九十學年度第一學期博士學位候選人資格考試時間表

時　間	考　試　科　目	考試地點
8:30 ｜ 10:10	▲ 有限元素法　(CLOSE BOOK) ▲ 工程數學　(CLOSE BOOK) ▲ 工程地質　(CLOSE BOOK) ▲ 路面材料　(CLOSE BOOK) ▲ 鋼結構學　(CLOSE BOOK) ▲ 工程成本與財務　(OPEN BOOK)	大會議室
10:20 ｜ 12:00	▲ 結構動力學　(OPEN BOOK) ▲ 基礎工程　(CLOSE BOOK) ▲ 鋪面工程　(CLOSE BOOK) ▲ 作業研究　(CLOSE BOOK) ▲ 混凝土組合律　(CLOSE BOOK) ▲ 工程時程控制　(OPEN BOOK)	大會議室
14:00 ｜ 15:40	▲ 土壤力學　(CLOSE BOOK) ▲ 岩石力學　(CLOSE BOOK) ▲ 交通工程　(OPEN BOOK) ▲ 施工學　(CLOSE BOOK)	大會議室

- 考試日期：90年10月26日（星期五）
- 地　　點：土木系大會議室
- 考試時請攜帶學生證。

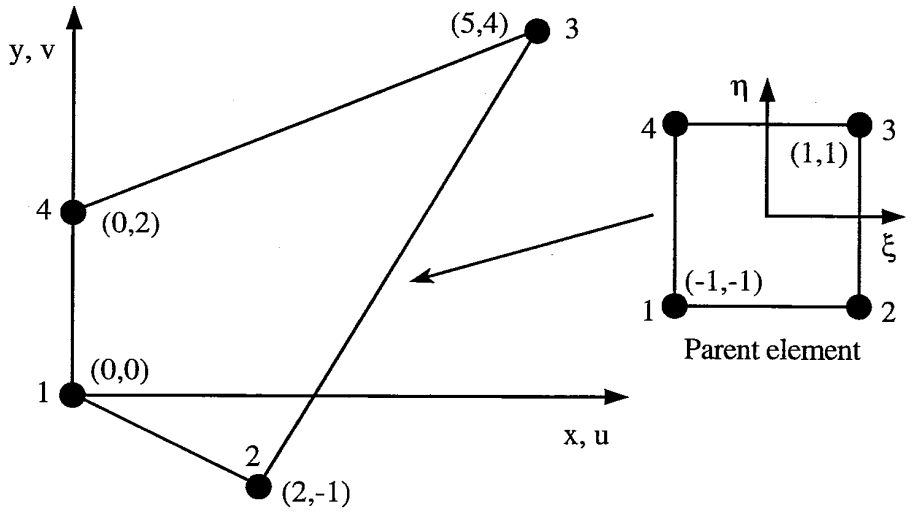
Qualified Examination

Fall 2001

Finite Element Method

(Close Book, 60% to Pass)

1. A 4-node isoparametric element with thickness t =1 is shown below left.



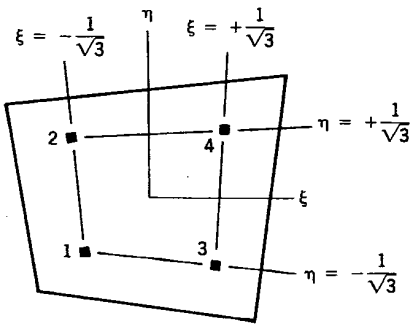
(i) Compute the Jacobian matrix [J] and its determinant |J| at the centroid of the element. (10%)

(ii) Compute the strains ε_x, ε_y, γ_{xy} at the centroid of the element for the nodal displacements given as $(u_1, v_1, u_2, v_2, u_3, v_3, u_4, v_4) = (3, 1, 3, -1, 3, 2, 3, 1)$. (10%)

