PROPOSAL SCC #99/00-435

CURRICULUM PROPOSAL FORM 1999-2000

NON-GENERAL EDUCATION PROCESS A

*DEADLINES: Deadline dates for 1999/2000 submissions: Regular proposals: October 22, 1999 to be implemented in Fall 2000; Short-Term proposals: December 10, 1999 to be implemented in Fall, 2000; Regular proposals February 18, 2000 to be implemented in Spring 2001; March 24, 2000 for short-term courses to be implemented in Spring 2001

PROPOSAL TITLE: Mechanics of Continuous Media (0910.551)

SPONSOR(S): Paris R. von Lockette

DEPARTMENT: Mechanical Engineering

COLLEGE: Engineering

IF LAS CHECK ONE:_____History/Humanities _____Math/Science ____Social/Behavioral Sciences

Check one: _____Undergraduate _____Graduate

THE ATTACHED ***NON-GEN-ED*** PROPOSAL IS BEST DESCRIBED BY THE ITEM(S) CHECKED.

___X__New non-gen-ed course
_____Short-term non-gen-ed course
_____Minor curricular changes (fewer than three) to:
_____existing non-gen-ed course
_____non-gen-ed degree requirements
_____major
_____minor, specialization, concentration, track certificate program

DEPARTMENT
(Signature indicates approval)

Ravi Prakash Ramachandran 2/24/00
Dept. Curriculum Chair/Date

T B Chandrupatla 2/24/2000
Dept. Chairperson/Date

ACADEMIC DEAN

Approved ✓ Not Approved____ Comments:

Dean's Signature/Date J M Tarkenton 2/24/00

COLLEGE CURRICULUM COMMITTEE

Date of open hearing (if necessary) 2/26/01 Approved ✓ Not Approved_____
Comments:

Signature of College Chair/Date: [signature] 2/22/01

UNIVERSITY CURRICULUM COMMITTEE

Date Received/Processed 4/27/01
Comments:

Curriculum Chair Signature: [signature] Date Announced At ~~Senate~~ 5-8-01

EXECUTIVE VICE PRESIDENT/PROVOST

Approved ✓ Not Approved_____ If no, reasons are as follows:

Student Credit Hours:_____ Faculty Load Hours:_____ Equalized Credit Hours_____

Official Copy & Approval Sheet Filed (Date): _____ Executive VP/Proved Signature/Date [signature] 12/11/01

REGISTRAR

Date Approved Course Description Required_____
Hegis Taxonomy & Course Number Assigned 0910-551

Registrar Signature/Date [signature] 12-17-01

NOTIFICATION FORWARD

12-18-01

✓ Senate Curriculum Committee Chairperson ✓ Academic Dean(s)

✓ Department Chairpersons ✓ Registrar Senate Pres ~~Sponsor(s)~~

Curr proposal form A 8 23 99
pink

Course Proposal

1. Details:

a) Course Title:	Mechanics of Continuous Media (0910.551)
b) Sponsor:	Dr. Paris R. von Lockette, Department of Mechanical Engineering, College of Engineering
c) Credit Hours:	3 credit hours
d) Course Level:	Graduate
e) Curricular Effect:	Elective course for chemical, civil, electrical, and mechanical engineering undergraduate students
f) Prerequisites:	
g) Suggested Time/ Scale of Implementation	One section during spring semesters
h) Resources:	Faculty: Existing faculty can teach this course Library: No library acquisitions will be required Equipment: No laboratory equipment will be required Computers: Computer laboratory access will be required and additional software may be acquired.

2. Rationale:

The proposed course is an additional engineering elective that would supplement the Engineering Curriculum Proposal approved by the College Senate in December 1994. The proposed course is consistent with the establishment of the School of Engineering approved by the Board of Trustees in February 1995.

The course provides the students with an introduction to the field of continuum mechanics. Continuum mechanics creates a common framework for the study of all materials that will enable the student to gain deeper understanding of the relationships between areas of past and possible future study including for example fluid dynamics and solid mechanics. Continuum mechanics draws on the student's knowledge of physics, mathematics and thermodynamics to deliver a unified approach to the formulation and solution of the most general mechanics problems and is therefore a fundamental extension of undergraduate coursework.

3. Essence of the Course:

The overarching goal of the course is to provide students with a top-down understanding of the continuum mechanics approach. At the top are the physical laws that must always hold true, i.e. conservation laws, material frame indifference, etc. Below the physical laws are the constitutive relations such as Hooke's law that determine the peculiarities of specific materials. And finally, the physical laws and the constitutive relationships are applied in the formulation and subsequent solution of boundary value problems. Since many boundary value problems do

not have closed form solutions, numerical solution techniques will be examined.

a) Objectives:

Upon completion of the course, the students will be able to

1. Perform tensor operations/transformations.
2. Determine principal stress/strain directions and values.
3. Derive equilibrium equations governing continuous bodies.
4. Formulate mechanics problems in terms of physical laws, constitutive laws, and boundary conditions.
5. Apply various analytical and numerical solution techniques to boundary value problems.
6. Work in either Cartesian or polar coordinate frames.

b) Topical Outline:

The topics to be covered are listed below. The instructor will supply the students with a syllabus during the first week of classes.

Introduction
- Tensor Operations
- Tensor Transformations
- Indicial Notation
- Calculus of Tensor Fields
- Eigenvector and Eigenvalue Operations
- Principal Stress Value and Direction Calculations
- Yield Criteria and Yield Surfaces

Linear Continuum Mechanics
- Kinematics:
  - Eulerian vs. Lagrangian Descriptions
  - In/Homogeneous Deformations
  - Strain Definitions
  - Compatibility Constraints
- Loading: Tractions and Body Forces
- Kinetics: Conservation of Mass, Momentum and Energy
- Governing Equations
- Constitutive Laws:
  - (Neo)Hookean Solids
  - Newtonian Fluids

Introduction to Boundary Value Problems
- Problem Formulation:
  - Derivation of Governing Equations

Determination of Boundary Conditions
Analytical Solution Techniques:
Methods of Differential Equations
Symbolic Mathematics Software
Derivation of Classical Solutions
Numerical Solution Techniques:
Finite Difference
Finite Elements
Conjugate Gradient Methods

Advanced Topics
Curvilinear Coordinates Systems
Nonlinear (Finite) Elasticity
Material Frame Indifference and Objectivity

c) Evaluation and Grading Procedure of Students:

Student grades will be determined on the basis of examinations, homework and/or projects, and reports. A course syllabus with stated method of arriving at the final grade, e.g., number of exams, projects, homeworks, percentage of grade, will be distributed to the students during the first week of classes.

d) Course Evaluation:

The proposed course will be evaluated on the basis of student evaluations and curriculum review by appropriate faculty.

4. Results of Consultations:

The proposed course is an additional elective that would supplement the Engineering Curriculum Proposal approved by the Faculty Senate in December 1994. Consultations were submitted with original proposal as specified by the Curriculum Committee

Catalog Description:

Mechanics of Continuous Media (0910.551)
Prerequisites:

Students will engage the three-tiered framework used to interrogate problems involving bodies of continuous media. This begins with derivation of the governing equations from the conservation of mass, momentum, and energy followed by the application of constitutive models, such as Hooke's law, that govern the behavior of particular materials, and concludes with the solution of boundary value problems. In addition to the study of classical problems and their solutions, students will be required to program numerical algorithms for the solution of problems that can not be solved in closed form. Kinetic and kinematic constraints, such as material frame indifference, compatibility, and objectivity, will be addressed. The material covered will include both cylindrical and Cartesian coordinate frames.