comprehends communication from others.** Attends to messages from others; correctly interprets messages and responds appropriately.

3. Continuous learning

- **Definition:** Actively identifying new areas for learning; regularly creating and taking advantage of learning opportunities; using newly gained knowledge and skill on the job and learning through their application.
- **Key Actions**
  - **Targets learning needs.** Seeks and uses feedback and other sources of information to identify appropriate areas for learning.
  - **Seeks learning activities.** Identifies and participates in appropriate learning activities (e.g., courses, reading, self-study, coaching, and experiential learning) that help fulfill learning needs.
  - **Maximizes learning.** Actively participates in learning activities in a way that makes the most of the learning experience (e.g., takes notes, asks questions, critically analyzes information, keeps on-the-job application in mind, does required tasks).

- **Applies knowledge or skill.** Puts new knowledge, understanding, or skill to practical use on the job; furthers learning through trial and error.
- **Takes risks in learning.** Puts self in unfamiliar or uncomfortable situation in order to learn; asks questions at the risk of appearing foolish; takes on challenging or unfamiliar assignments.

4. Cultural Adaptability

- **Definition:** Being open to and making changes to accommodate the differences found in other cultures in order to interact effectively with individuals and groups from a different cultural background.
- **Key Actions**
  - **Demonstrates inclusive behavior.** Establishes effective relationships with people of other cultures and backgrounds; shows genuine acceptance of people from backgrounds different from one's own.
  - **Exhibits sensitivity.** Exhibits sensitivity to and respect for the perspectives and interests of people of a different culture; attends to and tries to understand different perspectives and approaches.
  - **Adapts behavior to other cultures.** Adjusts own approach to interactions, communications, and decision making to be appropriate and effective within another culture without sacrificing own values.
  - **Adapts products and processes to cultural concerns.** Identifies, understands and incorporates cultural factors into the design of products and processes

5. Customer Focus

- **Definition:** Making customers and their needs a primary focus of one's actions; developing and sustaining productive customer relationships.
- **Key Actions**
  - **Seeks to understand customers.** Actively seeks information to understand customers' circumstances, problems, expectations, and needs.
  - **Educates customers.** Shares information with customers to build their understanding of issues and capabilities.
  - **Builds collaborative relationships.** Builds rapport and cooperative relationships with customers.
  - **Takes action to meet customer needs and concerns.** Considers how actions or plans will affect customers; responds quickly to meet customer needs and resolve problems; avoids over-commitments.
  - **Sets up customer feedback systems.** Implements effective ways to monitor and evaluate customer concerns, issues, and satisfaction and to anticipate customer needs.

6. Engineering/Technical Knowledge

- **Definition:** Having achieved a satisfactory level of knowledge in the relevant specialty areas of mathematics, science and engineering/technology.
- **Key Actions**
  - **Knowledge of Mathematics.** Demonstrates a knowledge of the mathematical principles required to practice engineering or apply and manage technology in one's specialty area.
  - **Knowledge of Science.** Demonstrates a knowledge of the scientific principles required to practice engineering or apply and manage technology in one's specialty area.
  - **Knowledge of experimental analysis.** Demonstrates a knowledge of the principles of experimental data analysis in one's specialty area.
  - **Knowledge of current engineering/technology tools.** Demonstrates a knowledge of the use of contemporary tools needed to practice engineering or apply and manage technology in an effective manner.
  - **Knowledge of technology.** Demonstrates a knowledge of engineering/technology principles required to practice in one's specialty area.

7. General Knowledge

- **Definition:** Having achieved a satisfactory level of knowledge outside the areas of mathematics, science, engineering and technology.
- **Key Actions**
  - **General Knowledge.** Demonstrates a knowledge of important current issues and events outside the areas of mathematics, science, engineering and technology
  - **Relates general knowledge to engineering/technology.** Demonstrates a knowledge of the interrelationships between important issues and events outside of engineering/technology and one's engineering/technology specialty area.

8. Initiative

- **Definition:** Taking prompt action to accomplish objectives; taking action to achieve goals beyond what is required; being proactive.
- **Key Actions**
  - **Responds quickly.** Takes immediate action when confronted with a problem or when made aware of a situation.
  - **Takes independent action.** Implements new ideas or potential solutions without prompting; does not wait for others to take action or to request action.
  - **Goes above and beyond.** Takes action that goes beyond job requirements in order to achieve objectives.

