Engineering Faculty Document No. 32-02

January 9, 2003

TO: Engineering Faculty

FROM: The Faculty of the School of Materials 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.

APPROVED FOR THE FACULTY
OF THE SCHOOLS OF ENGINEERING
BY THE COMMITTEE ON
FACULTY RELATIONS

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

CFR Minutes 972

Date 3/5/04

Chairman CFR Robert E Montgomery

ABE 501 Welding Engineering Sem. 2., Class 3. cr. 3 Prerequisite: ABE 450

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ABE 501
Welding Engineering
Spring

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 102
Wednesday	1:30 – 3:20	ABE 102

HWK due the following class meeting

Jan	8	Chapter 2 – Krutz	
	9	Chapter 6.2 pgs. 179-197 – Krutz	Hwk 6.6, 6.7, 6.8, 6.9, 6.11
	15	Chapter 5 – Linnert	
	16	Videos 1, 2 and 3 Demo – Scott Brand manual weld	
	22	Chapter 6 – Linnert pgs. 441-477	Hwk #1
	23	Videos 4, 5 and 6	
	29	TIG welding – Linnert pgs. 478-501	Hwk #2
	30	Demo – Scott – TIG welding	
Feb	5	Submerged arcs (UCS), pgs. 501-547	Hwk #3
	6	Practice weldings & test weld	
	12	Electron Beam, etc., pgs. 548 – 593	
	13	Hardness test in MET	Hwk #4
	19	Friction Welding, ultrasonic welding, etc., pgs. 594 - 620	
	20	Soldering, brazing	Hwk (Krutz) 6.12
	26	Gas Cutting, pgs. 621 – 651	
	27	Field trip – Plasma Cutting & TIG (2 PM)	Hwk #5
Mar	5	**Exam #1**	
	6	Projects start	
	19	Cat Simulation – Harlow	
	20	Projects (continued)	
	26	Thermo Changes, pgs. 653 – 707	
	27	PC – meet with Prof. Krutz weekly (i.e., tours)	
Apr	2	FEA – nonlinear K & C_p and C_f9	Hwk #6
	3	**Project Draft Due** – 10 minute presentations	

	9	FEA – heat of transformation & fusion	Hwk #7
	10	Chapter 8 – Plastic Welding in lab	Hwk #8
	16	FEA – gauss flux – time dependent	
	17	Chapter 9 (to pg. 855) – CCT curves	Hwk #9
	23	Residual stresses – handouts	
	24	Toughness in welds, pgs. 856 – 891	Hwk #10
	30	Robot welding	
May	1	**Project Due** – Review for final	

Final Exam 100 pts.
Exam #1 100 pts.
Project report 100 pts.
Hwk – 10 problems 160 pts.

Grading Scale:

Grade	*Scale*
A	90 – 100 %
B	80 – 89 %
C	70 – 79 %
D	60 – 69 %
F	0 – 59 %

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 (10-15 page report). Practical hands-on-experience.
4. Understand FEA (thermo and elastic-plastic) non-linear affects caused by welding (i.e., commercial CAT program).
5. Become 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.