2. Use a 2×2 Gauss integration rule to evaluate the following integral ($3 \le x \le 9, -2 \le y \le 2$)

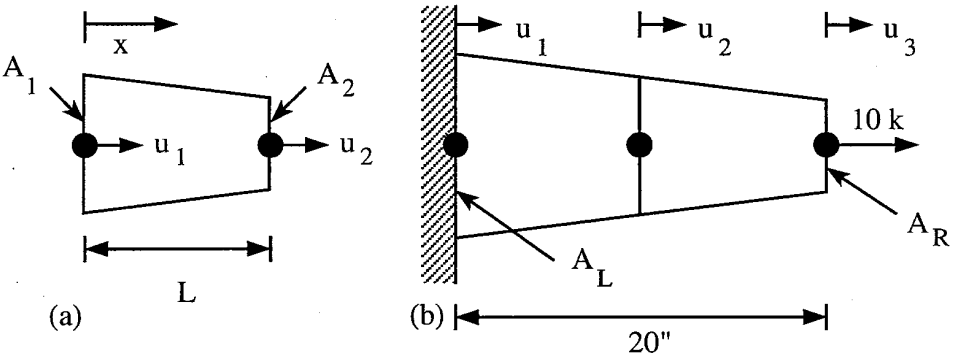
$$I = \int_3^9 \int_{-2}^2 (2 + \frac{1}{3x} + 6x^2 - 12y^3 + 4xy^2) dy dx$$

The weight factor at Gauss points is W = 1. (20%)

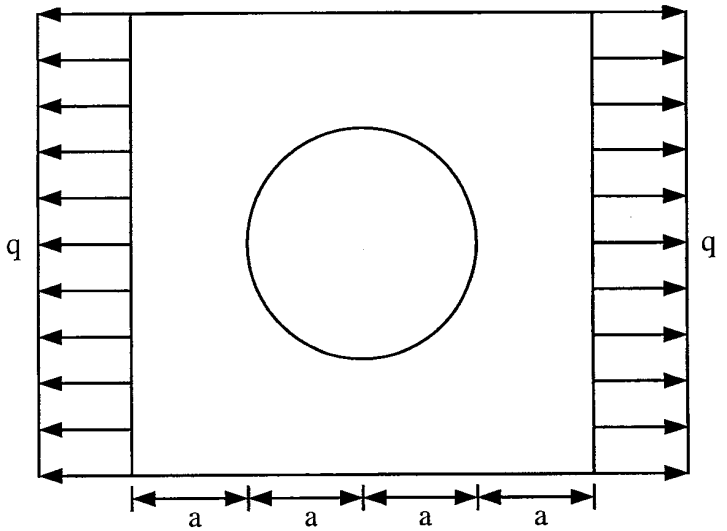


3. (i) A tapered bar element with two degrees of freedoms is shown in Fig. (a) below. The element has a constant thickness and its cross-sectional area can be represented by $A(x) = A_1 + x(A_2-A_1)/L$, where A_1 and A_2 are cross-sectional areas of the element at the two ends. Assume the displacement in the element is $u(x) = a_0 + a_1x$. Formulate the stiffness matrix for the tapered bar element. (10%)

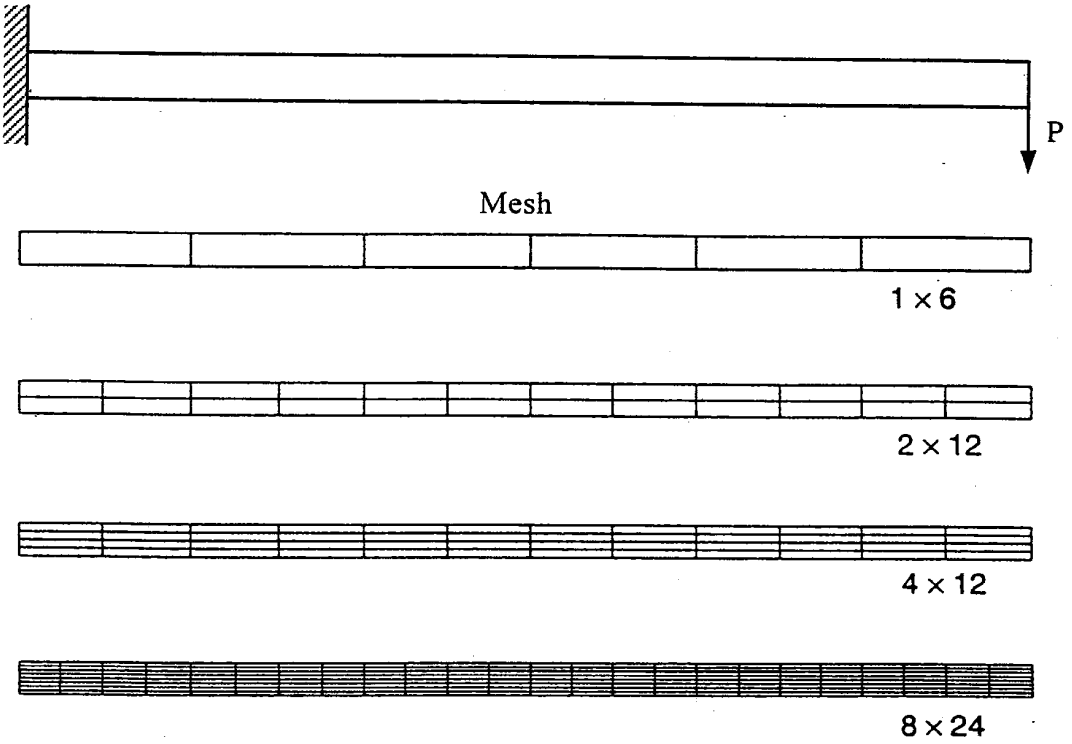
   (ii) An axially loaded tapered bar structure modeled by two tapered bar elements is shown in Fig. (b) below. Assume that $A_L = 10$ in^2, $A_R = 1$ in^2 and the Young's modulus E = 10000 ksi. Calculate the displacements u_2, u_3. (10%)



