INTEROFFICE MEMORANDUM

TO: UNDERGRADUATE CURRICULUM COMMITTEE
FROM: PEI-FENG HSU
SUBJECT: PROPOSED NEW UNDERGRADUATE ELECTIVE COURSES
DATE: DECEMBER 15, 2008
CC: ED KALAJIAN

It is proposed to create four new elective courses in the Mechanical and Aerospace Engineering Department in the area of nuclear engineering:

MAE 4250/5250 Nuclear Reactor Physics
MAE 4260/5260 Nuclear Reactor Engineering
MAE 4270/5270 Nuclear Criticality and Reactor Safety
MAE 4280/5280 Radiological Engineering

Note that these courses are bi-level and that the Graduate Council is also reviewing them.
This course is available for student registration only after the approval process has been completed.

**SUBJECT** MAE

**COURSE NO.** 4250

**CREDIT HOURS** 3

**TERM TO BE ADDED TO THE FILE** Fall 2009 (e.g., Fall 2006)

**CLASS HOURS** 3

**LECTURE HOURS** 3

**LAB HOURS**

**CONTACT HOURS (CEU ONLY)**

**DEPARTMENT** Mechanical & Aerospace Engineering

**SCHEDULE TYPE** Lecture

**COLLEGE OF AERONAUTICS-23**

**COLLEGE OF PSYCHOLOGY AND LIBERAL ARTS-25**

**COLLEGE OF BUSINESS-24**

**COLLEGE OF SCIENCE-26**

**COLLEGE OF ENGINEERING-01**

**UNIVERSITY COLLEGE EXTENDED STUDIES-27**

**COMPUTER TITLE** Restricted to 25 characters, including spaces

NUCLEAR REACTOR PHYSICS

**THE PHYSICAL PRINCIPLES OF NUCLEAR REACTORS**

**CATALOG TITLE** NUCLEAR REACTOR PHYSICS

**THE PHYSICAL PRINCIPLES OF NUCLEAR REACTORS**

**CATALOG DESCRIPTION OF COURSE** Limited to 350 characters, including spaces

This course presents the fundamental physical principles of nuclear reactors. It covers the equivalence of matter and energy, nuclear reactions and radiation, neutron diffusion and slowing-down theory, criticality condition, reactor core, composition, configurations and long-term behavior, reactor kinetics and control.

In addition, you may attach a course syllabus and/or more detailed description.

**REQUIREMENTS**

☑ Prerequisite

Phy 2002

Course Number

☐ Corequisite

Course Number

☐ Prerequisite

Course Number

☐ Corequisite

Course Number

☐ Prerequisite

Course Number

☐ Corequisite

Course Number

**ADDITIONAL RESTRICTION** Dual-numbered with graduate-level course (e.g., Major, Class Level, Department Head Approval)

**GRADES TO BE ISSUED**

☑ A, B, C, D, F

☐ A, B, C, D, F, CEU

☐ CEU

☐ S, U

☐ P, F

☐ Other

**APPROVALS:** Upon completion of appropriate department approvals, submit form to Chair, Graduate Council, or Chair, Undergraduate Curriculum Committee for approval below and forward to Catalog Director.

**N/A**

**Chair**

**Date**

**OR**

**Dean or Associate Dean**

**Date**

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(150 West University Boulevard, Melbourne, FL 32901-6975 • (321) 674-8114 • Fax (321) 674-7827)

RG-271-9001
MAE 4250 NUCLEAR REACTOR PHYSICS (3 credits)

Catalog Description: This course presents the fundamental physical principles of nuclear reactors. It covers the equivalence of matter and energy, nuclear reactions and radiation, neutron diffusion and slowing-down theory, criticality condition, reactor core, composition, configurations and long-term behavior, reactor kinetics and control.


