

NCKU 2017 Fall Semester
Qualifying Examination for Ph. D. Candidates

Department: Civil Engineering

Course: Dynamics of Structure

Qualifying score: 60

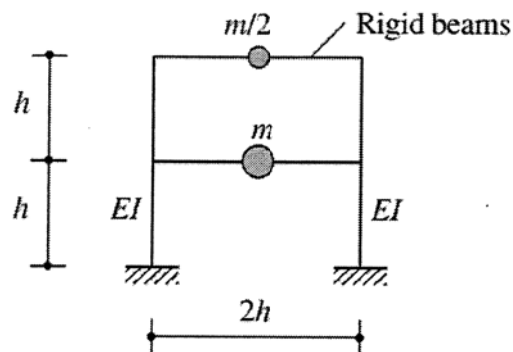
Time: 100 minutes

1. Short questions about an underdamped SDOF system:

- (1) Explain the characteristics of the steady state response. (10%)
- (2) Explain the phenomena of resonant for displacement response. (10%)
- (3) Indicate two methods to evaluate the structural damping. (10%)
- (4) What are the specified requirements for stability in average acceleration method and linearly acceleration method, respectively? (10%)
- (5) Indicate the procedure to construct a pseudo acceleration response spectrum due to earthquake excitation. (10%)

2. For the two-story shear building of Fig. 1 excited by horizontal ground motion $\ddot{u}_g(t)$, please determine:

- (a) the natural frequencies (15%)
- (b) mode shapes (15%)
- (c) the floor displacement responses in terms of $D_n(t)$ (10%)
- (d) the story shear responses in terms of $A_n(t)$ (10%)



106 學年度第一學期博士學位候選人資格考試

高等瀝青材料學 (20% for each question)

1. Explain the following paragraph.

Asphalt cement is one of man's oldest engineering materials. Its adhesive and waterproofing properties have been known since early civilization. It was used by a thriving shipbuilding industry in Samaria about 6000 B.C. As early as 2600 B.C, Egyptians used native asphalts for waterproofing, mummification, and building structures. The use of naturally occurring asphalts as a mortar for building and paving blocks, caulking for ships, and numerous waterproofing applications continued in later years in various parts of the world.

2. Briefly describe the asphalt cement grading system.
3. Briefly describe the reasons to develop the superpave asphalt binder tests and specifications.
4. Briefly describe the procedures of the superpave mix design method.
5. Briefly describe the two principal types of HMA facilities (mixing plants).

106年成大土研所博士資格考 工程統計
(每題25分)

1. 假設兩檢定中的型I與型II誤差，請說明之。
2. 線性迴歸式 $Y = a + bX$ ，請以最小誤差平方法推導迴歸係數之計算式
3. 樣本平均值的標準誤 $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$ ，為何？請推導之。
4. 何謂一致估計量 (Consistent Estimators)？

Mechanical Properties of Materials
Ph.D. Qualifying Examination (Fall 2017)

1. Please briefly explain the following terminologies. (20%)
 - (a) fatigue striation, (b) fracture toughness, (c) dislocation defect, (d) elastic compliance.

2. Please answer the following questions regarding interatomic potential and elastic constants of materials. (20%)
 - (a) For the Lennard-Jones potential $U(r) = A/r^m - B/r^n$, please determine the stability criterion on m and n for the two atoms being stable around their equilibrium point ($r = r_0$).
 - (b) According to the aforementioned interatomic potential in (a), calculate the Young's modulus of a simple cubic material when the uniaxial loading is parallel to one of its material axis.
 - (c) For the simple cubic material in (b), calculate all non-zero C_{ijkl} for simple cubic lattice with spring constants k_1 and k_2 . Here k_1 is the spring constant for the horizontal and vertical springs, and k_2 for the diagonal springs,
 - (d) Following (c), calculate the directional Young's modulus of the simple cubic lattice under uniaxial loading along the $[112]$ crystallographic direction.

3. Explain (a) why metals usually cannot possess their ideal strength, (b) the Hall-Petch relationship to describe the increase of strength with decreasing grain sizes. (20%)

4. Starting from the elastic constitutive relationship $\sigma_{ij} = C_{ijkl} \epsilon_{kl}$, that requires 81 elastic constants, show that isotropic materials require only two independent elastic constants. (20%)

5. For the one-dimensional linear viscoelastic materials, establish the mathematical relationships between (a) the creep compliance $J(t)$ and relaxation modulus $E(t)$, (b) the complex modulus $E^*(\omega)$ and $E(t)$. Assume $E(t)$ has been experimentally determined. (20%)