

Preliminary Examination
January 2004

**TO: MECHANICAL ENGINEERING GRADUATE STUDENTS
TAKING THE PRELIMINARY EXAMINATION IN
January 2004**

**FROM: Professor Benson Tongue
Chairman, Preliminary Examination Committee**

Attached is a copy of the information sheets pertaining to the Doctoral Preliminary Examination. Please read carefully for answers to questions you may have concerning the examination.

The schedule for the next examination is given below:

Area	Date	Time	Place
Dynamics	Monday, January 12, 2004	10:00 - 12:00 pm	3107 Etcheverry
Controls	Monday, January 12, 2004	1:30 - 3:30 pm	3107 Etcheverry
Materials	Tuesday, January 13, 2004	10:00 - 12:00 pm	3107 Etcheverry
Design	Tuesday, January 13, 2004	1:30 - 3:30 pm	3107 Etcheverry
Solid Mechanics	Wednesday, January 14, 2004	10:00 - 12:00 pm	3107 Etcheverry
Heat Transfer	Wednesday, January 14, 2004	1:30 - 3:30 pm	3107 Etcheverry
Thermodynamics	Thursday, January 15, 2004	10:00 - 12:00 pm	3107 Etcheverry
Fluid Mechanics	Thursday, January 15, 2004	1:30 - 3:30 pm	3107 Etcheverry
Manufacturing	Friday, January 16, 2004	10:00 - 12:00 pm	3107 Etcheverry

Sign-up sheets for the Preliminary Examination must be completed and turned into the Student Services Office, 6189 Etcheverry Hall by **THURSDAY, December 4, 2003**. Failure to do so will make you ineligible to sit for the Preliminary Examination. Pat Giddings will assign you an identification number which you will use to identify your examination paper. **REMEMBER IT!** Students are responsible for obtaining information regarding the date, time and location of the exams.

All petitions should be submitted to the Graduate Student Affairs Officer. Petitions for exceptions deadline is **FRIDAY, November 14, 2003**.

MOST COMMONLY ASKED QUESTIONS ABOUT THE PRELIMINARY EXAMINATION:

1. *Why must I take the Preliminary Examination?*

You must take and pass the Preliminary Examination to be considered eligible for the Ph.D. program.

2. *Can I take courses S/U prior to passing the Preliminary Examination?*

Yes. However, all courses in the major field must be taken for a letter grade, (except ME 299 research units) and at most, one third of the total units may be taken S/U prior to passing the Preliminary Examination.

3. *What would it mean if I miss my deadline to sign up and take the Preliminary Examination?*

Missing the deadline to take the Preliminary Examination means that you will no longer be eligible for the PhD program.

4. *When is the earliest I may take the Preliminary Examination?*

If you are coming into the ME program with either a Bachelor of Science Degree or a Master of Science, the earliest you may take the Preliminary Examination will be after one registered semester of graduate course work completed at the University of California at Berkeley.

5. *When is the latest I **must** take the Preliminary Examination to be eligible for the Ph.D. program?*

M.S. students: **Must** take the Preliminary Examination upon completion of one registered semester of completed course work within the Mechanical Engineering Department.

B.S. students: **Must** take the Preliminary Examination upon completion of two registered semesters within the Mechanical Engineering Department.

6. *Is there a minimum GPA requirement to take the Preliminary Examination?*

Yes, all students must have a minimum graduate GPA of 3.3 to take the Preliminary Examination.

7. *How do I pass the Preliminary Examination?*

You pass the Preliminary Examination when you have passed three area examinations, one of which must be in your *major strength area*. If your major field is represented in a preliminary examination area, you must choose this area as your major strength area. If your major field is not represented in the preliminary examination areas, you must select, in consultation with your major field advisor, one of the preliminary examination areas as your major strength area. The chosen strength area must be reported by you to the Vice Chair of Graduate Study. If you do not sign up for your major strength area, you will be ineligible to take the prelims.

