Siemens Gas Turbine Professional Course

西门子冠名课程“先进燃气轮机技术”

课程简介

本课程是一门介绍**燃气轮机理论基础与应用技术的高级课程**，由上海交通大学开设，邀请**美国宾州州立大学**知名学者讲授，并由西门子冠名赞助。本课程面向上海交通大学机械与动力工程学院研究生以及燃气轮机相关企业员工。本课程中，四位教授将分别从**燃气轮机总体性能、传热、燃烧以及制造（3D打印）**等四个重要领域出发，结合自身深厚的理论知识与从事相关研究的丰富经历，深入讲授燃气轮机一系列关键技术的发展现状与未来趋势。本课程强调基础理论与应用技术的紧密结合，关注国际化视野的拓展，旨在促进燃气轮机领域中外合作交流。

授课语言： 英文
开课时间： 2018年春季学期（11-13、15周）
课程学时： 48学时，3学分（针对本校学生）

Teaching Arrangements of Gas Turbine Professional Course

Notes	1)48 class hours(3 credits) in total. 1 class hour =45 min.						
	2)12 class hours per week (4 times *3 class hour/time/week).						
Academic Calender		Mon.	Tue.	Wed.	Thu.	Fri.	Instructor
Week 11 (Module 1)	Date	May.7	May.8	May.9	May.10	May.11	Rob Kunz
	Time	9:00-11:40					Email: rfk102@engr.psu.edu
	Venue	TBD					
Week 12 (Module 2)	Date	May.14	May.15	May.16	May.17	May.18	Karen Thole
	Time	9:00-11:40					Email: kat18@psu.edu
	Venue	TBD					
Week 13 (Module 3)	Date	May.21	May.22	May.23	May.24	May.25	Yuan Xuan
	Time	9:00-11:40					Email: yux19@psu.edu
	Venue	TBD					
Week 15 (Module 4)	Date	Jun.4	Jun.5	Jun.6	Jun.7	Jun.8	Rich Martukanitz
	Time	9:00-11:40					Email: rxm44@arl.psu.edu
	Venue	TBD					

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Prof. Karen Thole

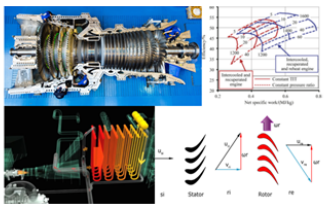
B. S. 1982 Mechanical Engineering, University of Illinois, Urbana-Champaign
M. S. 1984 Mechanical Engineering, University of Illinois, Urbana-Champaign
Ph.D. 1992 Mechanical Engineering, University of Texas, Austin
August 2006 – present, Professor and Department Head, Mechanical and Nuclear Engineering Department, Penn State

Research Projects(directed funded research projects in excess of $18M):
Experimental and Numerical Studies in Gas Turbine Heat Transfer – Funding support from the Department of Energy, ARPA-E, National Science Foundation, Siemens Energy, Mitsubishi Heavy Industries, IHI (Japan), United Technologies Research Center, and United Technologies-Pratt & Whitney's Center of Excellence
Development of a Rotating Rig for Internal Secondary Flow Studies – Financial support from the Department of Energy and United Technologies-Pratt & Whitney's Center of Excellence

Professional Service:
National Research Council's Low Carbon Aviation Committee, Co-Chair, 2015-present
ASME Energy Conversion and Storage Segment, Leader, 2014-2015
NASA Advisory Council, Aeronautics Committee, 2013-present
ASME Committee on Honors, Member from 2009-10; Chair for 2010-14
Board of Directors for the International Gas Turbine Institute, Vice Chair, 2012-13; Chair 2013-14

Prof. Robert F. Kunz

B. S. , SUNY at Buffalo, Aerospace Engineering, 1983
M. S. , University of Illinois, Aeronautical and Astronautical Engineering, 1985
Ph.D. , Pennsylvania State University , Aerospace Engineering, 1991
1985-1988: Pratt and Whitney, Applied Technology Group, Engineer.
1991-1992: General Motors Technical Center, Private Consultant.
1992-1997: Knolls Atomic Power Laboratory, Senior Engineer.
1997-present: Professor and Head of Computational Mechanics Division, Mechanical and Nuclear Engineering, The Pennsylvania State University



