FORM A
College of Technology

Revised 7/23/07

PROPOSAL SUMMARY AND ROUTING FORM

Proposal Title: Temporarily configure WELD 422 Material Science course from a 3+0 configuration to a 2+3 configuration as an experimental offering. Experimental course identification is WELD 490 – Welding Metallurgy.

Initiating Unit or Individual: Department of Welding Engineering Technology
Contact Person's Name: Jeffrey Carney **e-mail:** carneyj@ferris.edu **phone:** x2952
Date or Term of Proposal Implementation: Spring 2009

- ☐ Group I - A – New degree/major or major, redirection of a current offering, or elimination of a degree, major or minor
- ☐ Group I - B – New minors or concentrations
- X Group II - A – Minor curriculum clean-up and course changes
- ☐ Group II - B – New Course
- ☐ Group III - Certificates
- ☐ Group IV – Off-Campus Programs

Group/Individual	Signature	Date	Vote/Action *
Program Faculty			5 Support 0 Support with Concerns 0 Not Support
Department Faculty			___ Support ___ Support with Concerns ___ Not Support
Department Head / Chair	JN Carney	10/15/08	1 Support 0 Support with Concerns 0 Not Support
College Curriculum Committee	N/A	N/A	___ Support ___ Support with Concerns ___ Not Support
Dean		10/17/08	___ Support ___ Support with Concerns ___ Not Support
University Curriculum Committee			___ Support ___ Support with Concerns ___ Not Support
Senate			___ Support ___ Support with Concerns ___ Not Support
Academic Affairs		10/16/08	✓ Support ___ Support with Concerns ___ Not Support

* Support with Concerns or Not Support must include a list of specific concerns. Votes must be shown for faculty groups. Administrators check appropriate action taken.

To be completed by Academic Affairs

President (Date Approved)	Board of Trustees (Date Approved)	President's Council (Date Approved)

1. Proposal Summary

(Summary is generally less than one page. Briefly: state what is proposed with a summary of rationale and highlights. Additional rationale may be attached.)

2. Summary of All Course Action Required*

a. **Newly Created Courses to FSU:**

Prefix	Number	Title
WELD	490	Welding Metallurgy

b. **Courses to be Deleted From FSU Catalog:**

Prefix	Number	Title

c. **Existing Course(s) to be Modified:**

Prefix	Number	Title
WELD	422	Material Science

d. **Addition of existing FSU courses to program**

Prefix	Number	Title

e. **Removal of existing FSU courses from program**

Prefix	Number	Title

*Contact Senate Secretary or UCC Chair if spaces for additional courses are needed.

NEW COURSE INFORMATION FORM

See Sample – Limit to Two Pages Please

FORM E

Course Identification:

Prefix:	Number	Title
WELD	**490**	**Welding Metallurgy**

Course Description:

This is a lecture and laboratory course designed to give the student exposure to the chemical composition, metallurgical aspects, applications, weldability and specific requirements for welding various metal alloys. The metallurgical response to heating and cooling during the welding cycle will be emphasized, along with proper welding techniques and requirements. Ferrous and nonferrous alloys will be addressed. Pre-Requisites: WELD 393.

Course Outline including Time Allocation:

CREDIT HOURS:	3 semester hours
CONTACT HOURS:	Lecture - 2 hours/week Laboratory – 3 hours/week
PREREQUISITES:	WELD 393 – Internship in Welding Engineering
TEXTBOOKS REQUIRED:	American Welding Society Welding Handbook, Volume 4, 8th Edition, Materials and Applications Part 2
COURSE OUTCOMES:	1. Students will apply proper welding procedures and techniques to join various ferrous and non-ferrous metals 2. Students will use experiential techniques to identify structures of various ferrous and non-ferrous metals 3. Students will produce and critique test samples that meet specified criteria incorporating the use of industrial methods 4. Students will plan and compare proper welding methods and techniques to control effects of material properties on various ferrous and non-ferrous metals

UNITS OF INSTRUCTIONS AND STUDENT LEARNING GOALS FOR EACH UNIT:

		Time Weight Lect.	Lab
I.	Introduction and Orientation	1	3
II.	The Structure of Metals	2	9
III.	The Iron-Carbon Phase Diagram	2	
IV.	Hardening Mechanisms	2	
V.	Structure of the Weld and Heat Affected Zone (HAZ)	1	3
VI.	The Weldability of Metals	3	12
VII.	Non-equilibrium Phase Change in Steel and Steel Alloys	4	
VIII.	Welding Carbon Steels	2	3
IX.	Welding Stainless Steels	3	6
X.	Welding Quenched and Tempered Steels (Q&T)	1	
XI.	Welding High Strength Low Alloy Steels (HSLA)	1	3
XII.	Welding High Alloy Steels	1	
XIII.	Welding Nickel and Nickel Alloys	1	
XIV.	Welding Chromium-Molybdenum Steels	1	
XV.	Welding Aluminum Alloys	3	6
XVI.	Tests	2	
	Total Hours	30	45

CREATE NEW COURSE

FORM F

Course Data Entry Form

Create New Course
Rev. 07/23/07

I. ACTION TO BE TAKEN: CREATE A NEW COURSE

Notes
1. Complete each item in Section I and Section II.
2. If this course is to be used as a prerequisite for other university courses, Form Fs that reflect the prerequisite change must be submitted for those courses as well.

