

Problem 1. (21 points)

A. $P = \text{Initial Payment} + A(P/A, i\%, n) + G(P/G, i\%, n) - SV(P/F, i\%, n)$

$$P = 500 + 300(P/A, 6\%, 10) + 50(P/G, 6\%, 10) - 200(P/F, 6\%, 10)$$

$$(P/A, 6\%, 10) = \frac{(1+i)^n - 1}{i(1+i)^n} = \frac{(1+.06)^{20} - 1}{.06(1+.06)^{20}} = 7.3603$$

$$(P/G, 6\%, 10) = \frac{(1+i)^n - (i \cdot n) - 1}{i^2(1+i)^n} = \frac{(1+.06)^{20} - (.6)1}{(.06)^2(1+.06)^{20}} = 29.5957$$

$$(P/F, 6\%, 10) = \frac{1}{(1+i)^n} = \frac{1}{(1+.06)^{10}} = .5584$$

$$P = \$4,076$$

B. $P = \text{Initial Payment} + F_1(P/F_1, i\%, g\%, n) - SV(P/F, i\%, n)$

$$P = 500 + 400(P/F_1, 6\%, 10\%, 10) - 800(P/F, 6\%, 10)$$

$$(P/F, 6\%, 10\%, 10) = \frac{(1+i)^n - (1+g)^n}{(i-g)(1+i)^n} = \frac{(1.06)^{10} - (1+.10)^{10}}{(.06 - .10)(1.06)^{10}} = 11.2082$$

$$P = \$4,537$$

C. $P = \text{Initial Payment} + 0 + A(P/A, i\%, n=5)(P/F, i\%, n=5) - SV(P/F, i\%, n)$

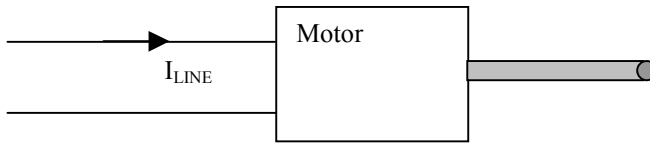
$$P = 500 + 0 + 1,000(P/A, 6\%, 5)(P/F, 6\%, 5) - 200(P/F, 6\%, 10)$$

$$(P/A, 6\%, 5) = \frac{(1+i)^n - 1}{i(1+i)^n} = \frac{(1+.06)^5 - 1}{.06(1+.06)^5} = 4.2131$$

$$(P/F, 6\%, 5) = \frac{1}{(1+i)^n} = \frac{1}{(1+.06)^5} = .7473$$

$$P = \$3,537$$

Problem 2. (18 points)



- A. Cost = input power in kilowatts x \$.05/KW-hr x 360 days/year x 12 hours/day

$$\text{Cost} = 40\text{KW} \times \$.05/\text{KW-hr} \times 360\text{days/year} \times 12\text{hours/day} = \$8,640$$

- B. Line Current = $\frac{P / PF}{V} = \frac{40 \times 10^3}{200(.8)} = 250$ amperes

$$\text{Power Lost} = I^2 R = (250)^2 (3 \times 10^{-3}) = 187.5 \text{ watts}$$

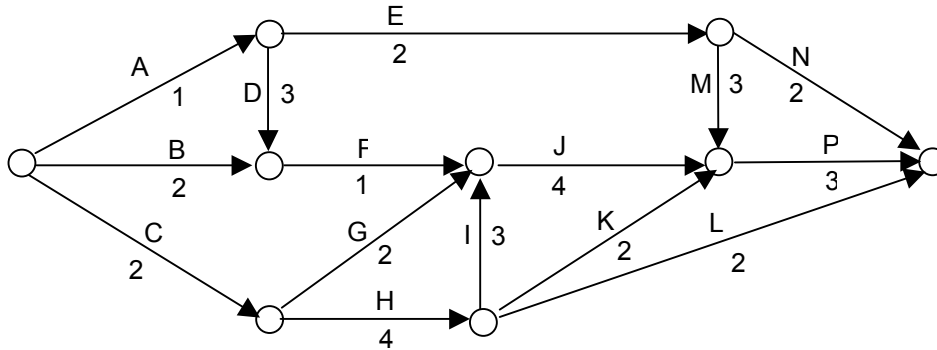
- C. (i) A less lagging power factor for the plant would mean lower current for the same real power to the plant. The lower current would produce less power loss in the line, so the power company would be willing to charge a reduced rate.
- (ii) If the motor (synchronous) were operated at a less lagging power factor at a leading power factor, the motor would probably be less efficient, requiring more input power for a given output

