MONTANA TECH

Metallurgical & Materials Engineering Department

EMET 595 – SPECIAL TOPICS: ADVANCED PYROPROCESSING

SYLLABUS

INSTRUCTOR

Dr. Jerry Downey
ELC 215; 406-496-4578
Office Hours: As posted (TBD)

COURSE DESCRIPTION

The course features detailed analyses of selected pyrometallurgical and thermal processes from the process engineering perspective. Emphasis is placed on the utilization of engineering principles in process development, design, and operation applications. The course is conducted with an "open forum" format to provide the flexibility to be responsive to current student interests such as topics that will benefit their research, economically strong industrial sectors, and pioneering/emerging technologies. Where applicable, the course will cover the application and integration of applicable environmental control technologies and efficient energy utilization practices.

CREDITS AND CLASS MEETINGS

Three (3) lecture credit hours. In the Spring 2019 semester, the class is scheduled to meet from 8:00 to 9:00 am on MWF in ELC 225.

DESIGNATION

EMET 595 – Special Topics: Advanced pyro-processing is offered as a graduate course or an undergraduate elective course.

PREREQUISITES

Graduate standing or consent of instructor.

TEXTBOOK AND REFERENCES

No textbook. Selected reading from supplemental literature will be assigned in class and/or posted on Moodle.

TOPICS

Multiple topics are covered in detail each semester. Topic selection is largely based on student preferences and career aspirations. Lecture topics may be drawn from the following list:

1. Property measurements in high temperature systems (e.g. TGA/DTA/DSC, density, viscosity, surface tension, diffusion coefficient, emissivity)
2. High temperature oxidation of metals
3. Physical chemistry of ionic melts (slags, glasses, and molten salts)
4. Secondary steelmaking
5. Direct reduction of iron (DRI)
6. Flash smelting and converting technologies
7. Silicon manufacturing and refining
8. Electronics recycling
9. Base metals (Cu, Ni, Co) recycling
10. Molten salt electrolysis

11. Energy audits of commercial processes (e.g. the Bayer and the Hall-Heroult Processes)
12. Biomass pyrolysis and gasification
13. Plasma process technologies
14. Vapor phase transport
15. Thermodynamic software (e.g., HSC Chemistry and ThermoCalc)
16. Environmental control technologies for pyro applications

OBJECTIVES AND OUTCOME – the course is designed to expand student knowledge and capabilities relative to the theory, design, and applications of thermal processes common to the practice of process engineering in general and Metallurgical and Materials Engineering in particular. Course graduates will have demonstrated their proficiency in:

1. Calculating mass and heat balances for industrial applications
2. Applying engineering principles to solve complex thermal processing problems
3. Selecting and sizing process equipment for specific pyro-processing applications
4. Developing and integrating the key elements of a process design criteria package (flowsheet, mass balance, energy balance, equipment list, capital cost, operating cost).

The course provides students the opportunity to perform detailed examinations of a selected few current and/or emerging thermal processes. The application of physical chemistry (thermodynamics, kinetics) and chemical engineering (heat and mass transfer, fluid flow, plant design, energy) principles to process technology are emphasized. The course objectives and outcome are responsive to the following ABET Criteria:

(1) Identify, formulate and solve complex engineering problems by applying principles of engineering, science, and mathematics.

(2) Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

(10) Apply and integrate knowledge from the four elements of the field using experimental, computational, and statistical methods to solve materials problems including selection and design consistent with the program educational objectives.

EVALUATION AND GRADING CRITERIA

Grades will be determined according a curve based on the cumulative point totals for all students who complete the course. The cumulative point totals will include scores from assignments and the culminating assignment. Individual grades will be decided according to natural breaks in the curve.

Attendance: This class is graduate-level, so students are expected to master the subject matter and are solely responsible for obtaining class notes, handouts, and other materials from missed lectures. Students with three consecutive unexcused absences or an overall attendance rate of less than 70% after the tenth lecture of the semester will be dropped from the class.

Students are responsible for notifying the instructor prior to planned absences. In the event of a genuine emergency, the student is urged to notify the instructor at the earliest reasonable time to make arrangements to submit missed assignments.

Examinations: no formal examinations are scheduled. Instead, students are to complete a series of practical, process-oriented assignments that pertain to the major lecture topics. Students are expected to submit graduate-level work. Each assignment will be graded on a 100-point basis.

In lieu of a comprehensive final examination, each student must complete a culminating assignment that incorporates several of the major themes covered throughout the semester. The final assignment is due at the date and time scheduled for the final exam by the Registrar's Office. The culminating assignment will be graded on a 200-point basis (total) according to technical content and depth, professionalism, delivery, and responsiveness.

It is the student's responsibility to complete the assignments at the scheduled dates and times. As a general rule, late assignment papers are not accepted following unexcused absences. Exceptions are decided on a case-by-case basis for unavoidable absences resulting from sudden illness or other extreme emergencies.

Academic Integrity: Students enrolled in the Metallurgical and Materials Engineering courses are expected to maintain an integrity standard that is consistent with the applicable fundamental canons of the NSPE Code of Ethics for Engineers. Specifically, students are expected to conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

Academic dishonesty or cheating will not be tolerated. Students are expected to adhere to the Montana Tech Academic Honesty policy (see the addendum and/or Montana Tech student handbook). If it is determined that a student has deliberately cheated on a quiz, examination, or assignment, the student will be dropped from the course with an "F" grade. In compliance with Montana Tech policy, cases of academic dishonesty will be reported to the Office of the Vice Chancellor for Academic Affairs.

With one exception, the Department policy is that electronic devices are not to be activated or evident during lectures or examinations. This restriction includes but is not limited to programmable calculators, cell phones, Ipods, or entertainment devices. The exception is that students are permitted to use a nonprogrammable calculator during some lectures, quizzes, and exams; however, calculators of any type will not necessarily be permitted for all quizzes and exams. Students that possess unapproved calculators or other electronic devices during a quiz or exam are subject to dismissal from the classroom. Unless used as part of an approved disability accommodation (see below), it is not permissible to record (video or audio) class lectures. Penalties for disregarding the electronic device policy will be imposed at the instructor's discretion.

Disability Accommodations: students in need of academic accommodation because of disabilities must:

1. Register with and provide documentation to the Montana Tech Student Disability Coordinator
2. Provide the instructor with a letter that states the need and type of accommodation. The letter should be provided during the first week of class.

In case that a student believes that he/she needs to record or tape classroom activities due to a disability, the student must request the appropriate accommodation by following the above-outlined steps. In the event that such and accommodation is arranged, the taped or recorded material is for the student's use only and must not be further copied, distributed, published or otherwise used for any purpose without the express written consent of the instructor.

PROFESSIONAL COMPONENT

Engineering Topics:	100%
Design Component:	Yes
Computer Usage:	Yes
Ethics:	Yes
Statistics:	No
Safety:	No

PREPARED BY

J. P. Downey November 9, 2018