8. *What happens if I don't pass the Preliminary Examination the first time?*

The Preliminary Examination Committee will decide, based upon your performance on the examinations, whether you will be allowed to retake the Preliminary Examination. If you do not pass the first time, and are permitted a retake, you may retake any part of the Preliminary Examination you wish, **but you must retake the Preliminary Examination the very next time it is scheduled**. If you fail to pass any of the attempted areas on your first sitting it is unlikely that the committee will allow you a second sitting.

For example:

- a. If you sign up for the three required area exams, pass your major and one other area, you may take the one area exam you did not pass or take any other area exam that you haven't already passed.
- b. If you sign up for more than three area exams, pass three but fail your major, you are still required to sign up and pass your major.

9. *Is there a limit to the number of area examinations I can sign up for?*

No, there is no limit. You may sign up for as many as you wish.

10. *Can I simply show up for the exam?*

No, you must register for the exam ahead of time.

11. *How many area examinations **must** I take?*

First sitting: For your first sitting you must sign up and take at least **three** area exams. Failure to do so will make you ineligible to take the Prelims and you will be considered only for the M.S. or M. Eng. program. Remember that one examination must be in your major strength area.

Second sitting: If a second sitting is necessary, you may sign up and take as many areas examinations as you wish to pass the Preliminary Examination.

12. *Once I have signed up for the Prelims, what is the latest date I may add or drop an area examination?*

You may add or drop an area examination up to the date of the examination as long as you take at least three examinations (first sitting).

If you drop an area examination and fall below the prescribed three area examinations, you may take the one or two exams you signed up for but you will be considered as having failed all three, regardless of your grade in the exams (first sitting).

13. *Once I have registered for the Preliminary Examination, may I change my major strength area before I pass the Examination?*

No, the committee expects you to commit to one major strength area throughout the Preliminary Examination.

14. *What if there are extenuating circumstances that have forced me out of compliance with the Preliminary Examination rules?*

Students may petition for an exception to the rules. However, the committee cannot guarantee hearing the petition unless submitted by the deadline.

15. *How do I find out how I did on the exams?*

The pass/not pass results will be posted outside room 6189 Etcheverry. The complete results will be mailed to your home address one to two weeks after the last exam. Pat Giddings will give you your individual results after the letters have gone out if you come by in person for them.

16. *With whom do I discuss my Prelim Exam scores?*

You must contact the Area Chair for each area exam you wish to review. The Area Exam Chair will verify that the scores are numerically correct and discuss your performance on the exam. The Area Chair will not re-interpret your answers, which must stand on their own merits. It is the student's responsibility to present clearly his or her answers on the exam.

Exceptions to Preliminary Examination Policies

Petitions for exceptions should be addressed to the Chair of the Preliminary Examination Committee, Professor Benson H. Tongue, and delivered to Ms. Pat Giddings in 6189 Etcheverry Hall.

Petitions are considered only in cases of serious extenuating circumstances that are beyond the student's control and are decided on a case-by-case basis. The committee reserves the right to impose any requirements that it deems necessary. Supporting evidence should be submitted with the petition.

Inspection of Exams and Re-grading

Students may inspect their exams and the exam solutions. Such inspection will be done in the office of the faculty member in charge of the exam area for which inspection is desired. Neither the exam nor the solution may be removed from the office, nor may copies be made.

Requests for re-grading should be directed to the Preliminary Examination Committee member in charge of the area for which re-grading is requested. Re-grading will only apply to numerical errors in grading, and not reinterpretations of student's answers.

