MAE 517: Advanced Precision Manufacturing for Products, Systems and Processes

In Workflow

1. 14MAE GR Director of Curriculum (paul_ro@ncsu.edu)
2. COE CC Coordinator GR (rfillin@ncsu.edu)
3. COE CC Chair GR (john_classen@ncsu.edu)
4. COE Final Review GR (rfillin@ncsu.edu)
5. COE Dean GR (reeves@csc.ncsu.edu)
6. jftu (jftu@ncsu.edu)
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8. ABGS Coordinator (mlnosbis@ncsu.edu)
9. ABGS Meeting (mlnosbis@ncsu.edu)
10. ABGS Chair (mlnosbis@ncsu.edu)
11. Grad Final Review (mlnosbis@ncsu.edu)
12. PeopleSoft (none)

Approval Path

1. Mon, 23 Jan 2017 14:39:50 GMT
   Paul Ro (paul_ro): Approved for 14MAE GR Director of Curriculum
2. Mon, 23 Jan 2017 16:23:07 GMT
   Robyn Fillinger (rfillin): Approved for COE CC Coordinator GR
3. Mon, 23 Jan 2017 21:50:19 GMT
   John Classen (john_classen): Approved for COE CC Chair GR
4. Fri, 27 Jan 2017 14:14:56 GMT
   Robyn Fillinger (rfillin): Approved for COE Final Review GR
5. Sat, 28 Jan 2017 20:10:01 GMT
   Douglas Reeves (reeves): Approved for COE Dean GR
6. Mon, 13 Mar 2017 14:05:48 GMT
   Juei Tu (jftu): Approved for jftu
7. Wed, 15 Mar 2017 16:53:17 GMT
   Juei Tu (jftu): Approved for jftu
8. Wed, 05 Apr 2017 14:57:28 GMT
   Melissa Nosbisch (mlnosbis): Approved for ABGS Coordinator
9. Tue, 18 Apr 2017 14:53:49 GMT
   Melissa Nosbisch (mlnosbis): Approved for ABGS Meeting

New Course Proposal

Date Submitted: Mon, 23 Jan 2017 13:21:26 GMT

Viewing: MAE 517 : Advanced Precision Manufacturing for Products, Systems and Processes

Changes proposed by: jftu

Change Type

Major

Course Prefix

MAE (Mechanical & Aerospace Engr)

Course Number

517

Dual-Level Course

No

Cross-listed Course

No

Title

Advanced Precision Manufacturing for Products, Systems and Processes

Abbreviated Title

Precision Manufacturing System

College

College of Engineering

Academic Org Code

Mechanical & Aerospace Engr (14MAE)

CIP Discipline Specialty Number

14.1901

CIP Discipline Specialty Title

Mechanical Engineering.

Term Offering

Fall Only

Year Offering

Offered Every Year

Effective Date

Fall 2017

Previously taught as Special Topics?

Yes

Number of Offerings within the past 5 years

4

Course Prefix/Number	Semester/Term Offered	Enrollment
MAE 589-004, 589-601	Fall, 2013	40
MAE 589-004, 589-602	Fall, 2014	33
MAE 589-653, as pre-recorded lectures for EOL	Summer I, 2015	19
MAE 589-603, as pre-recorded lectures for EOL	Fall, 2016	17

Course Delivery

Face-to-Face (On Campus)
Distance Education (DELTA)
Hybrid (Online/Face to Face)
Online (Internet)

Grading Method

Graded/Audit

Credit Hours

3

Course Length

16

weeks

Contact Hours (Per Week)

Component Type	Contact Hours
Lecture	3

Course Is Repeatable for Credit

No

Instructor Name

Juei-Feng Tu

Instructor Title

Professor

Grad Faculty Status

Full

Anticipated On-Campus Enrollment

Open when course_delivery = campus OR course_delivery = blended OR course_delivery = flip

Enrollment Component	Per Semester	Per Section	Multiple Sections?	Comments
Lecture	30	30	No	Single section with 30 on campus students each semester

DELTA/Online Enrollment:

Open when course_delivery = distance OR course_delivery = online OR course_delivery = remote

Delivery Format	Per Semester	Per Section	Multiple Sections?	Comments
LEC	30	30	No	Single section with 30 EOL students each semester

Course Prerequisites, Corequisites, and Restrictive Statement

Undergraduate courses in manufacturing (MAE496) or engineering design (MAE415) , equivalent, or consent of instructor

Is the course required or an elective for a Curriculum?

