New Course Request **Indiana University** Indianapolis Campus

Check Appropriate Boxes: Undergraduate credit ☑ Graduate credit ☐ Professional credit ☐

1. School/Division School of Engineering and Technology 2. Academic Subject Code MET
3. Course Number 38800 (must be cleared with University Enrollment Services) 4. Instructor David Goodman
5. Course Title Thermodynamics and Heat Power

   Recommended Abbreviation (Optional) _____
   (Limited to 32 Characters including spaces)
6. First time this course is to be offered (Semester/Year): Fall/2009
7. Credit Hours: Fixed at 4 or Variable from _____ to _____
8. Is this course to be graded S-F (only)? Yes ____ No ☑
9. Is variable title approval being requested? Yes ☐ No ☑
10. Course description (not to exceed 50 words) for Bulletin publication:

    Course provides the engineering technology student with an introduction to the principles of thermodynamics and heat transfer. Basic thermodynamic processes are used to evaluate the performance of energy-based systems such as internal combustion engines, power plants, and refrigeration equipment.
11. Lecture Contact Hours: Fixed at 3 or Variable from _____ to _____
12. Non-Lecture Contact Hours: Fixed at 2 or Variable from _____ to _____
13. Estimated enrollment: 24 of which 0 percent are expected to be graduate students.
14. Frequency of scheduling: yearly Will this course be required for majors? yes
15. Justification for new course: Combining current MET 230 and MET 330 to one course
16. Are the necessary reading materials currently available in the appropriate library? Yes
17. Please append a complete outline of the proposed course, and indicate instructor (if known), textbooks, and other materials.
18. If this course overlaps with existing courses, please explain with which courses it overlaps and whether this overlap is necessary, desirable, or unimportant.
19. A copy of every new course proposal must be submitted to departments, schools, or divisions in which there may be overlap of the new course with existing courses or areas of strong concern, with instructions that they send comments directly to the originating Curriculum Committee. Please append a list of departments, schools, or divisions thus consulted.

Submitted by:

_____ Date 9-29-09
Department Chairman/Division Director

_____ Date _____
Dean of Graduate School (when required)

Approved by:

_____ Date 9-28-09
Dean

_____ Date _____
Chancellor/Vice-President

_____ Date _____
University Enrollment Services

After School/Division approval, forward the last copy (without attachments) to University Enrollment Services for initial processing, and the remaining four copies and attachments to the Campus Chancellor or Vice-President.

UPS 724

University Enrollment Services Final—White; Chancellor/Vice-President—Blue; School/Division—Yellow; Department/Division—Pink; University Enrollment Services Advance—White

MET 38800 – Thermodynamics & Heat Power

Required Course: **Yes**

Catalog Description: Credit (4): Class (3) Lab (1)
Course provides the engineering technology student with an introduction to the principles of thermodynamics and heat transfer. Basic thermodynamic processes are used to evaluate the performance of energy-based systems such as internal combustion engines, power plants, and refrigeration equipment.

Prerequisite: PHYS 218 and MATH 221

Co-requisite: None

Textbook: Thermodynamics and Heat Power
Granet & Bluestein, 7th edition ©2009, Prentice-Hall.

Coordinator: Workman, J., Associate Professor of Mechanical Engineering Technology

Goals:

1. To give the students a functional understanding of the thermal processes used in automobiles, power plants, and HVAC systems.
2. To give students a basic understanding of the equipment used in real world thermal systems.
3. To give the students firsthand experience in preparing for and performing waste heat, energy audit, and thermal studies.
4. To give students respect and understanding of the power and danger associated with thermal process equipment and have them recognize the need for safety at all times.
5. To provide a basic understanding of how to calculate or determine state variables from tables or complex Mollier or Pyschrometric charts for thermal systems.
6. To provide a basic understanding of how state properties affect the efficiency of thermal processes.

Course Outcomes: *After completion of this course, the students should be able to:*

Lecture Outcomes

1. Identify and describe basic concepts, terminology, and industrial applications of thermodynamics and heat transfer. Provide accurate measurements using basic metrology equipment. [a]
2. Determine basic properties of gases, steam, and refrigerants using equations, tables, charts, and graphs. [f]
3. Apply the First Law of Thermodynamics and conservation of mass to analyze fixed mass (closed) and steady flow control volume (open) systems and devices. [f]