Educational Objectives: To teach the student the basic theory of nuclear fission reactors laying a foundation for nuclear reactor and radiological engineering

Topics to be covered:
1. Nuclear reactor fundamentals
2. Binding energy curve
3. Nuclear stability
4. Radioactivity
5. Nuclear fission
6. Fission byproducts
7. Nuclear cross section
8. Cross sections energy dependence
9. Fissionable materials
10. Neutron scattering
11. Neutron moderating materials
12. Nuclear fission reactor
13. Reactor types
14. Neutron balance equations
15. Delayed neutron kinetics
16. Reactor period
17. Spatial diffusion of neutrons
18. Neutron distributions in reactors
19. Energy transport
20. Reactivity feedback
21. Long-term core behavior

Grading Policy:
Homework - 20%
Midterm Exam - 40%
Final Exam - 40%
This course is available for student registration only after the approval process has been completed.

**Subject:** MAE  
**Course No.:** 4260  
**Credit Hours:** 3  
**Term to be added to the file:** Fall 2009  
(e.g., Fall 2006)

**Class Hours:** 3  
**Lecture Hours:** 3  
**Lab Hours:**  
**Contact Hours (CEU only):**

**Department:** Mechanical & Aerospace Engineering  
(e.g., Computer Sciences)
(Select)  

- COLLEGE OF AERONAUTICS-23
- COLLEGE OF BUSINESS-24
- COLLEGE OF SCIENCE-26
- COLLEGE OF ENGINEERING-01
- UNIVERSITY COLLEGE EXTENDED STUDIES-27

**Computer Title:** Restricted to 25 characters, including spaces  
NUCLEAR REACTOR

**Catalog Title:** NUCLEAR REACTOR ENGINEERING

**Catalog description of course:** Limited to 350 characters, including spaces

This course covers the fundamental principles of nuclear reactor design and operation as they pertain to various reactor systems.

In addition, you may attach a course syllabus and/or more detailed description.

**Restrictions:**

- Prerequisite: MAE 4250
- Corequisite
- Course Number

**Grades to be issued:**

- A, B, C, D, F
- A, B, C, D, F, CEU
- CEU
- S, U
- P, F
- Other

**Additional restriction:**

Dual-numbered with graduate-level course  
(e.g., Major, Class Level, Department Head Approval)

If this course replaces a course currently offered in BANNER, please indicate old course information.

**Subject:** Alpha Prefix (e.g., CSE)  
**Course No.** (e.g., 1301)

**Approvals:** Upon completion of appropriate department approvals, submit form to Chair, Graduate Council, or Chair, Undergraduate Curriculum Committee for approval below and forward to Catalog Director.

**Originator**  
Date  
1/21/08

**Chair, Graduate Council**  
Date  
N/A

**Department Head or Program Chair**  
Date  
1/21/08

**Dean or Associate Dean**  
Date  
12-10-08

**Catalog Director**  
Date

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150 West University Boulevard, Melbourne, FL 32901-6975 • (321) 674-8114 • Fax (321) 674-7827
MAE 4260 NUCLEAR REACTOR ENGINEERING (3 credits)

Prerequisites: MAE 4250

Catalog Description: This course covers the fundamental principles of nuclear reactor design and operation as they pertain to various reactor systems.


Reference: Nuclear Energy Conversion by M.M. El-Wakil, American Nuclear Society
Thermal Analysis of Pressurized Water Reactors by L.S. Tong and J. Weisman, American Nuclear Society
The Thermal-Hydraulics of a Boiling Water Reactor by RT. Lahey and F.J. Moody, American Nuclear Society

Educational Objectives: To educate the student in the basic design and operation of reactor systems and their unique characteristics

Topics to be covered:
1. Preliminary reactor design
2. Reactor structures
3. Reactor fuels and moderator materials
4. Reflector materials
5. Core composition
6. Control rods
7. Mechanical and structural components
8. Energy removal
9. Thermal problems in reactor design
10. Reactor cooling systems
11. Reactor core temperature distribution
12. Reactor core hydraulics
13. Radiation effects on materials
14. Shielding and reactor systems
15. Sources of reactor fuels
16. Fuel burn-up
17. Fuel management
18. Spent fuel storage
19. Reprocessing of irradiated fuel
20. Light water reactors
21. Gas cool reactors
22. Breeder reactors

If possible, a field trip to an operating nuclear power plant will be planned
Grading Policy:
Homework - 20%
Midterm Exam - 40%
Final Exam - 40%
**Florida Institute of Technology**

**ADDING A NEW COURSE TO THE CURRICULUM**

This course is available for student registration only after the approval process has been completed.

