ECE 4000 RC
Quiz #1 Solution 2/5/03

1. A. $P = F(P/F, i\%, n)$

$P = 6{,}000\,(P/F, 8\%, 4)$

$$(P/F, 8\%, 4) = \frac{1}{(1+i)^n} = \frac{1}{(1.08)^4} = .7350$$

$P = 6{,}000(.7350) = \$4{,}410$

B. 9% per year, nominal $= \frac{9\%}{3} = 3\%$ every 4 months

4 years = 12 periods

$F = A\,(F/A, 3\%, 12)$ [Note: A = payment every 4 months]

$$(F/A, 3\%, 12) = \frac{(1+i)^n - 1}{i} = \frac{(1.03)^{12} - 1}{.03} = 14.1920$$

$F = 10{,}000\,(14.1920) = \$141{,}920$

C. Let K_1 = 1st four payments = 8,000

K_2 = 4,000 = last two payments − K_1

several solutions

$P = K_1\,(P/A, 8\%, 6) + K_2\,(P/A, 8\%, 2)(P/F, 8\%, 4)$

or

$P = (K_1 + K_2)(P/A, 8\%, 6) - K_2\,(P/A, 8\%, 4)$

or

$P = K_1\,(P/A, 8\%, 4) + (K_1 + K_2)\,(P/A, 8\%, 2)(P/F, 8\%, 4)$

RC

$$(P/A, 8\%, 6) = \frac{(1.08)^6 - 1}{.08(1.08)^6} = 4.6229$$

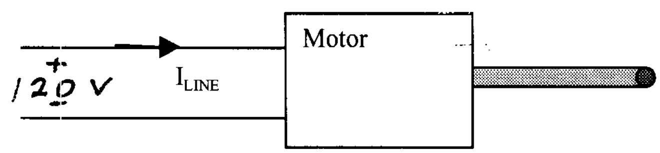
$$(P/A, 8\%, 2) = \frac{(1.08)^2 - 1}{.08(1.08)^2} = 1.7833$$

$$(P/F, 8\%, 4) = \frac{1}{(1.08)^4} = .7350$$

$$P = (8,000)(4.6229) + 4,000(1.7833)(.7350)$$

$$P = \$42,226$$

2.



A. $$\text{COST} = \text{OUTPUT Power in Kilowatts} \cdot \frac{1}{\text{Efficiency}} \cdot \frac{\$.07}{\text{KW-hr}} \cdot \frac{300 \text{ days}}{\text{year}} \cdot \frac{8 \text{ hr}}{\text{day}}$$

$$\text{COST} = \frac{30 \text{ KW}}{.8} \times \frac{\$168}{\text{KW-year}}$$

$$\text{COST} = \$6,300/\text{year}$$

B. $$P = F_1 (P/F_1, i\%, g\%, n)$$

$$(P/F_1, 6\%, 8\%, 6) = \frac{(1+i)^n - (1+g)^n}{(i-g)(1+i)^n} \qquad 1.06)^6 - (1.08)^6$$

$$P/F_1 = 5.9342$$

$$P = 800(5.9342) = \$4,747$$

C(i) the line current is the APPARENT Power DIVIDED BY the Voltage, or

$$I_L = \frac{P}{V(PF)}$$

If we specify V to be the source voltage, then P is the total power of load plus line, and PF is the total (overall) power factor of load plus line. The line is lagging. The more lagging the load, the lower the value of the overall power factor, and the larger the line current. Since losses in the power line are $I_{line}^2 R_{line}$, the power company offers incentives to the plant in the form of rate reductions if the motor operator changes the power factor of the motor to a value closer to unity.

(ii) there may be practical reasons for an actual situation where the lowest cost solution, as determined by calculation, may not be the best choice. Examples of other factors that relate to recitation # 3 are:

Another solution may allow greater plant expansion.