Term Effective (6 digit code only): 200901 **Examples: 200801(Spring), 200805(Summer), 200808(Fall)**
Note: The first four digits indicate year, the next two digits indicate month in which term begins.

II. PROPOSED FOR NEW COURSE: Complete all sections a through r, See manual for clarification.

a. Course Prefix: WELD
b. Number: 490
c. Enter Contact Hours per week in boxes.
LECture 2 LAB 3 INDependent Study – Check (x) ☐
Practicum: ☐ Seminar: ☐

d. Course Title: **WELD 490 – Welding Metallurgy** (Limit to 30 characters/spaces.)

e. College Code: TEC **f.** Department Code: WELD
Credit Hours: Check (x) type and enter maximum and minimum hours in boxes.

g. Type: ☐ Variable ☒ Fixed **h.** Minimum Credit Hours 3 **i.** Maximum Credit Hours 3

j. May Be Repeated for Added Credit: Check (x) ☐ Yes ☒ No

k. Levels: Check (x) ☒ Undergraduate ☐ Graduate ☐ Professional

l. Grade Method: Check (x) ☒ Normal Grading ☐ Credit/No Credit only (Pass/Fail)

m. Does proposed new course replace an equivalent course? Check (x) ☒ Yes ☐ No

n. Equivalent course: Prefix WELD Number 490 See instructions on Replacement courses.

o. CATALOG DESCRIPTION – Limit to 75 words – PLEASE BE CONCISE.
This is a lecture and laboratory course designed to give the student exposure to the chemical composition, metallurgical aspects, applications, weldability and specific requirements for welding various metal alloys. The metallurgical response to heating and cooling during the welding cycle will be emphasized, along with proper welding techniques and requirements. Ferrous and nonferrous alloys will be addressed. Pre-Requisites: WELD 393.

p. Term(s) Offered: 200901 (See instructions for listing.) **q.** Max. Section Enrollment: 15

r. Prerequisites/Co-requisites/Restrictions: (If none, leave blank.) Limited to 100 spaces. WELD 393. Welding Engineering Technology majors only.

UCC Chair Signature/Date: _____ __/__/__

Academic Affairs Approval Signature/Date: Darrell Parker 9/15/08

To be completed by Academic Affairs Office: - Standard & Measures Coding and General Education Code
☐ Basic Skill (BS) ☐ General Education (GE) ☐ Occupational Education (OC) ☐ G.E. Codes

Office of the Registrar use ONLY

Date Rec'd: ____ **Date Completed:** ____ **Entered: SCACRSE** __ **SCADETL** __ **SCARRES** __ **SCAPREQ** __

Welding Engineering Technology Department Course Syllabus

Course: Weld 490 – Welding Metallurgy

INSTRUCTOR: Blaine Danley SEMESTER: Spring

COURSE DESCRIPTION: This is a lecture and laboratory course designed to give the student exposure to the chemical composition, metallurgical aspects, applications, weldability and specific requirements for welding various metal alloys. The metallurgical response to heating and cooling during the welding cycle will be emphasized, along with proper welding techniques and requirements. Ferrous and nonferrous alloys will be addressed. Pre-Requisites: WELD 393.

CREDIT HOURS:	3 semester hours
CONTACT HOURS:	Lecture 2 hours per week; Lab 3 hours per week
PREREQUISITES:	WELD 393 – Internship in Welding Engineering
REQUIRED COURSE FOR PROGRAM:	Yes
TEXTBOOKS REQUIRED:	AWS Welding Handbook, 8th ed., Vol 4. Materials and Applications–Part 2
COURSE OUTCOMES:	1. Students will apply proper welding procedures and techniques to join various ferrous and non-ferrous metals 2. Students will use experiential techniques to identify structures of various ferrous and non-ferrous metals 3. Students will produce and critique test samples that meet specified criteria incorporating the use of industrial methods 4. Students will plan and compare proper welding methods and techniques to control effects of material properties on various ferrous and non-ferrous metals

UNITS OF INSTRUCTIONS AND STUDENT LEARNING GOALS FOR EACH UNIT:

I. Introduction and Orientation
- A. Know instructor name, background, office location, office hours and telephone number.
- B. Understand goal of course and requirements.

II. The Structure of Metals
- A. Know structure - sensitive and structure - insensitive mechanical properties of metals.
- B. Understand stress and strain, modulus of elasticity, elastic limit and other mechanical properties.
- C. Understand solidification process.