<table>
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<th>SUBJECT</th>
<th>MAE</th>
<th>COURSE NO.</th>
<th>4270</th>
<th>CREDIT HOURS</th>
<th>3</th>
<th>TERM TO BE ADDED TO THE FILE</th>
<th>Fall 2009</th>
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| CLASS HOURS | 3 | LECTURE HOURS | 3 | LAB HOURS | CONTACT HOURS (CEU ONLY) |

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<thead>
<tr>
<th>DEPARTMENT</th>
<th>Mechanical &amp; Aerospace Engineering</th>
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<tr>
<td>SCHEDULE TYPE</td>
<td>Lecture</td>
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☑ COLLEGE OF AERONAUTICS–23  ☐ COLLEGE OF PSYCHOLOGY AND LIBERAL ARTS–25
☐ COLLEGE OF BUSINESS–24  ☐ COLLEGE OF SCIENCE–26
☑ COLLEGE OF ENGINEERING–01  ☐ UNIVERSITY COLLEGE EXTENDED STUDIES–27

COMPUTER TITLE Restricted to 25 characters, including spaces  NUCLEAR REACTOR SAFETY

CATALOG TITLE  NUCLEAR CRITICALITY AND REACTOR SAFETY

CATALOG DESCRIPTION OF COURSE Limited to 350 characters, including spaces

This course deals with nuclear criticality concerns in the processing, transport, and storage of nuclear materials. It also deals with reactor safety systems in reactor operation, fuel storage, transportation and processing.

In addition, you may attach a course syllabus and/or more detailed description.

REQUIREMENTS

- ☑ Prerequisite MAE 4250
- ☐ Corequisite

- ☐ Prerequisite
- ☐ Corequisite

- ☐ Prerequisite
- ☐ Corequisite

- ☑ Prerequisite
- ☐ Corequisite

ADDITIONAL RESTRICTION  Dual-numbered with graduate-level course

If this course replaces a course currently offered in BANNER, please indicate old course information

| SUBJECT | Alpha Prefix (e.g., CSE) | COURSE NO. | 1301 |

APPROVALS: Upon completion of appropriate department approvals, submit form to Chair, Graduate Council, or Chair, Undergraduate Curriculum Committee for approval below and forward to Catalog Director.

<table>
<thead>
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<tr>
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<td>Date</td>
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<tr>
<td>Chair, Undergraduate Curriculum Committee</td>
<td>Date</td>
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CATALOG DIRECTOR

These changes/additions have been made for the University/Extended Studies Catalog and entered into the BANNER term named above.

Catalog Director | Date

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RG-271-506
MAE 4270 NUCLEAR CRITICALITY AND REACTOR SAFETY (3 credits)

Prerequisites: MAE 4250

Catalog Description: This course deals with nuclear criticality concerns in the processing, transport, and storage of nuclear materials. It also deals with reactor safety systems in reactor operation, fuel storage, transportation and processing.


Reference: Computational Methods of Neutron Transport by E.E. Lewis and W.F. Miller, John Wiley & Sons, 1984

Educational Objectives: To educate the student in the principles of nuclear criticality safety in the nuclear fuel cycle and in the nuclear safety systems in reactor operations, fuel storage, transportation and processing

Topics to be covered:
1. Principles of safety
2. Criticality accidents
3. Risk assessment
4. Sub-critical limits
5. Criticality safety standards
6. Double contingency
7. Calculations: buckling shape, conversion, surface density, solid angle method
8. Standards, regulations, related impacts, and practices
9. Nuclear fuel facility applications
10. Criticality safety in enrichment
11. Criticality safety in fuel fabrication
12. Criticality safety in spent fuel storage
13. Criticality safety in spent fuel shipment
14. Criticality safety in reprocessing
15. Reactor safety
16. Philosophy of safety
17. Emergency core cooling and containment
18. Probabilistic risk assessment in nuclear power plant operation

Grading Policy:
Homework - 20%
Midterm Exam - 40%
Final Exam - 40%
This course is available for student registration only after the approval process has been completed.