One may desire all motors to be the same type, so only one set of spare parts is necessary, thereby reducing maintenance expense.

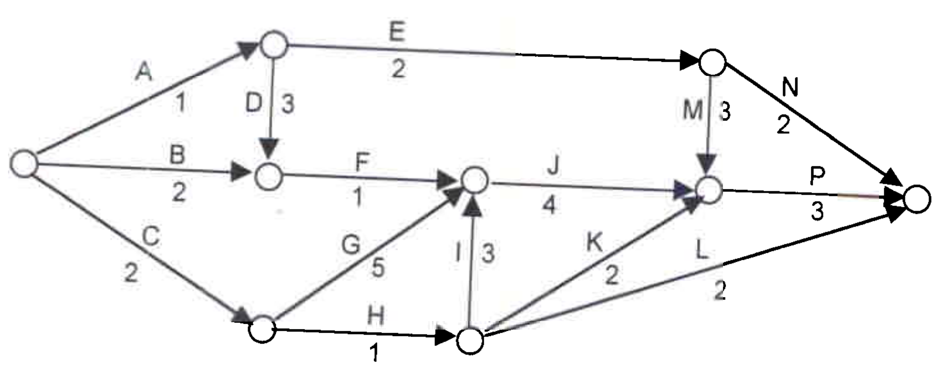
May be able to negotiate a better purchase price if use only one vendor, assuming two types would require two vendors.

3A. The primary advantage of PERT charts over CPM diagrams for project scheduling is that PERT charts allow for variations in time for each activity and allow for a probabilistice estimate of a given delay. CPM diagrams only have a single number. Both PERT charts and CPM diagrams show logical precedence relations. GANTT charts show chronological relations among the various activities more clearly. (c)

B. 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. (b)

C. Recitation #2 discussed the staggered parallel development of a family of microprocessors to produce progressively high performance machines. (c)

4.



A. Critical path = Longest path
= CGJP

RC

B. Length of critical path = project duration

$= C + G + J + P = 2 + 5 + 4 + 3 = 14$

(i) Latest start = project duration − length of longest backward path

Latest start for activity I = $14 - 10 = 4$

[Note: backward path = PJI]

Earliest start for activity I = CH = $2 + 1 = 3$

Float for activity I = LS − ES = $4 - 3 = 1$

(ii) Float for activity J = 0, since all activities on the critical path have float = 0.

C. Standard deviation = σ = 3 months

$$Z = \frac{T - T_e}{\sigma} = -\frac{18 - 14}{3} = -1.333$$

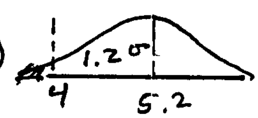
From tail-end Z distribution,

$\text{Prob}(Z < -1.333) = \text{Prob}(Z > 1.333) = Z(1.333) = .091$

$= 9.1\%$

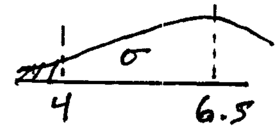
5. Two quiz versions: $R > 4 \times 10^6$

Mean = 5.2×10^6 $\quad Z\left(\frac{5.2 - 4}{1}\right) = Z(1.2)$



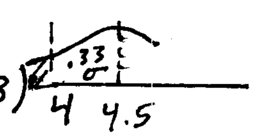
$\sigma = 10^6$

Mean = 6.5×10^6 $\quad Z\left(\frac{6.5 - 4}{2.5}\right) = Z(1)$



$\sigma = 2.5 \times 10^6$

Mean = 4.5×10^6 $\quad Z\left(\frac{4.5 - 4}{1.5}\right) = Z(.33)$



$\sigma = 1.5 \times 10^6$

For least number of defects, need Z of largest = Z(1.2)

This is batch A for one quiz and batch B for the other quiz.

RC

$Z(1.2) = .11507$

The number of defects for a batch of 100,000 devices is

Number $= .11507(100{,}000) = 11{,}507$