4. A square panel with a central circular hole and subjected to uniaxial tensile stress q is shown below. (i) Sketch the mesh and describe the best type of element that you would use to analyze the panel (need to take the symmetric conditions into account), (ii) specify the boundary conditions on your mesh. (20%)



5. A cantilever beam subjected to a concentrated load is analyzed by 4-node and 8-node plane stress elements. The mesh used in the analyses and the normalized beam deflections at the free end are shown below. When the normalized beam deflection is equal to 1, it means the numerical result is the same as the analytical solution.



Normalized beam deflections

Element	Mesh Size (Depth × Length)			
	1×6	2×12	4×12	8×24
4F	0.074	0.242	0.242	0.561
8F	0.994	1.000	1.000	1.000
4R	20.30	1.308	1.051	1.012
8R	1.000	1.000	1.000	1.000

4F: 4-node with full integration, 8F: 8-node with full integration,
4R: 4-node with reduced integration, 8R: 8-node with reduced integration.

Please explain: (i) why the results obtained by 8-node elements (8F or 8R) are better than those obtained by 4-node elements (4F or 4R)? (ii) why the results obtained by elements using the reduced integration rule (4R or 8R elements) are better than those using the full integration rule (4F or 8F elements)? (iii) why the normalized deflection of the 4F element with 1×6 mesh is so small? (iv) why the normalized deflection of the 4R element with 1×6 mesh is so large? (iv) what is the influence of mesh sizing effect on the results of the numerical analyses? (20%)

Department of Civil Engineering, National Cheng Kung University
Qualifying Examination, Fall, 2001
(Engineering Mathematics)

1. Solve $u_{xx}+u_{yy}=0$ in the disk(r<a) with the boundary condition $u=1+3\sin\theta$ on r=a. (25%)

2. Consider the integral

$$I=\int_0^{\infty}\frac{dx}{x^2+1}$$

a) Evaluate I from the integral

$$I_1(a)=\int_{-\infty}^{\infty}\frac{e^{iax}}{x^2+1}dx \quad (a>0)$$

and note that $I_1(0)=2I$. (10%)

b) Evaluate I from the integral

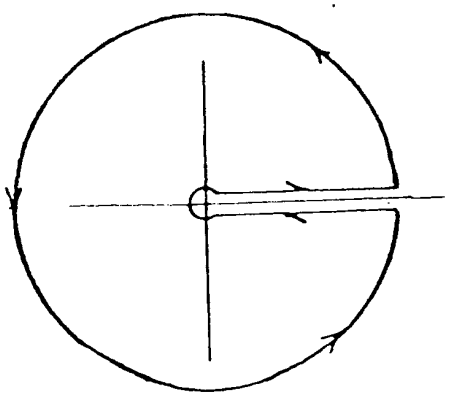
$$I_2=\oint\frac{\ln x}{x^2+1}dx$$

and show that

$$I_2=(-2\pi i)\,I$$

For part b) use the contour shown below and note that

$x\ln x \to 0$ as $x \to 0$
$(\ln x)/x \to 0$ as $x \to \infty$ (15%)



3. Find the general solution of

$$x(x-2)y''-(x^2-2)y'+2(x-1)y=3x^2(x-2)^2e^x$$

given that $y=e^x$ and $y=x^2$ are linearly independent solutions of the corresponding equation. (25%)

4. Derive the differential equation for the longitudinal oscillations of a thin rod of variable cross section A=A(x). (25%)

2001年土木研究所博士資格考試 工程地質試題 (2001.10)

1. 請繪出台灣的板塊構造，並說明其对台灣地震的影响。(15%)

2. 何謂斷层？何謂節理？斷层的种類有那些？其与大地応力之間的関係如何？(20%)

3. 何謂地震規模？何謂地震強度？台灣的地震帶分佈如何？(15%)

4. 岩体分類法中由 Bieniawski 所提出之 Rock Mass Rating 之内容為何？(20%)

5. 請敘述 工地調查応有那些程序？ (10%)

6. 請解釈下列名詞 (20%)

(a) 泥岩 (b) 砂岩 (c) 花崗岩 (d) 片麻岩 (e) 大理岩

(f) 不整合面 (g) 背斜 (h) 褶曲度.