RESEARCH EXPERIENCE:

- *CFD algorithm/code development*
- *Turbomachinery*
- *Multi-phase flow*
- *Biomedical engineering and biological system simulation*
- *Turbulence modeling and turbulence dispersion*
- *Heat exchanger thermal-hydraulics and thermal systems management*

Prof. Rich Martukanitz

The head of Laser Processing Division of Applied Research Laboratory and director of the Center for Innovative Materials Processing through Direct Digital Deposition (CIMP-3D)He obtained his Ph.D. in the area of Materials Science and Engineering from Pennsylvania State University. His research interests mainly focus on deposition of light alloys.

Dr. Yuan Xuan

B.S. in Mathematics & Physics, Lycée La Martinière Monplaisir, 2007
B.S. & M.S. in Mechanical Engineering, Ecole polytechnique, 2010
Ph.D., Aerospace Science and Technology, California Institute of Technology, 2014
2014-present: Assistant Professor, Advanced Combustion Center, Mechanical and Nuclear Engineering, The Pennsylvania State University

Research Interest:
Computational fluid dynamics, Turbulent combustion, Soot formation, Numerical methods, Uncertainty quantification.

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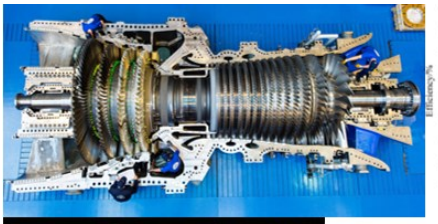
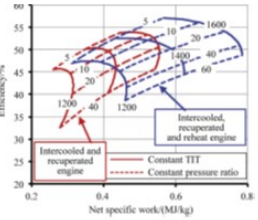
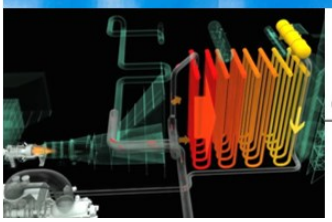
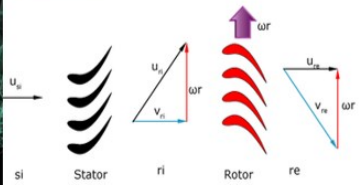
Module 1: Fundamentals of Gas Turbine Operation and Performance

Course Syllabus:
Hour 1-2: Review of necessary fundamentals – dimensional analysis, compressible flow, thermodynamics
Hour 3-5: Land based and aircraft gas turbine configuration and performance
Hour 6: Inlet and exhaust components
Hour 7: Velocity triangles, Euler's turbomachinery equation
Hour 8-9: Compressors
Hour 10-11: Turbines
Hour 12: Special topics: Combined cycle, Recuperation, CFD modeling

Instructor:
Dr. Robert F. Kunz
Professor of Mechanical and Nuclear Engineering
The Pennsylvania State University
rfk102@engr.psu.edu

Class Format:
The 12 lecture hours will include presentation slides and worked examples. All presentation slides will be made available on-line to the class in advance of the course. Students are encouraged to print these slides in advance or to have them available for personal editing (tablet) so that they can take notes directly on them during the class. Worked examples will be posted online after the class lectures.

Grading:
Each student will be assigned a grade for Module 1 based on the assignment described below.

Textbook (not required): Mechanics and Thermodynamics of Propulsion by Philip Hill and Carl Peterson, Addison-Wesley, Second Edition, 1992.

Assignment:
A problem set will be distributed on the first day of lecture, Wednesday May 3. This assignment will be due Friday May12 and will be submitted on-line. The problem set will be graded by the instructor and the TA. The class TA will be available for help with the assignment while at SJTU and through e-mail afterwards.