UNIVERSITY OF CALIFORNIA
Department of Mechanical Engineering

**THE HIGHEST LEVEL OF UNDERGRADUATE COURSES TO BE COVERED IN THE
PRELIMINARY EXAMINATION FOR PROSPECTIVE DOCTORAL STUDENTS
IN MECHANICAL ENGINEERING**

1. **FLUID MECHANICS**
ME106
2. **MATERIALS**
ME 102A, ME 102B (with emphasis on ME 102A)
3. **HEAT TRANSFER**
ME 109
4. **DESIGN**
ME 102A, ME 102B (with emphasis on ME 102B)
5. **THERMODYNAMICS**
ME 105
6. **DYNAMICS**
ME 104
7. **SOLID MECHANICS**
ME 185
8. **CONTROLS**
ME 134
9. **MANUFACTURING**
ME 101, ME 122

UNIVERSITY OF CALIFORNIA
Department of Mechanical Engineering

**The Preliminary Examination for Prospective Doctoral Students in
Mechanical Engineering**

A. OBJECTIVE

The objective of the Preliminary Examination is the early assessment of a student's potential for satisfactory completion of the doctoral degree. The exams are entirely closed books and notes.

All students admitted to the Ph.D. program on entry are required to take the examination. Students who enter with a declared M.S. or M. Eng. degree goal and who wish to petition for a change in degree goal to Ph.D. or D. Eng. must pass the examination before such petitions can be approved. Change of Degree goal petitions must be filed before completion of the M.S. or M. Eng. degree requirements and must be approved if a student is to register beyond the Master's degree.

B. DATES OF THE EXAMINATION

The examination will be given twice a year, in January and August. The examination must be taken following two semesters of registration for those students entering with Bachelor's degrees. Those entering with a Master's degree will take the examination at the **beginning** of the second semester of registration. Some flexibility is allowed for students who do not have undergraduate degrees in Mechanical Engineering or closely related areas. These students may petition the Preliminary Examination Committee to take the examination at a later than normal time.

C. GRADE POINT REQUIREMENT

College regulations state that a student studying for the doctoral degree should maintain a GPA of 3.5 or better in the major field, and at least a 3.0 in the minor fields, and a 3.5 overall. With this in mind, **students are only admitted to the Preliminary Examination with an overall GPA of 3.3**, based on work done at Berkeley.

D. RESULTS

The Preliminary Examination Committee will meet approximately one week after the last exam is given. The results will then be mailed to the students. The results of the examination will be one of the following:

1. Pass – Continue in the doctoral program (for change of degree goal candidates- admit to doctoral program). Such students then prepare for the PhD Oral Qualifying Examination.
2. Not Pass – The Examination Committee decides whether or not such students may take the examination a second time. The examination may not be taken more than twice.

E. GRADING

There are nine (9) core examination areas. In each area the two grades are: PASS and NOT PASS. The student must pass in three areas, one of which **must** be in the proposed doctoral major. Students may attempt the examination in as many areas as they please at one offering. If a student only passes in one (or two) area(s) at the first offering, the student will still have to pass two (or more) areas at the following offering (provided a second examination is permitted). A student must attempt no fewer than three areas at the first offering. Students may review their solutions along with a set of recommended solutions to the problems.

F. AREAS, FORMAT, TOPICS

Area 1. **FLUID MECHANICS**

Topics to be drawn from:

Kinematics, statics and dynamic of fluid flows. Boundary condition on fluid motion. Formulation of problems involving mass, momentum and energy balances. Laminar and turbulent flows in ducts and about immersed bodies. Boundary layers. Similitude. Steady and unsteady motion of compressible fluids.

Area 2. **MATERIALS**

Topics to be drawn from:

Mechanics of materials; transformation of stress and strain, mechanical behavior materials; mechanical properties of materials; material selection and heat treatment; static failure theories; fatigue failure: effects of load, size, surface, stress concentration, mean stress, combined loading; introductory fracture mechanics: stress intensity factor.

Area 3. **HEAT TRANSFER**

Topics to be drawn from:

Steady and transient conduction; lumped analysis; principles of convection, thermal boundary layer, free, forced, laminar, and turbulent convection; radiation properties, shape factor, black and non-black bodies, simple gas radiation, absorbing and transmitting media; simple numerical analysis; heat exchangers; basic elements of mass transfer; condensation and boiling.

