Engineering Faculty Document No. 32-02

January 9, 2003

TO: Engineering Faculty

FROM: The Faculty of the School of Agricultural and Biological Engineering

RE: New Dual-Level Course, ABE 501

The faculty of the Department of Agricultural and Biological Engineering has approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

ABE 501 Welding Engineering

Sem. 2, Class 3, cr. 3 (Offered in alternating years)

Prerequisite: ABE 450

Design of weldments and modeling of heat transfer and residual stresses of the welding processes. Finite element theory of non-linear properties for the many processes including laser, submerged arc, manual, Gas Tungsten Arc Welding (GTAW), plasma, electron beam. Metallurgy topics will include continuous cooling transformation curves in optimizing engineered joint strength including cutting and welding.

Reason:

This class has been offered three times as an ABE 591 with good enrollment of 6 in 2001, 13 in 2002, and 10 in 2003. This course is organized to provide engineers with welding background for small production volumes. The need was expressed by Midwest industries who hire our students. Background in heat transfer, cooling, metallurgy and the processes for various productivity rates will be covered. Simulation of distortion and cracking are the major areas where engineering knowledge is needed to assure faster production process start-up-times.

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Vincent F. Bralts
Head, Department of Agricultural and Biological Engineering

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ABE 501
Welding Engineering

Instructor: Professor Gary W. Krutz, Ph.D., P.E.

Text: Welding Metallurgy (Carbon & Alloy Steels), Vol. 1 Fundamentals
By G. E. Linnert, AWS Publisher, 1994

Reference: Machine Design by G.W. Krutz, 1999

Prerequisite: ABE 450 or equivalent

Lecture: Tuesday 9:30 - 10:20 ABE
Wednesday 1:30 - 3:20 ABE

HWK due the following class meeting

Jan	14	Chapter 2 - Krutz	
	15	Chapter 6.2 pgs. 179-197 – Krutz	Hwk 6.6, 6.7, 6.8, 6.9, 6.11
	21	Videos 1, 2 and 3	
	22	Chapter 5 – Linnert Demo – Scott Brand manual weld	
	28	Chapter 6 – Linnert pgs. 441-477	Hwk #1
	29	Videos 4, 5 and 6	
Feb	4	TIG welding – Linnert pgs. 478-501	Hwk #2
	5	Demo – Scott – TIG welding	
	11	Submerged arcs (UCS), pgs. 501-547	Hwk #3
	12	Practice weldings & test weld	
	18	Electron Beam, etc., pgs. 548-593	
	19	Hardness test in MET	Hwk #4
	25	Friction Welding, ultrasonic welding, etc., pgs., 594-620	
	26	Soldering, brazing	Hwk (Krutz) 6.12
Mar	4	**Exam #1**	
	5	Gas Cutting, pgs., 621-651	
	11	Field trip – Plasma Cutting & TIG (2PM)	HWK #5
	12	Projects start	
	22	Cat Simulation – Harlow	
	23	Projects (continued)	
	29	Thermo Changes, pgs., 653-707	

	30	PC – meet with Prof. Krutz weekly (i.e., tours)	
Apr	1	FEA – nonlinear K & C and C	Hwk#6
	2	**Project Draft Due – 10 minute presentations**	
	8	FEA – heat of transformation & fusion	Hwk #7
	9	Chapter 8 – Plastic Welding in lab	Hwk #8
	15	FEA – gauss flux – time dependant	
	16	Chapter 9 (to pg. 855) – CCT curves	Hwk # 9
	22	Residual stresses – handouts	
	23	Toughness in welds, pgs., 856-891	Hwk #10
	29	Robot welding (tolerance stackup)	
	30	**Project Due – Review for final**	

Purdue Student Honesty Policy in effect.

Class Goals:

1. Become proficient in designing a welded joint.

2. Capable of specifying welding process for manufacturability.

3. Complete a welding engineering design project (15 page report). Practical hands-on-experience.

4. Understanding FEA (thermo and elastic-plastic) non-linear affects caused by Welding (i.e., commercial CAT program)

5. Becomes knowledgeable of the 20 plus welding, cutting, and brazing processes.

6. Evaluate weld quality – understand certification process.

Justification: Many joining processes use automatic welding in automotive construction and component manufacturing. The demand for background in welding engineering has been expressed by mid-west industry.