路面材料

1. Briefly describe the usage of Dynamic Shear Rheometer in the Superpave asphalt binder specification.(25%)

2. Briefly describe the Marshall and Superpave mixture design methods.(25%)

3. The repeated flexural test is conducted to evaluate the fatigue properties of an asphalt mixture and, hence to estimate pavement life for fracture. Describe the test procedures and its usage.(25%)

4. Describe what kind of improvements should be made to be an ideal pavement binder.(25%)

STEEL STRUCTURE

1. Determine the capacity of the splice shown in Fig.1. All plate materials are A36 steel (Fy=36 ksi, Fu=58 ksi). Fasteners are 6/8-in A325 bolts (Fv=30 ksi) in a bearing-type connection with threads excluded from the shear planes. Standard holes. Please use allowable-stress-design (ASD) method to solve this problem. (3/100)

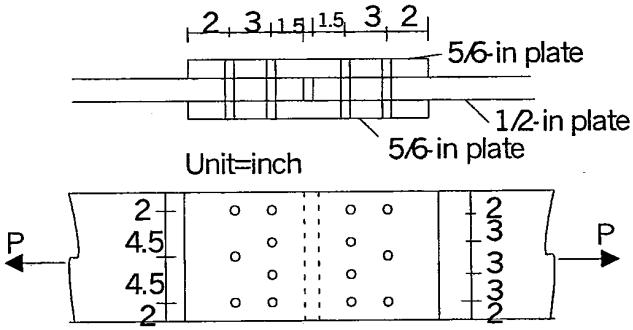


Fig.1

2. Use LRFD method to do problem 1 again. ($R_n=60A_b$) (3/100)

3. Check the W12x45 section to carry an axial compression and biaxial bending, as shown in Fig.2. Use A36 steel. (ASD method) (W12x45, d=12.06, tw=0.335, bf=8.045, tf=0.575, A=13.2 in^2, rx=5.15, ry=1.94, r_T=2.15, Sx=58.1 in^3, Sy=12.4 in^3; unit=in) E=29000ksi. (3/100)

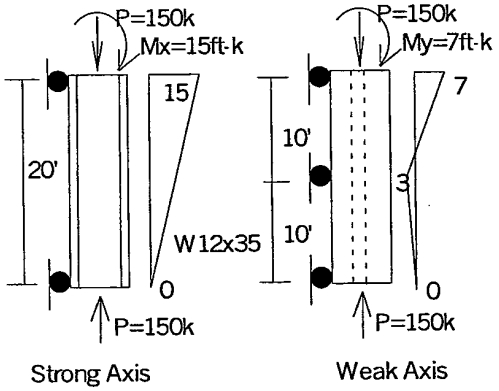


Fig.2

工程成本與財務　博士資格考　90 年 10 月

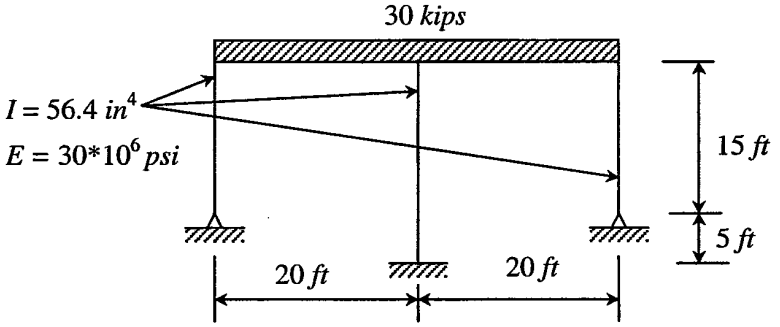
一、 Chart of accounts 與 Project cost accounts 有何不同？總分類帳 (general ledger accounts) 及在建工程明細帳 (Subsidiary ledger accounts) 又如何與上述二者有關？(20 分)

