Dedan Kimathi University of Technology

University Examinations 2020/2021

SPECIAL EXAMINATION FOR DEGREE OF
MASTERS OF SCIENCE IN GEOTHERMAL ENERGY TECHNOLOGY

EIE 4104: ENGINEERING ECONOMY

DATE: **TIME:** 3 HOURS

INSTRUCTIONS

1. This examination contains two sections, **A and B**
2. Section **A** is **compulsory**
3. Attempt **ONLY ONE** questions in section **B**

SECTION A: COMPULSORY

Q1. (20 Mks)

a) Briefly explain what Engineering economy means and give two examples where (and how) Engineering economy can be applied? (4mks)

b) What is the time value for money (2Mks)

c)

A Wind Plant Controllers Company is developing a new design for 'next generation' Power plant, which will be remotely controlled from a central location. From the historical experiences, the designer earns an average of 400,000 Euros from a 'hit' design and loses an average of 100,000Euros on a 'flop' design. Of all the designs reviewed by the company, only 25% turns out to be a hit while 75% turns out to be a flop.

For 40,000Euros, a market research firm will have a customer's view a pilot of the prospective design and give its view about whether the design will be a hit or a flop. If the design is actually going to be a hit, there is a 90% chance that the market research firm will predict the design to be a hit. If the design is actually going to be a flop, there is an 80% chance that the marketing research firm will predict the design to be a flop. Advice the Designer on:

a) A plausible tool (fully constructed with all values) to use for decision making (4Mks)
b) The most attractive alternative that maximize the expected profit. (4Mks)
c) Should they hire the services of Market Research Expert? If yes, what is the maximum pay should they offer him. (4Mks)

d) What is the VOII and the VOPI (2Mks)

Q2. (20Mks)

a) Outline and discuss the **four** important elements that are required when making a decision under uncertainity (4Mks)

b) A utility company is considering adding a second feed water heater to its existing system unit to increase the efficiency of the system and thereby reduce the fuel costs. The feed water heater is a power plant component used to preheat the water delivered to the boiler to reduce the amount of energy needed to make steam and thus reduce the plant operation cost.

The 150MW unit will cost $1,650,000 and has a service life of 25 years. The expected salvage value of the unit is considered negligible. With the second unit installed, the efficiency of the system will improve from 55% to 56%. The fuel cost to run the feed water is estimated at $0.05KWh. The system unit will have a load factor of 85%, meaning that the system will run 85% of the year (of the total 365 days in an year).

a) Determine the energy consumption of the system before and after the installation of the system. What is the total energy saving in KW after the installation of the system? (3Mks)
b) Determine the Present Worth (PW) and annual worth (AW) of adding the second unit with an interest of 12%. What is the pay back period (in years) for this investment? (5Mks)
c) If the fuel cost increases at the annual rate of 4% after first year, what is the equivalent annual worth of having the second feedwater heater at interest of 12%.? What is the pay back period (in years)? (6Mks)
d) Comparing the results in (b) and (c) above, is the investment justified? (2Mks)

SECTION B: CHOOSE ONE QUESTION ONLY

Q3.(20 Mks)

a) Briefly explain the process of analyzing the various alternatives in Engineering Economy and outline the key information needed for such analysis? (5Mks)

b) An independent dirt contractor is trying to determine which size dump truck to buy. The contractor knows that as the bed size increases, the net income increases, but he is uncertain whether the incremental expenditure required for the larger trucks is justified. The cash flows associated with each size truck are estimated below. The Contractor's MARR is 18% per year, and all trucks are expected to have a useful life of 8 years.
   i. Determine which size truck should be purchased.(Hint: Use ROR and Incremental cash flow analysis) (12Mks)

ii. If two trucks are to be purchased, what should be the size of the second truck? (3Mks)

Truck Bed Size, Cubic Meters	Initial Investment, $	Annual Operating Cost, $/year	Salvage Value, $	Annual Income, $/year
8	−30,000	−14,000	+2000	+26,500
10	−34,000	−15,500	+2500	+30,000
15	−38,000	−18,000	+3000	+33,500
20	−48,000	−21,000	+3500	+40,500
25	−57,000	−26,000	+4600	+49,000

Q4. (20 Mks)

a) Describe the key steps in decision making process in Engineering Economy. (5Mks)

b) A window frame manufacturer is searching for ways to improve revenue from its triple-insulated sliding windows, sold primarily in the far northern areas of the United States. Alternative A is an increase in TV and radio marketing. A total of 300,000€ spent now is expected to increase revenue by 60,000 per year. Alternative B requires the same investment for enhancements to the in-plant manufacturing process that will improve the temperature retention properties of the seals around each glass pane. New revenues start slowly for this alternative at an estimated 10,000€ the first year, with growth of 15,000€ per year as the improved product gains reputation among builders. The MARR is 8% per year, and the maximum evaluation period is 10 years for either alternative. Use both payback analysis and present worth analysis at 8% (for 10 years) to select the more economical alternative. State the reason(s) for any difference in the alternative chosen between the two analyses. (15MKS)

Q5. (20 Mks)

a) Discuss **five** decision situations based on the degree of knowledge or information in the particular situation.(5Mks)

b) The HighTech company manufactures product X, which seems to be very successful. However, recently their market share (for this product) reduced from 20 to 5 percent. An investigation indicates that this reduction was due to a better product on the market. HighTech company considers following three possibilities:

- start an investigation to improve product X
- stop producing product X
- do nothing, and proceed with producing product X

If this investigation yields a positive result, HighTech company finds an improved product, one expects (with a probability of 90 percent) that selling this new product will result in a revenue of 160,000 $. In the other case (10 percent), one expects only a revenue of 20,000 $.

If HighTech company holds the old product X, there is only a chance of 30 percent that revenues will increase from 20,000 $ to 80,000 $. The investigation costs 30,000 $, and will only be successful with a chance of 30 percent. If HighTech company stops producing product X and withdraws it from the market, one can save 30,000$.

i). Construct a decision tree. (7Mks)

ii). What is the optimal policy? (4Mks)

iii). How is the result influenced by the chance of a successful investigation? (4Mks)

APPENDIX: Formulae

$$(F/P,i,n) = (1+i)^n \text{ and } (P/F,i,n) = \frac{1}{(1+i)^n}$$

$$(P/A,i,n) = \frac{(1+i)^n-1}{i(1+i)^n} \text{ and } (A/P,i,n) = \frac{i(i+1)^n}{(1+i)^n-1}$$

$$(F/A,i,n) = \frac{(1+i)^n-1}{i} \text{ and } (A/F,i,n) = \frac{i}{(1+i)^n-1}$$

$$(P_G/G,i,n) = \frac{(1+i)^n-in-1}{i^2(1+i)^n} \text{ and } (A_G/G,i,n) = \frac{1}{i} - \frac{n}{(1+i)^n-1}$$

$$P_g = \frac{A_1\left[1-\left(\frac{1+g}{1+i}\right)^n\right]}{i-g} \; for\; g \neq i \text{ and } P_g = A_1\frac{n}{1+i} \; for\; g = i$$