No

Catalog Description

This is a graduate level course designed for graduate students and undergraduate seniors. This course examines precision issues for products, manufacturing machines, processes, and instruments. Modern manufacturing technologies are distinct in their multifarious nature in product sizes, materials, energy forms, theories, and information types; however, the key to their success relies on the management of precision. This course discusses issues critical to both existing precision manufacturing and future sub-micron/nano technology. Important topics include fundamental mechanical accuracies; manufacturing systems and processes; geometric dimensioning and tolerancing; process planning, tolerance charts, and

statistical process control; principles of accuracy, repeatability, and resolution; error assessment and calibration; error budget; reversal principles; joint design and stiffness consideration; precision sensing and control; precision laser material processing.

Justification for new course:

Currently, there is a related graduate level course, MAE 545 Metrology for Precision Manufacturing, taught by Prof. Tom Dow, within Department of Mechanical and Aerospace Engineering, which emphasizes metrology and instrumentation. This proposed course was designed in coordination with Prof. Dow to keep the overlaps between these two courses minimal when it was first offered in 2013. In fact, the overlapping parts are covered in the first two lectures, which are limited to fundamental mechanical accuracy. Because Precision Manufacturing is a diverse area, students benefit from this new course to cover different aspects of precision manufacturing, related to tolerancing, gauging, and statistical process control; principles of accuracy, repeatability, and resolution; error assessment and calibration; joint design and stiffness consideration; precision sensing and control; precision laser material processing at Department of Mechanical and Aerospace Engineering and School of Engineering at NCSU. This course is also suitable as an elective for aspiring seniors who are interested in careers in manufacturing industry. The advance of manufacturing critically depends on the management of precision and the University will be able to help advancing manufacturing technologies by offering broader coverage of precision manufacturing to students.

Does this course have a fee?

No

Consultation

Instructional Resources Statement

NCSU has recommended minimum specifications for computers used for classes. Depending on your computer needs, we recommend your computer meet or exceed the following minimum specifications below.
PCs must have an Intel-compatible 800 MHz processor, 256MB RAM, 8GB hard drive with 1GB free space available, 256 Color Display, CD-ROM drive, 800x600 (min.) video adapter, sound card, and speakers. The operating system should be Windows 2000 or XP. RealOne Player Basic (available free online) and high speed Internet connection such as cable, DSL, T1 or LAN will be required for EOL courses.
Mac users must have a G3 processor with firewire and USB factory built-in, 256MB RAM, 10GB with 1GB free space available, 256 Color Display, CD-ROM drive, 800x600 (min) video adapter, sound card, and speakers. The operating system must be Mac OS X "Panther" 10.3 (minimum) along with the above RealOne and Internet specifications above.
For more detailed information on computer specifications and recommendations, please refer to our website at: http://engineeringonline.ncsu.edu/currentstudents/computeraccess.htm

Course Objectives/Goals

The goals of this course are to provide students in-depth knowledge related to precision manufacturing by focusing on the precision aspects of products, machines, processes, and process management. This focus on precision also provides a coherent treatment to unify products, machines, processes, and process management as one close-knit field. As a result, students, after completing this course, will have a systematic view of modern manufacturing and the skills to address the precision related problems for advancing productivity and quality.

