Problem 1. (26 points)

For each motor, the present value of the operating cost =
Purchase Price (not considered here) + Present value of (Maintenance +Electricity –Salvage Value). There are several approaches.

Motor #1:
Cost= 3,000(P/A, 6%, 10)+3000(P/A, 6%, 10)+1000(P/A, 6%, 5) (P/F,6%,5) -500(P/F,6%,10)
Cost= 6,000(7.3603)+1000(4.2124)(.7473)-500(.5584)
Cost=$47,034

Motor #2:
Cost= 2,000(P/A, 6%, 10)+400(P/G, 6%, 10)+4,000(P/A, 6%, 10) -500(P/F,6%,10)
Cost= 2,000(7.3603)+400(29.6)-500(.5584)
Cost=$55,726

Motor #3:
Cost=3,000(P/A, 6%, 10)+3,000(P/F_1, 6%, 4%, 10) -1000(P/F,6%,10)
Cost=3,000(7.3603)+3,000(8.6721)-1,000(.5584)
Cost=$47,54 1

Cheapest Motor: #1

The following factors were used:

(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/A, 6%, 5)= $\frac{(1+i)^n-1}{i(1+i)^n} = \frac{(1+.06)^{5}-1}{.06(1+.06)^{5}}$ =4.2124

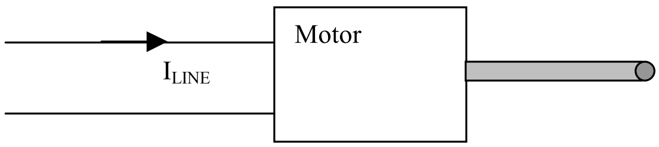
(P/G, 6%, 10)= $\frac{(1+i)^n-(i\bullet n)-1}{i^2(1+i)^n} = \frac{(1+.06)^{20}-(.6)1}{(.06)^2(1+.06)^{20}}$ =29.5957

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

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

(P/F_1, 6%,4%,10)= $\frac{(1+i)^n-(1+g)^n}{(i-g)\ (1+i)^n} = \frac{(1.06)^{10}-(1+.04)^{10}}{(.06-.04)(1.06)^{10}}$ =8.6721

Problem 2. (18 points)



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

input power = output power/efficiency

Cost =(40KW/.9) x $.04/KW-hr x 300days/year x 12hours /day = $6,400

B. $P_{out} = V_T I_L (PF)(Eff)$

$[V_T I_L (PF)(Eff)]_1 = [V_T I_L (PF)(Eff)]_2$

Initial Line Current= 200 amperes

$$I_{L2} = I_{L1} \frac{PF_1}{PF_2} \frac{Eff_1}{Eff_2} = 200 \frac{.8}{.6} \frac{.9}{.8} = 300 \text{ amperes}$$

C. A rate of 8% nominal, compounded every three months, corresponds to 2% four times per year.

A=20,000(A/P,2%,40)

$$(A/P, 2\%, 40) = \frac{i(1+i)^n}{i(1+i)^n - 1} = \frac{.02(1+.02)^{40}}{(1+.02)^{40} - 1} = .0366$$

A=20,000(.0366)=$731

Problem 3. (8 points)

A. The primary advantage of Gantt charts over CPM diagrams for project scheduling is that Gantt charts clearly show the chronological relations completion time among the various activities; CPM diagrams more clearly show the logical precedence relations. (a)

B. The use of self-contained sub-assemblies is an example of modularity. A design would probably be partitioned to be modular, but it would be possible to have a partitioned design that is not modular. (b)

C. A utility company sometimes adjusts the cost of power if a purchaser adjusts the load power factor to be less lagging (closer to unity). A plant I s normally lagging because of the presence of lagging machinery, and the line is also lagging. 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. (b)

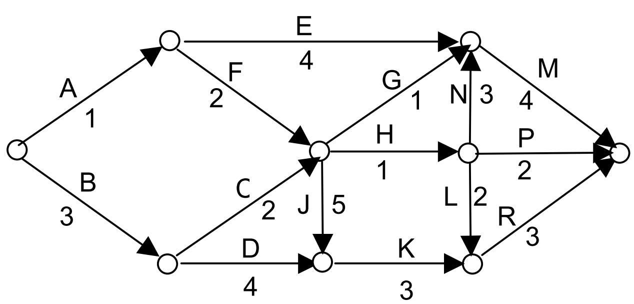
D. Number of bands = 20,000 (1-Z (x))

x=(1,200-800)/200 =

Number =20,000(1-Z(2))=20,000(1-.15866)=19,495 bands (e)

Problem 4. (20 points)

A. (8 points)



Critical Path=longest path=B C J K R

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=16-5=11

Earliest start for Activity G=5

Float for Activity G=11-5=6

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

C. (6 points) Project duration = 18 months
standard deviation = 6 months.
Probability that the project will require greater than 15 months to complete obtained from tail-end Z distribution.

Z=(15-18)/6 = -.5

P (Z>-.5)=1—Z(.5) = 1-.3085=.691

Probability .691

Problem 5. (9 points)

A. Partitioning is the separating of a design into multiple parts at the same level of abstraction. This separation allows multiple items to be tackled in parallel. The calendar time to completion is determined by the longest part, in general, shorter than that of a less partitioned design, even at the expense of requiring more personnel. # 2

B. In group decision–making, the number of possible communication interactions is not linearly proportional to the number of group members. If the group has N members, each member can interact with N-1 others. By considering each member, there are N(N-1)/2 possible interactions, with the 2 in the denominator preventing double counting. For large N, the leading term is N2/2. #1

C. The term biannual means either every two years or twice a year; the term semiannual only means occurring twice a year. #2

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. It is called accelerated because more of the expense is allocated to the earlier periods, in order to lower income taxes and encourage investment. (True)

B. The effective rate of interest is always greater than the nominal rate if the compounding period is less than one year. If the compounding rate is one year, then the effective rate is equal to the nominal rate. (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 book value is equal to the purchase price minus the accumulated depreciation. The book value therefore decreases with time. For straight line depreciation, the book value becomes equal to the estimated salvage value at the end of the estimated life of the item. (False)

E. For a series of 40 annual payments such that each payment is 9% greater than the previous payment, then the tenth payment is equal to the first payment times $(1.09)^9$=first payment times 2.17, greater than twice the first payment of the series. (True)