4. Understand the fundamental concepts of the Second Law of Thermodynamics and their application to conversions between heat and work and to thermal efficiency. [a]
5. Analyze thermodynamic systems involving multiple processes in ideal cycles such as Otto, Diesel, Rankine, and refrigeration cycles. [b]
6. Understand basic steady and transient heat transfer principles and use them to analyze simple systems. [a]
7. Apply basic conduction, convection, and radiation heat transfer concepts and equations to solve applied heat transfer problems. [k]
8. Evaluate heat exchanger performance and specify heat exchanger requirements. [c]
9. Identify basic components of complex thermal systems and the relevant thermodynamics and heat transfer principles needed to analyze such systems. [a]
10. Identify and operate laboratory equipment typically used in measurement and analysis of thermal systems. [b]
11. Use application software for analyzing, documenting, and presenting the results of technical work. [a]
12. Understand professional, ethical, and social issues and responsibilities within the context of thermal systems applications. [a]
13. Understand the need for safety in the workplace. [a]
14. Identify potential limitations of a given thermal cycle. [b]
15. Recognize the complexity of Otto, Diesel, Rankine, and etc. cycles in the world today. [a]
16. Work as a team to investigate topics, write reports, and make presentations on a specified manufacturing topic. [e, g]
17. Calculate enthalpy, entropy, etc. required to fully define a state variable in the thermal processes covered in course. [f]
18. Recognize the impact that changing state variables will have on the efficiency of a thermal process. [b]
19. Provide basic cost estimation for energy savings in energy audit studies in various thermal processes. [b]
20. Work as a team to investigate topics, write reports, and make presentations on a specified material removal topic. [e,g]

Laboratory Outcomes

1. Utilize thermodynamic process equipment, similar to small industrial settings. [a]
2. Identify the importance and need for safety and awareness in thermal processes. [a]
3. Recognize the advantages and limitations of various thermal cycles through hands-on experimentation. [c]
4. Develop a better understanding of the concepts presented in lecture through hands-on experimentation. [c]
5. Provide accurate measurements using basic metrology equipment. [a]
6. Utilize basic metrology equipment to collect and analyze data on measurements. [k]

7. Identify the importance of and need for safety at all times while in the presence of thermal equipment. [a]
8. Present data in a concise, readable, and professional format. [g]
9. Work with equipment in a team environment for the completion of laboratory projects. [e]

Note: The letters within the brackets indicate the program outcomes of MET program.

Topics:	**#Lectures:**
1. Introduction	1
2. Temp, Force, Mass, Pressure	2
3. Energy Closed Sys.	1
4. Energy Open Sys. and Ethalpy	1
5. 1st Law of Thermodynamics	2
6. 2nd Law of Thermodynamics	1
7. Entropy	2
8. Properties of Pure Substances	1
9. Ideal Gases	3
10. Mixed Gases	2
11. Psychrometrics	1
12. Rankin Cycle	3
13. Energy Audit	3
14. Otto Cycle (Engines)	2
15. Carnot Cycle (Refrigeration)	2
16. Heat Exchange (Energy Recovery)	2

Laboratory Experiments:

1. Introduction, Units
2. Solar Thermal Energy
3. Solar Photovoltaic Energy
4. Phase Change
5. Bernolli
6. Power Plant
7. Energy Audit
8. Engine Measurements
9. Air Conditioning
10. Heat Pipes/Heat Exchanger

Computer Usage: Word processors, spreadsheets, and property table software. Laboratory reports are to be submitted in word-processor form including spreadsheets and graphs for data representation.

Evaluation Methods: Homework, Lab Projects, Lab Reports, Exams, Quizzes

Prepared by: David Goodman

Revised: April 15, 2009

School of Engineering and Technology
Course Outcomes and Assessment Data Sheet

Course #: MET 38800 Course Title: Thermodynamics & Heat Power

PRINCIPLES OF UNDERGRADUATE LEARNING *Require All Students to Demonstrate An Ability to:*	TECHNOLOGY OUTCOMES - TAC CRITERIA #2; items (a) to (k)										
	a	b	c	d	e	f	g	h	i	j	k
1(a) - Express ideas and facts effectively in written formats							✓				
1(b) - Comprehend, interpret, and analyze texts			✓			✓					
1(c) - Communicate orally in one-on-one and group settings					✓						
1(d) - Solve problems that are quantitative in nature	✓					✓					
1(e) - Make efficient use of information resources and technology for personal and professional needs	✓										✓
2(a) - Analyze complex issues and make informed decisions						✓					
2(b) - Synthesize information in order to arrive at reasoned conclusions		✓				✓					
2(c) - Evaluate the logic, validity, and relevance of data			✓			✓					
2(d) - Solve challenging problems		✓				✓					
2(e) - Use knowledge and understanding to generate and explore new questions											
3(a) - Apply knowledge to enhance personal lives											
3(b) - Apply knowledge to meet professional standards and competencies											
3(c) - Apply knowledge to further the goals of society											
4(a) - Display substantial knowledge and understanding of at least one field of study	✓					✓					
4(b) - Compare and contrast approaches to knowledge in different disciplines											
4(c) - Modify their approach to an issue or problem based on contexts and requirements of particular situations											
5(a) - Compare and contrast the range of diversity and universality in human history, societies, and ways of life											
5(b) - Analyze and understand the interconnectedness of global and local concerns											
5(c) - Operate with civility in a complex social world											
6(a) - Make informed and principled choices regarding conflicting situations in their personal and public lives and to foresee the consequences these choices											
6(b) - Recognize the importance of aesthetics in their personal lives and to society											

Course Outcomes and Assessment Data Sheet – Procedure

This is an internal document to identify and record expected outcomes and anticipated assessment strategies for all courses taught within the School of Engineering and Technology. Submission of this form, as noted below, is required and must accompany all new course and course change requests. Copies of this form should also be retained within the department and kept on file with the outline or syllabus for each course.