二、 請自行用六筆交易或會計事項，最好涵蓋資產、負債、業主權益、收入及費用類科目，做分錄於日記簿，過帳至分類帳或 T 字帳，然後結帳，做損益表，及資產負債表。(40 分)

三、依照 Activity-Based Costing，製造業的作業可分爲單元、批次、產品、顧客、品牌、整廠等類，若比照，營造業的作業可能的分法又如何？並舉例說明。直接成本、工地間接成本，公司間接成本又如何對應？這些作業的間接成本又如何依附產生？(40 分)

土木系九十學年度博士班資格考試
結構動力學試題

1. (30%)Compute the natural frequency in the horizontal mode of the steel rigid frame shown in Fig. 1. the horizontal girder may be assumed infinitely rigid, and the mass of the columns may be neglected.



2. (40%)The rigid frame of Prob. 1 is subjected to a horizontal force applied at the girder lever. The force increases linearly from zero at $t = 0$ to 4 *kips* at $t = 0.5$ *sec* and then remains constant.
   a. Compute the horizontal deflection at $t = 0.7$ *sec*.
   b. Determine the maximum deflection and the time of maximum deflection.

3. (30%)Repeat Prob. 1, taking into account the girder flexibility. The moment of inertia of the horizontal member is $I = 112.4\ in^4$.

基礎工程 博士班資格考

2001.10. ，Close-book

考試時間 100 分，滿分 100 分，60 分及格

1. 試列舉並說明三種樁尖承載力(End bearing capacity)理論。(25 分)

2. 如何評估震實砂樁(Sand compaction pile)改良之軟弱地盤之抗液化(Liquefaction)強度? (25 分)

3. 試說明位於斜坡上之淺基礎在地震時之極限承載力評估時有那些不同於平時之考慮因素? (25 分)

4. 如何估計版式基礎(Mat foundation)柱間之差異沈陷量(Differential settlement)? (25 分)

鋪面工程

1. Pavement design has gradually evolved from art to science. Describe what do art and science relate to pavement design. (25%)

2. Discuss the basic design differences between an airport and a highway pavement.(25%)

3. A composite pavement is composed of both HMA and PCC. Describe the cross section of premium composite pavement recommended by Von Quintus et al. (25%)

4. Briefly describe the distresses in HMA pavements. (25%)

Civil Engineering Department Ph.D. Program Qualification Exam

Subject: Operations Research

Note: The following questions may be answered by Chinese and/or English.

Problem 1 [25 points]

(a) Describe the use of Kuhn-Tucker conditions, by expressing the relationship between Kuhn-Tucker conditions and Lagrangeans.

(b) Solve the following problem using Kuhn-Tucker conditions. If the constraint is replaced by $X_1+X_2=2$, how the solution to this problem is affected? Does the result differ from the concept of shadow price?

Maximize

$$Z = 3X_1X_2^2$$

Subject To

$$X_1 + X_2 = 3$$

$$X_1, X_2 > 0$$

Problem 2 [25points]

SYM must determine how many motorcycles should be produced during each of the next 4 quarters (one quarter = three months). This decision has to be made at the beginning of each quarter. The demands of each quarter are: 40, 60, 75 and 25. SYM must meet the demand on time and it has an inventory of 10 motorcycles at the beginning. We may assume that motorcycles manufactured during a quarter can be used for that quarter. During each quarter, SYM can produce up to 40 motorcycles with regular cost of $400 per motorcycle. However, it is allowed to produce additional motorcycles at the cost of $450 per motorcycle. At the end of each quarter, a holding cost of $20 per motorcycle is incurred.

(a) Use linear programming to formulate a model that determines the best production schedule during the next four quarters.

(b) Use balanced transportation problem to model this problem.

(c) Describe this problem with appropriate network flow representation.

Problem 3 [25 points]

You are given the tableau shown in Table 1 for a maximization problem. Give conditions on the unknowns ***a1***, ***a2***, ***a3***, ***b*** and ***c*** that make the following statements true:

(a) The current solution is optimal.
(b) The current solution is optimal, and there are alternative optimal solutions.

Table 1

z	x1	x2	x3	x4	x5	rhs
1	***-c***	2	0	0	0	10
0	-1	***a1***	1	0	0	4
0	***a2***	-4	0	1	0	1
0	***a3***	3	0	0	1	***b***

Problem 4 [15 points]
The government wishes to maximize the hydroelectric power produced by building dams on three different river basins, subject to a budget of $3 million. Assume the power from each dam is independent of the others and dynamic programming approach is used to solve this problem. The power generated from various levels of investments is shown in Table 2. Formulate a backward recurrence representation for this problem and solve it. Please clearly define the notation and assumptions, if any.