SUBJECT  MAE  COURSE NO. 4280  CREDIT HOURS 3  TERM TO BE ADDED TO THE FILE Fall 2009

CLASS HOURS 3  LECTURE HOURS 3  LAB HOURS  CONTACT HOURS (CEU ONLY)

DEPARTMENT  Mechanical & Aerospace Engineering  SCHEDULE TYPE  Lecture

☐ COLLEGE OF AERONAUTICS--23  ☐ COLLEGE OF PSYCHOLOGY AND LIBERAL ARTS--25
☐ COLLEGE OF BUSINESS--24  ☐ COLLEGE OF SCIENCE--26
☒ COLLEGE OF ENGINEERING--01  ☐ UNIVERSITY COLLEGE EXTENDED STUDIES--27

COMPUTER TITLE  Restricted to 25 characters, including spaces  RADIOLOGICAL ENGINEERING

CATALOG TITLE  RADIOLOGICAL ENGINEERING

CATALOG DESCRIPTION OF COURSE  Limited to 350 characters, including spaces

This course covers biological effects of radiation, natural and manmade radiation, radiation detection and measurement, radioactive waste, x-rays and radiography, and radiation protection.

In addition, you may attach a course syllabus and/or more detailed description.

RESTRICTIONS  ☒ Prerequisite  MAE4250  ☐ Corequisite  Course Number

☐ Prerequisite  Course Number  ☐ Corequisite  Course Number

☐ Prerequisite  Course Number  ☐ Corequisite  Course Number

☐ Prerequisite  Course Number  ☐ Corequisite  Course Number

ADDITIONAL RESTRICTION  Dual-numbered with graduate-level course

(e.g., Major, Class Level, Department Head Approval)

GRADES TO BE ISSUED  ☒ A, B, C, D, F
☐ A, B, C, D, F, CEU
☐ CEU
☐ S, U
☐ P, F
☐ Other

If this course replaces a course currently offered in BANNER, please indicate old course information

SUBJECT  Alpha Prefix (e.g., CSE)  COURSE NO. (e.g., 1301)

APPROVALS: Upon completion of appropriate department approvals, submit form to Chair, Graduate Council, or Chair, Undergraduate Curriculum Committee for approval below and forward to Catalog Director.

Originator  Date  Chair, Graduate Council  Date

Department Head, Program Chair  Date

Dean or Associate Dean  Date  Chair, Undergraduate Curriculum Committee  Date

CATALOG DIRECTOR  REGISTRAR’S USE ONLY

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BANNER term named above.

Catalog Director  Date

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SCARRIES  Operator Ini.  Date

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RG-271-5000
MAE 4280 RADIOLOGICAL ENGINEERING (3 credits)

Prerequisites: MAE 4250

Catalog Description: This course covers biological effects of radiation, natural and manmade radiation, radiation detection and measurement, radioactive waste, x-rays and radiography, and radiation protection.


Radiological Assessment: Sources and Exposures by R.E. Faw and J.K. Shultis, PTR-Prentice Hall, 1993

Educational Objectives: To educate the student in the fundamentals of the biological effects of radiation, internal and external dosimetry, radiation protection and radiation shielding

Topics to be covered:
1. Structure of matter
2. Isotopes
3. Radioactivity and radiation
4. Interaction of radiation with matter
5. Radiation units
6. Radiation fields and sources
7. Radiation from terrestrial sources
8. Radioactivity in the body
9. Manmade sources of radiation
10. Radiation hazards from nuclear reactors
11. Radiation dose limitations
12. External radiation hazards
13. Neutron sources
14. Internal radiation hazards
15. Radiotoxicity
16. Radiation shielding
17. Radioactive waste
18. Solid, liquid and gaseous radioactive waste
19. Radiological emergencies
20. Pre-planning for emergencies
21. Radiation detection and measurement
Grading Policy:
Homework - 20%
Midterm Exam - 40%
Final Exam - 40%