23

M.Sc. in Civil Engineering

03 October, 2023 (Tuesday)
Time: 02.30 p.m. to 04.00 p.m.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Term: Mid -Semester Examination
Course No: CEE6121
Course Title: Engineering Economics and Project Evaluation

Winter Semester: 2022-2023
Time: 1.5 Hours
Full Marks: 75

There are 3 (Three) questions. Answer ALL the questions. Programmable calculators are not allowed. Do not write on this question paper. The figures in the right margin indicate full marks. Symbols convey their usual meanings. Assume reasonable values for any necessary data where required.

1. (a) Explain capitalized cost with two relevant examples in real-life scenario. (05)

   (b) Five years ago, when the relevant cost index was 120, a nuclear reactor cost $40,000. The reactor had a capacity of separating 1500 gallons of ionized solution per hour. Today, it is desired to build a reactor with capacity of 4500 gallons per hour, but the cost index now is 300. Assuming a power-sizing exponent to reflect economies of scale, x, of 0.75, use the power-sizing model to determine the approximate cost (expressed in today's dollars) of the new reactor. (10)

   (c) Why consideration of break-even point analysis is important in engineering economic analysis? Which estimation technique is used to define annual budget? (05)

   (d) An investor wishes to purchase 100 preference shares with a face value of $10 each that pay 7% per annum. What is the present value of this investment? (05)

2. (a) List the situations and economic criteria in a tabular form, which are usually considered in carrying out present worth analysis for selecting alternatives that would achieve economic efficiency. (05)

   (b) You borrow $10,000 to purchase a car. You must repay the loan in 48 equal end-of-period monthly payments. Interest is calculated at $1\frac{1}{4}\%$ per month. Determine the following: (10)
   (i) The nominal annual interest rate
   (ii) The effective annual interest rate
   (iii) The amount of the monthly payment

   (c) Engineers of a paint manufacturing company have recommended to management an investment of $200,000 now in novel methods that will reduce the amount of wastewater, packaging materials, and other solid waste in their consumer paint manufacturing facility. Estimated savings are $15,000 per year for each of the next 10 years and an additional savings of $300,000 at the end of 10 years in facility and equipment upgrade costs. Draw the cash flow diagram and determine the rate of return. Use relevant data from the following table. (10)

For n=10

i	(P/A, i, n)	(P/F, i, n)
9%	0.4224	0.06582
11%	0.3522	0.05980

3. (a) A product that a life insurance company is selling a retirement annuity. The purchaser is to deposit an amount each year. The amount each year escalates at a constant rate, which the purchaser can choose. Considering the annuity earns 8%, what is it worth at the end of a period of ten years if the annuity amount is $100 and it is increased at a rate of 15% each year? How much difference would there be in the fund if the purchaser escalated payments by 7%? Use relevant formula mentioned below. (15)

(b) What do you understand by economies of scale? Give two real-life examples of diseconomies of scale. (05)

(c) What is compound interest? Name the different analysis-period situations that are encountered in engineering economic analysis. (05)

Relevant Engineering Economic Formulas

Arithmetic Gradient Formulas

Arithmetic gradient present worth:

$$P = G\left[\frac{(1+i)^n - in - 1}{i^2(1+i)^n}\right] = G(P/G, i, n)$$

Arithmetic gradient uniform series:

$$A = G\left[\frac{(1+i)^n - in - 1}{i(1+i)^n - i}\right] = G\left[\frac{1}{i} - \frac{n}{(1+i)^n - 1}\right] = G(A/G, i, n)$$

Geometric Gradient Formulas

Geometric series present worth, where $i \neq g$:

$$P = A_1\left[\frac{1 - (1+g)^n(1+i)^{-n}}{i - g}\right] = A_1(P/A, g, i, n)$$

Geometric series present worth, where $i = g$:

$$P = A_1[n(1+i)^{-1}] = A_1(P/A, g, i, n) = A_1(P/A, i, i, n)$$