Table 2

Level of investment (million) X_i	Return function, $G_i(X_i)$		
	i = 1	i = 2	i = 3
0	0	0	0
1	2	1	3
2	4	5	5
3	6	6	6

Problem 5 [10 points]
For a typical furniture manufacturer's activity analysis, the problem may be expressed with a linear programming model as below. Please write the dual problem and state the economic interpretation of this primal-dual problem.

$$\text{Max} \quad g(\mathbf{X}) = \mathbf{cX}$$
$$\text{s.t.} \quad \mathbf{AX} \le \mathbf{b}$$
$$\mathbf{X} \ge \mathbf{0}$$

混凝土組合律 Fall 2001

Qualify Exam.

1. A simply-supported beam made from a concrete is under a central concentrated load P; the span = S, the height = H and the thickness of the beam = B. If the concrete obeys power-law creep: $\dot{\varepsilon} = A\sigma^n$. Calculate the central deflection rate of the concrete beam. Discuss your result for the limiting cases of an elastic beam and a plastic beam. (25%)

2. Describe the corresponding stress-strain curve and failure mechanism for
   (a) A foamed concrete under compression.
   (b) A steel fiber reinforced concrete under tension.
   (c) A high strength concrete under tension.
   (d) A normal strength concrete under compression.

   (25%)

3 Discuss the applicability and compare the difference of the following three failure criteria when they are employed in concrete application: Tresca, von Mises and Coulomb-Mohr. (25%)

4. A concrete with 10% porosity in cement paste ($E_{SolidCementPaste}$ =32GPa and $G_{SolidCementPaste}$ =12GPa) and with 16% volume fraction of granite aggregate ($E_{aggregate}$ =90GPa and $\nu_{aggregate}$ =0.3) is under a hydrostatic stress state: $\sigma_{11} = \sigma_{22} = \sigma_{33}$ =10MPa. Calculate the dilatation of the concrete.

   (25%)

工程時程控制 Qualification Exam

1. Your bonding company has asked for the status of a telecommunications revitalization project. You decided to calculate Schedule Variance (SV), Schedule Performance Index (SPI), Cost Variance (CV), and Cost Performance Index (CPI) as performance indicators. Your cost accounting system section and project manager have provided you with the information in Table 1.

Table 1

Activity #	Description	Total cost forecast	Scheduled percentage complete	Actual Percentage complete	Actual cost to date	BCWS	BCWP
1	Building permits*	2000	100	100	1253.75		
2	Temp. networks*	25000	100	100	26497.83		
3	Order cable trays	8000	100	100	7907.27		
4	Order routers, cabling	10000	100	100	9017.32		
5	Remove ceilings*	18000	100	100	11427.49		
6	Install cable trays*	28000	100	100	19743.19		
7	New servers*	20000	100	70	11271.25		
8	Cable TV	10000	100	10	793.21		
9	Backbone and routers	20000	100	5	327.19		
10	LANs	17500	20	0	--		
11	Connect and test*	15000	0	0	--		
12	New Ceilings*	20000	0	0	--		
		193500			88238.5		

* Asterisks indicate the critical path for this project

1.1. Find the BCWS and BCWP of each activity (fill in the table) (10%)
1.2. Calculate the SV, CV, SPI, and CPI of the project (10%)
1.3. Predict the performance of the project in terms of schedule and cost. (10%)

2. Consider the project information in Table 2.

2.1. Develop an unrestrained schedule in Gantt Bar Chart form. (5%)
2.2. Develop resource histograms for mason and helpers, respectively. (10%)
2.3. Level the project, using 4 masons and 2 helpers. (15%)

Table 2

Activity	Duration	Predecessors	Masons	Helpers
A	1	None	2	1
B	4	A	2	1
C	2	A	2	1
D	1	B	1	0
E	4	B	3	0
F	3	C	3	0
G	4	C	1	2
H	2	C	1	1
J	2	D	2	2
K	6	J	2	1
L	2	F, G, H	3	2
M	1	K, L	2	1