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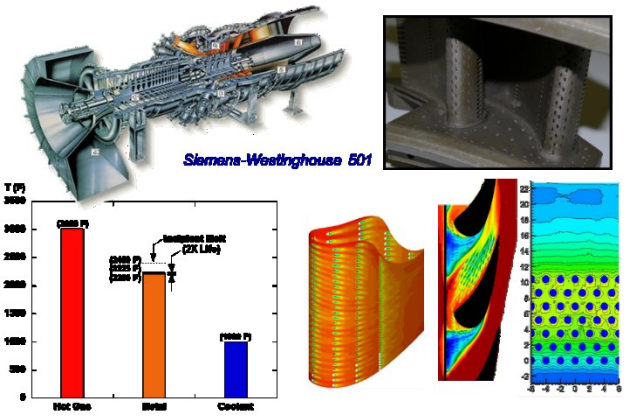
Module 2: Fundamentals of Gas Turbine Heat Transfer



Course Syllabus:
Hour 1-3: Review of necessary fundamentals – convective heat transfer principles
Trade-offs of internal/external cooling
Overall and adiabatic effectiveness principles
Hour 4-7: Internal cooling methodologies
Effects of rotation
Hour 8-11: External cooling methodologies
Effects of curvature and freestream turbulence
Hour 12: Special topics
Additive manufacturing

Instructor:
Dr. Karen Thole
Professor of Mechanical Engineering
Mechanical and Nuclear Engineering Depatment
The Pennsylvania State University
kthole@psu.edu

Class Format:
The 12 lecture hours will include presentation slides and worked examples. All presentation slides will be made available on-line to the class in advance of the course. Students are encouraged to print these slides in advance or to have them available for personal editing (tablet) so that they can take notes directly on them during the class. Worked examples will be posted online after the class lectures.

Grading:
Each student will be assigned a grade for Module 1 based on the assignment described below.

Textbook (not required): Gas Turbine Heat Transfer and Cooling Technology, J.C. Han, S. Dutta, and S. Ekkad

Assignment:
A problem set will be distributed on the first day of lecture. This assignment will be due on the last day of class and will be submitted on-line. The problem set will be graded by the instructor and the TA. The class TA will be available for help with the assignment while at SJTU and through e-mail afterwards.

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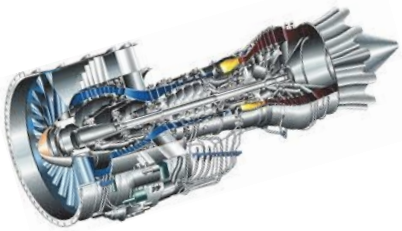
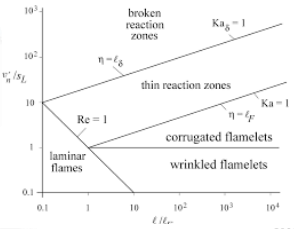
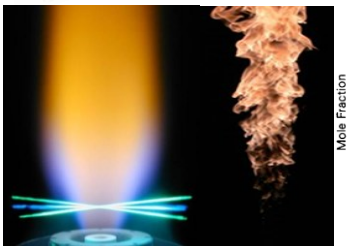
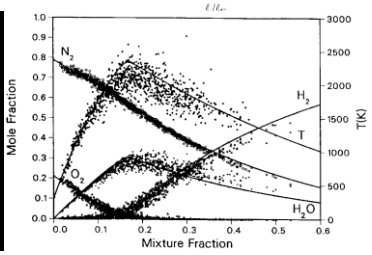
Module 3: Fundamentals of Gas Turbine Combustion









Course Syllabus:
Hour 1-4: Review of necessary fundamentals
- Statistical description of turbulent flows
- Navier-Stokes equations and turbulence models
- Governing equations and chemical kinetics
- Modes of turbulent combustion

Hour 5-8: Laminar and turbulent non-premixed flames
- Fundamentals physics; experiments and modeling

Hour 9-12: Laminar and turbulent premixed flames
- Fundamental physics; experiments and modeling

Instructor:
Dr. Yuan Xuan
Assistant Professor of Mechanical Engineering
Mechanical and Nuclear Engineering Depatment
The Pennsylvania State University
yux19@psu.edu

Class Format:
The 12 lecture hours will include presentation slides and worked examples. All presentation slides will be made available on-line to the class in advance of the course. Students are encouraged to print these slides in advance or to have them available for personal editing (tablet) so that they can take notes directly on them during the class. Worked examples will be posted online after the class lectures.

