Department of Materials Science and Engineering
CER E 421 Ceramic Engineering
Ceramic Processing (4 credits)

Catalog Description:
Technology of ceramic fabrication processes. Material characterization at processing stages for control. Laboratory study of all operations in the manufacture of selected ceramics products.

Prerequisites:
Senior level standing in Ceramic Engineering

Textbooks and other required materials:

Textbook:
Principles of Ceramic Processing, 2nd Edition, by James S. Reed, New York: Wiley & Sons, 1995.

Reading books:
Physical Ceramics: Principles for Ceramic Science and Engineering
Yet-Ming Chiang, Dunbar P. Birnie, III, W. David Kingery
New York: J. Wiley, 1966

Introduction to Ceramics
W. D. Kingery, H. K. Bowen, D. R. Uhlmann
New York: J. Wiley, 1976

Ceramics and Glasses
Engineered Materials Handbook, Vol. 4
ASM International, 1991

Course objectives:

1. Gaining of fundamental knowledge in ceramic processing science.
2. Learning technologies involved with ceramic processing.
3. Hands-on experience gained by laboratory experiments.
4. Working on a team and improving technical writing skills by reporting the experimental results.

Topics Covered:

- Overview on ceramics industry and research; traditional and advanced ceramics
- Ceramic powder synthesis and characterization
- Processing additives and colloidal science of ceramic processing
- Particle mechanics and rheology of slurries and pastes
- Beneficiation processes; milling, mixing, particle separation, washing, drying
- Forming processes I; pressing, extrusion, injection molding

- Forming processes II; slip casting, sol-gel processing, drying and novel forming techniques
- Sintering Processes I; diffusion, sintering mechanisms
- Sintering Processes II; methods used for densification, microstructural control
- Processing, microstructure and property relationship of selected ceramics, overview on high temperature superconductors, smart materials, non-oxide ceramics and other recent developments

Laboratory Projects:

- Introduction to laboratory safety. Powder preparation by precipitation and combustion synthesis techniques
- Stability and viscosity of colloidal suspensions. Electrostatic and steric stabilization of alumina suspensions and viscosity measurements
- Plaster mold making and slip casting of alumina slurries
- Shape forming techniques by pressing (uniaxial and isostatic), role of organic additives, addition of binders and plasticizers; tape casting using aqueous and nonaqueous slurries. Sol-gel processing of thin films and monoliths.
- Sintering of green ceramics; use of equipment including furnaces, sample cutting, polishing, optical and scanning electron microscope, relationships between processing and microstructural development

Class Schedule:
Three, one hour sessions weekly

Contribution of course to meet the professional component:
This course introduces to science and technology of ceramic processing to the students and includes hands-on laboratory projects to gain practical and professional experience.

Contribution of course to program objectives:
This course provides the students fundamental understanding of ceramic processing which are applied in laboratory sessions towards a successful fabrication of ceramic components. The students gain experience in functioning on a team, in oral and written communication as well as in solving of ceramic engineering problems in a laboratory and manufacturing environment.

Prepared by: Fatih Dogan, Research Associate Professor, October 24, 2000