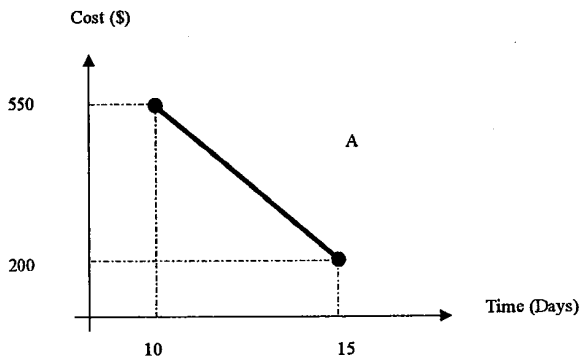
3. Please answer the following questions based on the project information in Table 3 and the activity information in Figure 1. Indirect cost =$100/Day

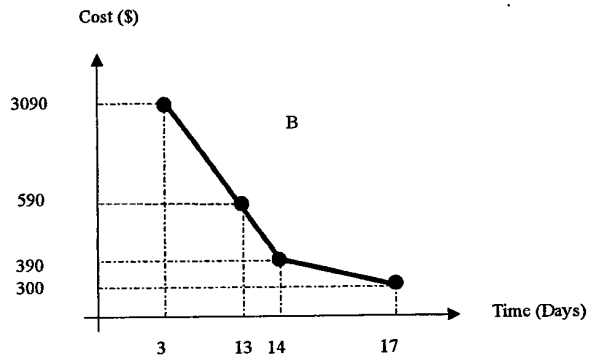
3.1. Draw the direct cost curve of the project. (15%) (Note: show the calculation steps)