III. The Iron-carbon Phase Diagram
- A. Know definition of a phase diagram
- B. Know phases of steel including; ferrite, pearlite, cementite, eutectoid composition, austenite and martensite.
- C. Understand effect of slow vs. rapid cooling of steel.
- D. Know effect of carbon content on composition.
- E. Know iron-carbon phase diagram.

IV. Hardening Mechanisms
- A. Know transformation hardening mechanism.
- B. Know solid solution hardening mechanism.
- C. Know precipitation-hardening mechanism.
- D. Know strain-hardening mechanism.
- E. Understand how welding heat input, cooling rate and chemical composition affect hardening mechanisms of metals.

V. Structure of the Weld and Heat Affected Zone (HAZ)
- A. Know fusion line, grain coarsened region, grain refined region, transformation region, recrystallization, and/or temper region for carbon and alloy steels.
- B. Understand factors that affect final HAZ structure.
- C. Know factors that determine the volume of metal brought to the molten temperature.

VI. The Weldability of Metals
- A. Know the AWS definition of weldability.
- B. Know the purpose of preheat and its effects on weldability.
- C. Understand the effects of welding heat input and cooling rate on weld metal and HAZ microstructure and properties.
- D. Know formula for calculating heat input.
- E. Understand hardenability and factors that affect hardenability.
- F. Know factors that affect weld and base metal cracking and methods to control it.
- G. Know purposes for and types of post weld heat treatment (PWHT).

VII. Non-equilibrium Phase Changes in Steel and Steel Alloys
- A. Know the potential microstructures resulting from non-equilibrium cooling of steel and steel alloys.
- B. Understand the nature and properties of martensite and bainite.
- C. Know the significance and origin of the isothermal transformation diagram or time - temperature - transformation (TTT) diagram.
- D. Know the significance and origin of the continuous cooling transformation diagram.
- E. Understand how various alloying elements affect the nature of the isothermal transformation diagram.

VIII. Welding Carbon Steels
- A. Know mechanical properties of low carbon steels and appropriate welding procedures.

B. Know mechanical properties of medium carbon steels and appropriate welding procedures.
C. Know mechanical properties of high carbon steels and appropriate welding procedures.

IX. Welding Stainless Steels
A. Know four (4) general classifications of stainless steels.
B. Understand carbide precipitation.
C. Know chemistry requirements, metallurgical aspects and procedures for welding austenitic stainless steels.
D. Know chemistry requirements, metallurgical aspects and procedures for welding ferritic stainless steels.
E. Know chemistry requirements, metallurgical aspects and procedures for welding martensitic stainless steels.
F. Know chemistry requirements, metallurgical aspects and procedures for welding precipitation hardening stainless steels.

X. Welding Quenched and Tempered Steels
A. Know mechanical properties and chemical composition of quenched and tempered steels.
B. Understand welding metallurgy and hardenability characteristics of Q & T steels.
C. Know applications for Q & T steels.
D. Know procedures for welding Q & T steels.

XI. Welding High Strength Low Alloy Steels (HSLA)
A. Know description, chemical composition and properties of HSLA steels.
B. Know applications for HSLA steels.
C. Know procedures for welding HSLA steels.

XII. Welding High Alloy Steels
A. Know general considerations of high alloy steels.
B. Know mechanical properties, metallurgical aspects and appropriate procedures for welding ultra high strength steels.
C. Know mechanical properties, metallurgical aspects and appropriate procedures for welding maraging steels.
D. Know mechanical properties, metallurgical aspects and appropriate procedures for welding austenitic manganesesteels.

XIII. Welding Nickel and Nickel Alloys
A. Know mechanical properties and metallurgical aspects of nickel and nickel alloys.
B. Know effects of minor elements on weldability.
C. Understand requirements for surface preparation for welding.
D. Know appropriate procedures for welding nickel and nickel alloys.

XIV. Welding Chromium - Molybdenum Steels
A. Know general description and applications.
B. Know chemical composition.
C. Know mechanical properties.
D. Understand welding metallurgy and weldability.
E. Know welding procedures.

XV. Welding Aluminum Alloys
A. Know general description and applications.
B. Know chemical composition.
C. Know mechanical properties.
D. Understand welding metallurgy and weldability.
E. Know welding procedures.

ATTENDANCE POLICY: Full attendance is expected but is at the discretion of the student.
EXAMINATIONS: 2
FINAL EXAM: 1
GRADING POLICY:
Final grade will be calculated as follows:
15% Quizzes/Homework
25% Lab Activities / Metallurgical analysis of Weld
40% Examinations (2 X 20% each)
20% Final Exam
GRADING SCALE:
100 - 93 = A
90 - 92 = A-
87 - 89 = B+
83 - 86 = B
80 - 82 = B-
77 - 79 = C+
73 - 76 = C
70 - 72 = C-
67 - 69 = D+
63 - 66 = D
60 - 62 = D-
0 - 59 = F