Area 4. **DESIGN**

Topics to be drawn from:

Machine design and design application of dynamics; force, mass, displacement, velocity, acceleration, energy, momentum, the kinetics and kinematics of plane motion; resonance and natural frequencies; mechanics of materials; static failure; fatigue failures; introductory fracture mechanics.

Area 5. **THERMODYNAMICS**

Topics to be drawn from:

Interrelationship of heat, work energy, enthalpy, entropy, Gibbs and Helmholtz functions, heat capacity; and non-ideal gas behavior, first and second law; reversible and irreversible processes; mixtures; phase and chemical equilibrium; thermochemistry; chemical potential; thermodynamic system analysis.

Area 6. **DYNAMICS**

Topics to be drawn from:

Planar and 3-D kinematics of systems of particles and rigid bodies, stationary and moving reference frames, coordinate transformations, linear and angular momentum, energy methods, impulsive motion (linear and angular), single degree of freedom vibrations.

Area 7. **SOLID MECHANICS**

Topics to be drawn from:

Continuum Mechanics: kinematics of deformation, balance laws, constitutive relations, invariance requirements;
Mechanics of Materials: beams and rods under axial loading, bending and torsion, statically indeterminate structures, buckling;
Linear Elasticity: fundamental equations of elasticity. Elementary boundary value problems.

Area 8. **CONTROLS**

Topics:

Derivation of state equations or transfer functions; solution of linear state equations; transfer function and Laplace (continuous time) domain solutions; characteristic or modal response and stability testing (Routh's Criterion); signal flow and block diagram representation; dynamics of continuous time feedback control systems including root locus technique and Nyquist Theorem.

Area 9. **MANUFACTURING**

Topics to be drawn from:

Manufacturing process, including machining, welding, extrusion, rolling, sheet metal forming and forging. The Upper Bound Theory for prediction forming loads. Lubrication. Tooling and die materials. The Taylor tool life equation and optimizing speeds and feeds.

Manufacturing systems, including flexible manufacturing system layout, flow of materials and tooling, line balancing and scheduling, general applications of fixturing, materials handling, group technology, and the use of robots in flexible manufacturing.

Elements of NC Programming, including the tool path kinematics, interpolation, positioning accuracy (control resolution), general material on quality assurance and control.

G. DEPTH OF EACH AREA EXAMINATION

The questions can be expected to be thought provoking and probing but requiring only a clear understanding of the foundations of each technical area. Material is generally at the level of basic undergraduate core Mechanical Engineering curriculum. The reference list is not meant to be exhaustive but is to provide some approximation of the scope of the exam.

H. AVAILABILITY OF OLD EXAMINATION

Copies of old examinations are kept in 6189 Etcheverry Hall. Please see Pat or Donna to get the files of old examinations to copy. **PLEASE BE SURE TO RETURN THESE OLD EXAMS TO PAT, OR DONNA AFTER YOU HAVE MADE YOUR COPIES SO THAT OTHER STUDENTS MAY USE THEM.**

I. REFERENCE LIST – The books are available in the Kresge Engineering Library. **Please refer to the most recent editions (versions) of the listed textbooks.**

Area I. **FLUID MECHANICS**

Munson, B.R., Young, D.F. and Okiishi, T.H. 1990 *Fundamental of Fluid Mechanics*, Wiley.

White, F.M., *Fluid Mechanics*, McGraw-Hill.

Area 2. **MATERIALS**

Popov. E.P., *Introduction to Mechanics of Solids*, Prentice-Hall.

Barrett, Nix and Tetelman, *Principles of Engineering Materials*, Prentice-Hall.

Van Vlack, L.H., *Elements of Materials Science and Engineering*, Addison Wesley.

Callister, W.D., Jr., *Materials Science and Engineering: An Introduction*, John Wiley & Sons, Inc.