3.2. Determine the best schedule that has the minimum total project cost. (5%)

Table 3

Activity ID	Predecessors
A	--
B	--
E	A
F	A
G	B, E
H	F, G





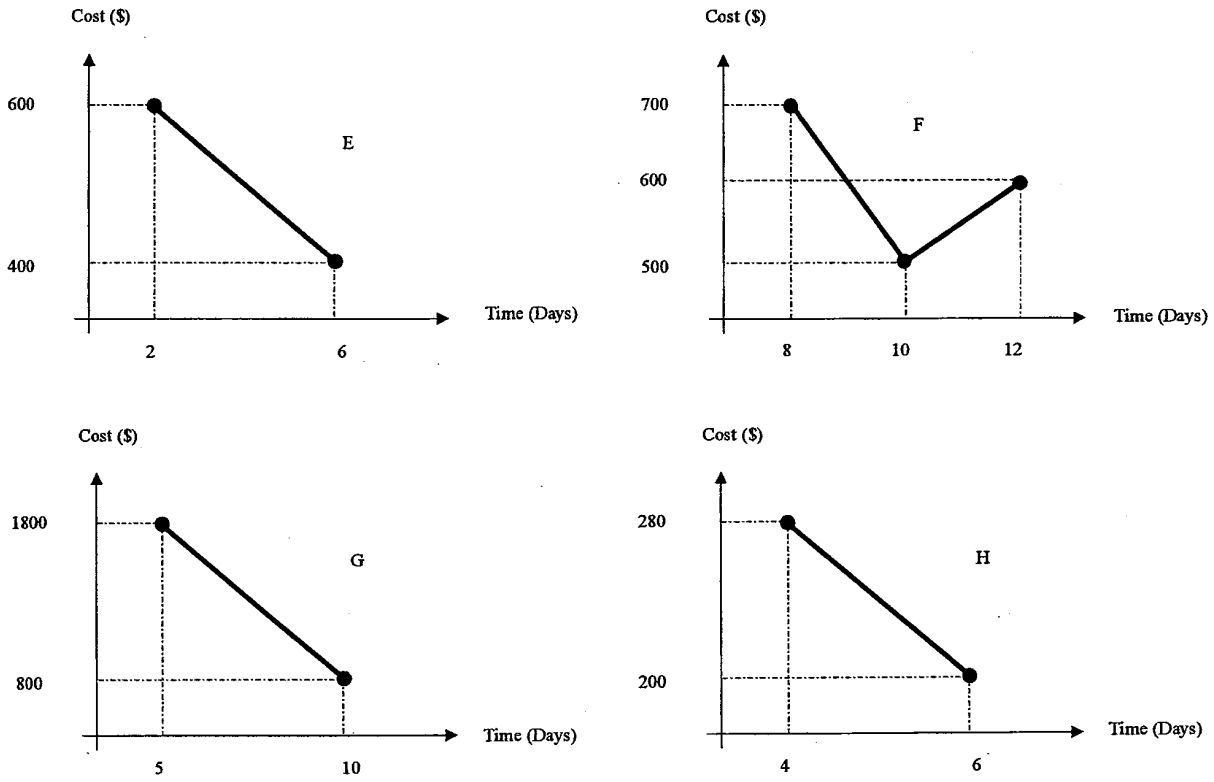


Figure 1

4. Answer the following questions based on the information in Table 4

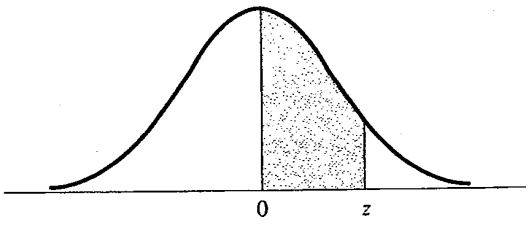
Table 4

Activity ID	Predecessors	Most Optimistic	Most Likely	Most Pessimistic	t_j	σ_j
A	--	52	60	74		
B	--	17	25	39		
C	--	8	10	18		
D	--	41	45	61		
E	A, B	2	4	9		
F	D	20	25	33		
G	C	8	12	19		
H	F	26	30	46		
I	E, G, H	9	12	18		

4.1. Fill in the t_j and σ_j (10%)

4.2. What is the expected duration of the expected critical path? (5%)

4.3. What is the probability that the project can be completed within 124 days? (5%)



The following table provides the area between the mean and normal deviate value *z*.

Normal Deviate *z*	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.49865	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
4.0	.49997									

土壤力學 博士班資格考

2001.10.　　，Close-book

考試時間 100 分，滿分 100 分，60 分及格

1. 對於平面式、圓弧式及任意形狀之破壞面，各列舉邊坡穩定分析法，並說明該法之內容與應用上的限制。(25 分)

2. 說明 Terzaghi 單向度壓密方程式中各參數之意義。從該理論來看，平均壓密度(Average degree of consolidation)是超額孔隙水壓消散的指標嗎 ？ 或是沈陷完成程度之指標 ？(25 分)

3. 列舉並說明三種常用的土壤應力~應變模式。(25 分)

4. 列舉三種適用於背填土(Back-fill)表面為傾斜時之擋土牆側向土壓力理論。(25 分)

2001年土木研究所博士資格考試岩石力学試題（2001.10）

一. 解釈名詞（30%）

(1) 関鍵岩塊（Key Block）

(2) RQD（Rock Quality Designation）

(3) 応変軟化（Strain Softening）

(4) 点載重試験（Point Load Test）

(5) 套金贊法（Over coring）

二. 為何使用剛性試験机可以求得岩石材料的完整応力-応変曲線.（20%）

三. 有一岩体具有三組節理面a、b、c，其走向与倾斜如下表：

節理	a	b	c
走向	N15°E	N120°E	N45°W
倾斜	60°SE	45°NE	85°NE

請問：(1) a与b，b与c，c与a之交線指向東北者為何.

(2) a与b，b与c，c与a之交線与水平面之夾角最小者為何.

（請絵図説明）（20%）

四. 請説明大地応力（最大主応力σ1，中間主応力σ2，最小主応力σ3）与断層種類之関係.（20%）

五. 火成岩如何形成，代表性的火成岩有那些，含有何種矿物.（10%

成功大學土木工程系九十學年博士班資格考試
交通工程試題

一、 何謂「time mean speed」、「space mean speed」？兩者間之關係為何？說明其在交通工程上之應用？（10%）

二、 請說明 peak-hour volume 與 design hour volume 間之關係（10%）

三、 請說明 HOV 之優點與缺點，並列舉台灣採行的例子。（20%）

四、 說明如何評定公路的服務水準？ (20%)

五、 在計算公路容量時，通常考慮哪些影響因素？（20%）

六、 簡要說明應變視距、停車視距之定義。
一般情形下，何者較大？為什麼？（20%）

九十學年度博士班資格考試題（close book）

科目：施工法

試題：每題 20 分

一、實施地下構造物之開挖作業，由於事前沒有對隆起作適當檢討或由於實際土層狀況與當初預測不同，施工中從量測設備紀錄中發現，有可能發生隆起現象實，試問在這種情況下，應採取哪些補救措施？

二、試述高速公路路堤填方工程施工之作業程序，所用機具、測試方法及應注意事項。

三、預力混凝土樑（或版）使用後拉法時之準備工作及注意事項、施工方法，請說明之。預力混凝土樑常發生不良現象之原因及預防措施爲何？

四、試述過港隧道施工方法。

五、就下列各種工法加以說明（1）NATM 工法（2）電熱鋼模工法（3）預載重工法（4）PIP 工法（5）預鑽工法