Grading:
Each student will be assigned a grade for Module 4 based on the assignment described below.

Textbook (not required): Turbulent Combustion, N. Peters, Combridge University Press, 2000.

Assignment:
A problem set will be distributed on the first day of lecture. This assignment will be due on the last day of class and will be submitted on-line. The problem set will be graded by the instructor and the TA. The class TA will be available for help with the assignment while at SJTU and through e-mail afterwards.

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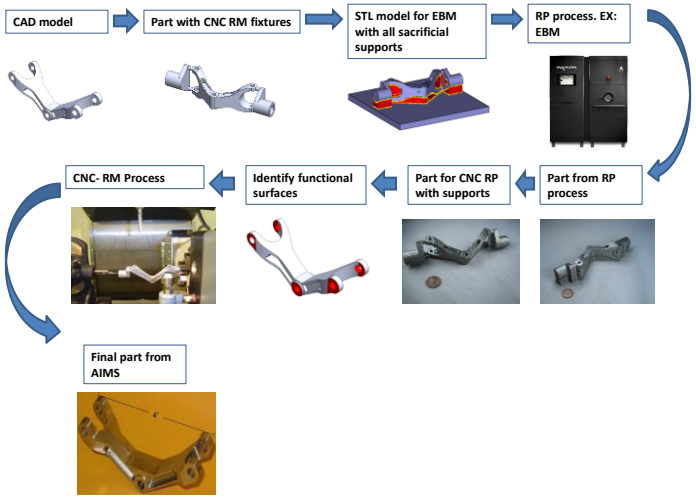
Module 4: Role of Advanced Manufacturing in Gas Turbines



Course Syllabus:

Hour 1-3: Fundamentals of advanced manufacturing
- Selection of Materials based on Engineering Specifications
- Classification of Manufacturing Processes
- Processing Principles, Advantages and Disadvantages

Hour 4-7: Advanced Topic#1
- Effects of Materials Processing on Thermo-Mechanical Performance

Hour 8-10: Advanced Topic#2
- Process Flow in Manufacturing of Gas Turbines: Design principles → Material Selection → Quality Control (GD&T, mechanical and material testing) → Non-Destructive Testing

Hour 11: Advanced Topic#3
- Additive and Hybrid manufacturing

Hour 12: Interactive Case-Study Presentations:
- Presentation by student teams on "Selection of Manufacturing Methods for Gas Turbine Components"

Instructor:

Dr. Guha Manogharan
Assistant Professor of Mechanical Engineering
Mechanical and Nuclear Engineering Depatment
The Pennsylvania State University
gum53@psu.edu

Class Format:

The 12 lecture hours will include presentation slides and examples of manufactured parts. All presentation slides will be made available on-line to the class in advance of the course. Students are encouraged to print these slides in advance or to have them available for personal editing (tablet) so that they can take notes directly on them during the class. Template for case-study report and presentation will be provided before the beginning of the course.

Grading:

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Each student will be assigned a grade for Module 3 based on the case-study described below.

Textbook (not required): Fundamentals of Modern Manufacturing, M. Groover, 5th edition, Wiley, ISBN-13: 978-1118393673

Case-Study:
Each student-team will pick one sub-component of the gas turbine to recommed material selection, relevant manufacturing methods and quality control methodology. The formats for case-study: (1) report and (2) presentation will be provided before the beginning of the course. The TA will provide help in preparing the presentation at SJTU for the student teams and the presentation will be held at the end of the course. A vase-study report will be submitted by the student-teams online within the specified date after the end of the course. The class TA will be available for help with the case-study while at SJTU and through e-mail afterwards.