Problem 3. (8 points)

- A. The project completion time for a PERT Chart is assumed to be a normally distributed random variable. This assumption is most closely related to the concept that the individual activity times are uncorrelated random variables, and the central limit theorem applies to the sum. (b)
- B. The design methodology described in the Power PC computer design case study is staggered parallelism of design. (c)

Problem 4. (20 points)

A. (8 points)



Critical Path=longest path=C H I J P

Project Duration=length of critical path=16

B. (6 points)

(i) Activity G: Latest start = Project duration-length of longest backward path

Latest start for Activity G=16-9=7

Earliest start for Activity G=2

Float for Activity G=7-2=5

(ii) Float for Activity I=0, since all activities on the critical path have a float of zero.

C. (6 points) Project duration = 15 months

standard deviation = 6 months.

Probability that the project will require greater than 9 months to complete obtained from tail-end Z distribution.

$$Z=(9-15)/6 = -1$$

$$P(Z>-1)=1-Z(1) = 1-.159=.841$$

$$\text{Probability}=.841$$

Problem 5. (9 points)

A. The term recyclability means the capability of being able to have the constituent materials extracted and reprocessed for use in another device. The term reuse refers to putting a device, or a modular part of a device, into service again. If there is a change in technology, the reuse process may become uneconomical. # 1

- B. Between is used when there are two persons or items; among is used when there are more than two: between the two students, among the three students. Affect is usually used as a transitive verb, meaning “to influence.” Effect is usually the one used as a noun, meaning the intent, appearance, or the accomplishment.” #2
- C. Less applies to matters of reduced degree; fewer applies to items that are countable. One would say “fewer students,” as opposed to “less students”, which is incorrect. Less is usually used to describe distances: “less than 500 kilometers” is correct. #1

Problem 6. (15 points)

- A. For the accelerated cost recovery method of depreciation, the depreciation expense charged is determined by multiplying the unadjusted basis times a percentage. The percentage is determined by law for each class of property. Salvage value and actual working life is irrelevant. (False)
- B. Although the uncertainty principle is usually used to describe the behavior of elementary particles, it also makes predictions that apply to ordinary physical objects, for example, maximum length of time that a sharp object can be balanced, or the maximum number of deterministic collisions of billiard balls. (False)
- C. A prototype, which is defined as an original model designed to be used as a basis for more refined versions is an independent concept from that of modular, which means that the design consists of an assemblage of separate component assemblages. (False)
- D. The term semiannual means occurring twice a year. Biennial means every two years; hence, semiannual payments occur four times more often than do biennial payments. (True)
- E. For the Payback Period method of project comparison, one merely determines the amount of time required to recoup the original investment, without regard for the time-value of money. One does not use the P/F factor (False)

Problem 7. (9 points)

Specification: $T < 1800$. Two batches of 10,000 fasteners

Batch A: mean $T = 1,200$
Standard deviation $T = 400$

Batch B: mean $T = 1,600$
Standard deviation $T = 300$

Fraction of expected defects, $A = Z((1800-1200)/400) = Z(1.5) = .0668$

Fraction of expected defects, $B = Z((1800-1600)/300) = Z(.67) = .2514$

A has the lower fraction

Number of expected defects, $A = .0668(10,000) = 668$