1. First, identify all instructional outcomes expected for this course, and then select all ABET outcomes which are consistent with those anticipated objectives from the table below:

TAC/ABET Outcomes Criteria 2

An engineering technology program must demonstrate that graduates have:	
a	an appropriate mastery of the knowledge, techniques, skills and modern tools of their disciplines,
b	an ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology,
c	an ability to conduct, analyze and interpret experiments and apply experimental results to improve processes,
d	an ability to apply creativity in the design of systems, components or processes appropriate to program objectives,
e	an ability to function effectively on teams,
f	an ability to identify, analyze and solve technical problems,
g	an ability to communicate effectively,
h	a recognition of the need for, and an ability to engage in lifelong learning,
i	an ability to understand professional, ethical and social responsibilities,
j	a respect for diversity and a knowledge of contemporary professional, societal and global issues, and
k	a commitment to quality, timeliness, and continuous improvement.

2. Subsets for each of the six IUPUI Principles of Undergraduate Learning (PUL) are given on the reverse side table. Using a number corresponding to each ABET outcome identified from the table above to select a column, place an "X" in the applicable cell(s) for each PUL. Courses will often address multiple ABET outcomes and ABET outcomes frequently will overlap more than one PUL subset. Thus, it is expected completed data sheets may contain marks in several cells thereby indicating the course simultaneously satisfies multiple Principles of Undergraduate Learning which fulfilling its intended ABET objectives(s).

3. After completing the table, briefly define or explain how the course outcomes or objectives will be evaluated within the context of the departmental assessment program in the space below:

Assessment methods will include:

- Evaluation of specific examination questions which are mapped to the course outcomes.
- Evaluation of laboratory report analysis problems which are mapped to the course outcomes.

Prepared by: David Goodman Date: April 15, 2009

Office of the Registrar
FORM 40 REV. 7/08

PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION, OR REVISION OF AN UNDERGRADUATE COURSE (10000-40000 LEVEL)

DEPARTMENT: Engineering Technology | EFFECTIVE SESSION: Fall 2009

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

- [x] 1. New course with supporting documents
- [ ] 2. Add existing course offered at another campus
- [ ] 3. Expiration of a course
- [ ] 4. Change in course number
- [ ] 5. Change in course title
- [ ] 6. Change in course credit/type
- [ ] 7. Change in course attributes (department head signature only)
- [ ] 8. Change in instructional hours
- [ ] 9. Change in course description
- [ ] 10. Change in course requisites
- [ ] 11. Change in semesters offered (department head signature only)
- [ ] 12. Transfer from one department to another

PROPOSED:		EXISTING:	
Subject Abbreviation	MET	Subject Abbreviation	
Course Number	38800	Course Number	
Long Title	Thermodynamics & Heat Power		
Short Title			

Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY)

TERMS OFFERED (Check All That Apply)
- [ ] Summer
- [x] Fall
- [x] Spring

CAMPUS(ES) INVOLVED
- [ ] Calumet
- [ ] Cont Ed
- [ ] Ft. Wayne
- [x] Indianapolis
- [ ] N. Central
- [ ] Tech Statewide
- [ ] W. Lafayette

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 4
2. Variable Credit Range:
   Minimum Cr. Hrs
   (Check One) To [ ] Or [ ]
   Maximum Cr. Hrs
3. Equivalent Credit: Yes [ ] No [x]

COURSE ATTRIBUTES: Check All That Apply
1. Pass/Not Pass Only [ ]
2. Satisfactory/Unsatisfactory Only [ ]
3. Repeatable [ ]
   Maximum Repeatable Credit: [ ]
4. Credit by Examination [ ]
5. Special Fees [ ]
6. Registration Approval Type — Department [x] Instructor [ ]
7. Variable Title [ ]
8. Honors [ ]
9. Full Time Privilege [ ]
10. Off Campus Experience [ ]

Schedule Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	75	2	15	75%
Recitation				
Presentation				
Laboratory	100	1	15	25%
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):

C: MET 38800 Thermodynamics & Heat Power (4cr.) P: PHYS 218 and MATH 221. Course provides the engineering technology student with an introduction to the principles of thermodynamics and heat transfer. Basic thermodynamic processes are used to evaluate the performance of energy-based systems such as internal combustion engines, power plants, and refrigeration equipment.

	Date		Date
Calumet Department Head		Calumet School Dean	
Fort Wayne Department Head		Fort Wayne School Dean	
Indianapolis Department Head	9-29-09	Indianapolis School Dean	9.29.09
North Central Department Head		North Central Chancellor	
West Lafayette Department Head		West Lafayette College/School Dean	

West Lafayette Registrar ____ Date

OFFICE OF THE REGISTRAR