Student Learning Outcomes

By the end of the course, the students will be able to:

-
- Apply basic principles related to fundamental mechanical accuracy.
-
- Interpret critical errors in precision of products, machines, and processes
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- Interpret geometric dimensioning and tolerancing in mechanical drawings
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- Identify key components which constitute a precision machine tool
-
- Conduct error budget analysis with correct mathematical treatments
-
- Analyze data to maintain product quality
-
- Calibrate machines with correct precision principles
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- Identify technologies critical to next-generation precision designs based on literature reviews and actual test data.
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- Apply laser material processing for manufacturing
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- Read and comprehend journal papers related to precision manufacturing
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- Relate the course materials to daily experience of living, in particular those related to precision performance, such as vehicle alignment, wood work, etc.
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Student Evaluation Methods

Evaluation Method	Weighting/Points for Each	Details
Quizzes	5	5 to 10 quizzes throughout the semester
Test	25	Mid-term
Final Exam	30	Final exam
Readings assignments	5	Journal papers related to precision manufacturing
Written Assignment	15	8 homework assignments
Major Paper	20	Final report on a special topic which requires students to conduct precision analysis and design.

Topical Outline/Course Schedule

Topic	Time Devoted to Each Topic	Activity
Course Syllabus and Policies; Introduction:	3 hours	Needs for Precision; Fundamentals of Mechanical Accuracy
Manufacturing Processes and Machines	3 hours	Overview of manufacturing processes, such turning, milling, and grinding, as well machine tools such as lathe, milling machine, etc. Orthogonal cutting model, theory and practical considerations.
Process Planning and Statistical Process Control	6 hours	Focus on the designs of a sequence of machining processes to reach the final dimension and statistical control charts to each machining process.
Geometric Dimensioning and Tolerancing	9 hours	Detailed discussion on ANSI GD&T Standards, size and geometric tolerance specifications, and CAD/CAM consideration for part precision requirements
Feature Measurement and Inspection	3 hours	Functional gage design, including go/no-go gages, instruments for roundness, flatness, concentricity, etc.
Assessment of Precision Machine Tool Errors	6 hours	Homogeneous Transformation Matrix, error budget reversal principles, calibration principles, axes of rotations, mapping geometric and thermal errors in machine tools.
Force Flow Analysis and Structure Design	3 hours	Joint and Fixture Design, Kinematic Coupling Design
Machine Tool Spindle and Tool Holder Design	6 hours	Major design consideration of high speed spindles and tool holders. Vibration and spindle stiffness are discussed.
Precision laser material processing	6 hours	Discuss lasing principle, energy coupling, plasma, melting, evaporation, and precision optics for laser material processing.
Modern gadget manufacturing	3 hours	Discuss the precision requirement and miniaturization of modern gadget manufacturing.

Syllabus

Course syllabus MAE 517 Precision Manufacturing Systems Fall 2017.docx

Additional Documentation

Graduate Course Syllabus Checklist.pdf
Learning Outcomes Guidelines.pdf

Additional Comments

I did upload the syllabus the first when I submitted this form. For some reasons, it was not attached. I am doing it again.

mlnosbis 2/15/2017: See justification for explanation of overlapping courses.
1) The information on the syllabus must match what is listed on the CIM Form. See prerequisites and student evaluation methods for an example where they do not match.
2) Syllabus needs attention. See these items from the Graduate Syllabus Checklist (additional attachment)
-1- office hours
-3- learning outcomes should be measurable, do not use "understand." See attachment.
-4- cost of textbooks
-6- course structure
-10- grade determination; include the grading scale so students can see what constitutes the different letter grades
-11- late assignments
-12- attendance policy
-13- disabilities statement
-14- NC States PRR statement

pjharrie 3/2/17: In addition to the concerns outlined above, the objectives read more like a continuation of the justification rather than statements about what the learning objectives for the course are.

ABGS Reviewer Comments:
- I do not see that the students will be using machines, therefore, no state of risk is needed, I have no edits for this course.

Course Reviewer Comments

ro (Fri, 20 Jan 2017 18:33:29 GMT): Jay, can you submit your course syllabus as well?
ro (Fri, 20 Jan 2017 18:50:39 GMT): Rollback: Please attach syllabus for the course and re-submit.
jftu (Wed, 15 Mar 2017 16:52:38 GMT): I have addressed every comment listed in the section of additional comments.

Key: 13473