9. Innovation

- **Definition:** Generating innovative solutions in work situations; trying different and novel ways to deal with work problems and opportunities.
- **Key Actions**
  - **Challenges paradigms.** Identifies implicit assumptions in the way problems or situations are defined or presented; sees alternative ways to view or define problems; is not constrained by the thoughts or approaches of others.
  - **Leverages diverse resources.** Draws upon multiple and diverse sources (individuals, disciplines, bodies of knowledge) for ideas and inspiration
  - **Thinks expansively.** Combines ideas in unique ways or makes connections between disparate ideas; explores different lines of thought; views situations from multiple perspectives; brainstorms multiple approaches/solutions.
  - **Evaluates multiple solutions.** Examines numerous potential solutions and evaluates each before accepting any.
  - **Ensures relevance.** Targets important areas for innovation and develops solutions that address meaningful work issues.

10. Integrity

- **Definition:** Maintaining social, ethical, and organizational norms; firmly adhering to codes of conduct and professional ethical principles.
- **Key Actions**
  - **Demonstrates honesty.** Deals with people in an honest and forthright manner; represents information and data accurately and completely.
  - **Keeps commitments.** Performs actions as promised; does not share confidential information.
  - **Behaves consistently.** Ensures that words and actions are consistent; behaves consistently across situations.

11. Planning

- **Definition:** Effectively managing one's time and resources to ensure that work is completed efficiently.
- **Key Actions**
  - **Prioritizes.** Identifies more critical and less critical activities and tasks; adjusts priorities when appropriate

- **Makes preparations.** Ensures that required equipment and/or materials are in appropriate locations so that own and others' work can be done effectively.
- **Schedules.** Effectively allocates own time to complete work; coordinates own and others' schedules to avoid conflicts.
- **Leverages resources.** Takes advantage of available resources (individuals, processes, departments, and tools) to complete work efficiently.
- **Stays focused.** Uses time effectively and prevents irrelevant issues or distractions from interfering with work completion.

12. Professional Impact

- **Definition:** Creating a good first impression; commanding attention and respect; showing an air of confidence.
- **Key Actions**
  - **Dresses appropriately.** Maintains professional, businesslike image.
  - **Displays professional demeanor.** Exhibits a calm appearance; does not appear nervous or overly anxious; responds openly and warmly when appropriate.
  - **Speaks confidently.** Speaks with a self-assured tone of voice.

13. Quality Orientation

- **Definition:** Accomplishing tasks by considering all areas involved, no matter how small; showing concern for all aspects of the job; accurately checking processes and tasks; being watchful over a period of time.
- **Key Actions**
  - **Follows procedures.** Accurately and carefully follows established procedures for completing work tasks.
  - **Ensures high-quality output.** Vigilantly watches over job processes, tasks, and work products to ensure freedom from errors, omissions, or defects
  - **Takes action.** Initiates action to correct quality problems or notifies others of quality issues as appropriate.

14. Safety Awareness

- **Definition:** Identifying and correcting conditions that affect employee safety; upholding safety standards.
- **Key Actions**
  - **Identifies safety issues and problems.** Detects hazardous working conditions and safety problems; checks equipment and/or work area regularly.
  - **Takes corrective action.** Reports or corrects unsafe working conditions; makes recommendations and/or improves safety and security procedures; enforces safety regulations and procedures.
  - **Monitors the corrective action.** Monitors safety or security issues after taking corrective action and ensures continued compliance.

15. Teamwork

- **Definition:** Actively participating as a member of a team to move the team toward the completion of goals.
- **Key Actions**
  - **Facilitates goal accomplishment.** Makes procedural or process suggestions for achieving team goals or performing team functions; provides necessary resources or helps to remove obstacles to help the team accomplish its goals.
  - **Involves others.** Listens to and fully involves others in team decisions and actions; values and uses individual differences and talents.
  - **Informs others on the team.** Shares important or relevant information with the team.
  - **Models commitment.** Adheres to the team's expectations and guidelines; fulfills team responsibilities; demonstrates personal commitment to the team.