Area 3. **HEAT TRANSFER**

Holman, J.P., *Heat Transfer*, McGraw-Hill.

Kreith, F. and Bohn, M., *Principles of Heat Transfer*, Harper & Row.

Rohsenow, W.M. and Choi, H.Y., *Heat, Mass and Momentum Transfer*, Prentice-Hall.

Edwards, Denny and Mills, *Transfer Processes*, McGraw-Hill.

Incropera, F.P. and DeWitt, D.P., *Fundamentals of Heat and Mass Transfer*, John Wiley & Sons.

Area 4. **DESIGN**

Dynamics

Hibbeler, R.C., *Engineering Mechanics Dynamics*, MacMillan.

Meriam, J.L., and Kraige, L.G., *Engineering Mechanics*, volume 2; 3rd edition.

(or any basic undergraduate text in dynamics)

Mechanics and strength of materials

Popov, E.P., *Introduction to Mechanics of Solids*, Prentice-Hall.

(or any basic undergraduate text in strength in materials)

Machine Design

Shigley, J.E., *Mechanical Engineering Design*, McGraw-Hill.

Deutschman, Michels and Wilson, *Machine Design—Theory and Practice*, Macmillan.

Juvinall, R.C., *Fundamentals of Machine Component Design*, Wiley.

Dieter, George E., *Engineering Design A Materials and Processing Approach*, McGraw-Hill.

Area 5. **THERMODYNAMICS** (Classical thermodynamics; no compressible flow)

Reynolds and Perkins, *Engineering Thermodynamics*, 2nd edition (1977), Chaps. 1-12, McGraw-Hill.

Van Wylen, Sonntag and Borgnakke, *Fundamentals of Classical Thermodynamics*, 4th edition (1992), Chaps. 1-13, Wiley.

Howell and Buckius, *Fundamentals of Engineering Thermodynamics*, 2nd edition (1992), Chaps. 1-12, McGraw-Hill.

Cengel and Boles, *Thermodynamics, An Engineering Approach*, 2nd edition (1994), Chaps. 1-15, McGraw-Hill.

Area 6. **DYNAMICS**

Beer, F.P., and Johnston, E.R., Jr., *Vector Mechanics for Engineers: Dynamics*, Prentice-Hall.

Meriam, J.L., and Kraige, L.G., *Engineering Mechanics*, volume 2, 4th edition.

Area 7. **SOLID MECHANICS**

P.M. Naghdi, ME 185 Class Notes.

Popov, E., *Introduction to Mechanics of Solids*, Prentice-Hall, Chaps. 5-8, 10-13.

Timoshenko, S.P. and Goodier, J.N., *Theory of Elasticity*, McGraw-Hill, 3rd edition (1970), Chaps. 1-3.

Sokolnikoff, I.S., *Mathematical Theory of Elasticity*, McGraw-Hill.

Area 8. **CONTROLS**

Ogata, K., *Modern Control Engineering*, Prentice-Hall.

Kuo, B.C., *Automatic Control Systems*, Prentice-Hall.

Nise, N.S., *Control Systems Engineering*, The Benjamin/Cummings Publishing Co., Inc.

Area 9. **MANUFACTURING**

Groover, M.P., *Automation, Production Systems, and Computer Integrated Manufacturing*, Prentice-Hall.

Schey, J.A., *Introduction to Manufacturing Processes*, McGraw-Hill.

Kalpakjian, S., *Manufacturing Engineering and Technology*, Addison-Wesley.

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COMMITTEE ON THE PRELIMINARY EXAMINATION:

Professor Andrew Packard	Controls
Professor Alice Agogino	Design
Professor Van Carey	Heat Transfer
Professor J. Y. Chen	Combustion
Professor Omer Savas	Fluids
Professor Kyriakos Komvopoulos	Materials
Professor Panos Papadopoulos	Solids
Professor Benson Tongue	Chair/Dynamics
Professor David Dornfeld	Manufacturing