Problem 1. (20 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.

Version #1:
Motor #1:
Present Cost= 3,000(P/A, 12%, 5)+500(P/G, 12%, 5)+200 (P/A,1.5%,60) -600(P/F,12%,5)
Present Cost= 3,000(3.6048)+500(6.3970))+200 (39.3803)-600(.5674)
Present Cost=$21,549
Motor #2:
Present Cost= 25,000(P/F, 12%, 4)+300(P/A, 1.5%,60)-800(P/F,12%,5)
Present Cost= 25,000(.6355)+300(39.3803)-800(.5674)
Present Cost=$27,248

Cheapest Motor: #1

Version #2:
Motor #1:
Present Cost= 3,000(P/A, 12%, 5)+500(P/G, 12%, 5)+300 (P/A,1.5%,60) -600(P/F,12%,5)
Present Cost= 3,000(3.6048)+500(6.3970))+300 (39.3803)-600(.5674)
Present Cost=$25,487
Motor #2:
Present Cost= 25,000(P/F, 12%, 4)+200(P/A, 1.5%,60)-800(P/F,12%,5)
Present Cost= 25,000(.6355)+200(39.3803)-800(.5674)
Present Cost=$23,310

Cheapest Motor: #2

Version #3:
Motor #1:
Present Cost= 5,000(P/A, 12%, 5)-500(P/G, 12%, 5)+200 (P/A,1.5%,60) -600(P/F,12%,5)
Present Cost= 5,000(3.6048)-500(6.3970))+200 (39.3803)-600(.5674)
Present Cost=$22,361
Motor #2:
Present Cost= 25,000(P/F, 12%, 3)+300(P/A, 1.5%,60)-900(P/F,12%,5)
Present Cost= 25,000(.7118)+300(39.3803)-900(.5674)
Present Cost=$29,098

Cheapest Motor: #1
The factors were obtained from the tables supplied.

Problem 2. (24 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. Recycling is the process whereby a discarded product is returned to its basic material components. This is an expensive process. Technology changes would not normally render the materials worthless, because they normally could just be used in another product 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 (a)

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

D. 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 is 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. One way to achieve a less lagging plant is to operate the synchronous machines at a leading power factor, but this is a less efficient mode of operation, resulting in more electricity usage for the same mechanical power. The fundamental trade-off is therefore efficiency of motor operation versus power rate. More electricity usage is required at the cheaper rate. (b)

E. For 8 annual payments, each increasing by 5 % over the previous one, with the first of the eight payments of amount F_1, with an initial payment of 10,000 occurring immediately, at an interest rate of 8%. $50{,}000=10{,}000 + F_1$ (P/ F_1, 8%, 5%, 8) $F_1=40{,}000(.14868)=\$5{,}947$ (b)

F. Two resistors are in series such that $R_{eq}=R_1+R_2$. The R_1 batch has a mean of 4 kilohms and a standard deviation of 200 ohms, and the R_2 batch has a mean of 6 kilohms and a standard deviation of 300 ohms. Th e mean of R_{eq} is 4+6=10 ohms, and the standard deviation of R_{eq} is $\{(200^2 +300^2)\}^{1/2}$ =361 ohms. (d)

Version #2:

A. The primary advantage of PERT charts over CPM diagrams for project scheduling is that PERT charts allow for a variation in time for each activity. The disadvantage is that one has to estimate an optimistic time and a pessimistic time, in addition to a most likely time. (c)

E. For 8 annual payments, each increasing by 5% over the previous one, with the first of the eight payments of amount F_1, with an initial payment of 10,000 occurring immediately, at an interest rate of 8%. $60{,}000=5{,}000 + F_1$ (P/ F_1, 8%, 5%, 8) $F_1=55{,}000(.14868)=\$8{,}177$ (d)

Problem 3. (9 points)

A. The term biennial only means occurring every two years; the term semimonthly means occurring twice a month. #2

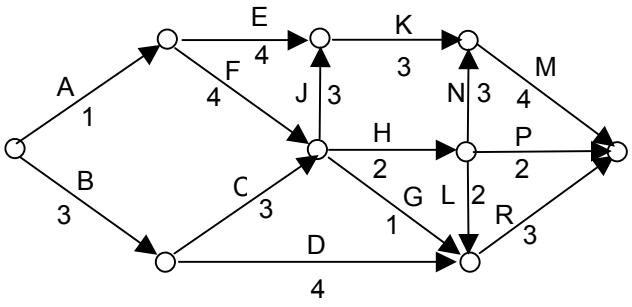
B. Affect is usually used as a transitive verb, meaning “to influence.” Effect may be used as a noun or as a verb. When used as a noun, it means the intent, appearance, or the accomplishment. Effect used as a transitive verb means “to accomplish.” #2

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. A hierarchical system has an item at one level of abstraction composed of multiple items at the next lower level. 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 simulation, which means that the operation or features of a process is represented through another process. The representation is usually theoretical in nature. #2

Problem 4. (13 points)

Version #1:

A. (7 points) terms of activity letters in order from start to finish. Example: AEKM, duration=12



Critical Path=longest path=B C J K M

Project Duration=length of critical path=16

B. (6 points)

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

(ii) Activity H: Latest start = Project duration -length of longest backward path

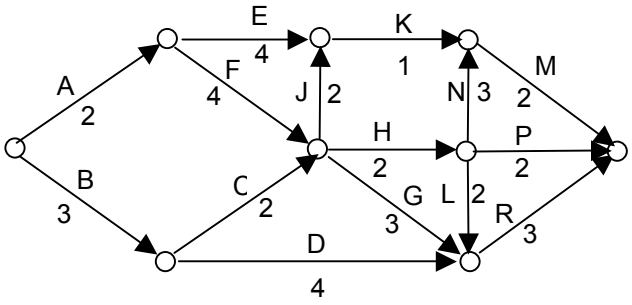
Latest start for Activity K=16-9=7

Earliest start for Activity K=6

Float for Activity K=7-6=1

Version #2:

A. (7 points) terms of activity letters in order from start to finish. Example: AEKM, duration=12



Critical Path=longest path=A F H L R or A F H N M

Project Duration=length of critical path=13

B. (6 points)

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

Latest start for Activity G=13-6=7

Earliest start for Activity G=6

Float for Activity G=7-6=1

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

Latest start for Activity J=13-5=8

Earliest start for Activity J=6

Float for Activity J=8-6=2

Problem 5. (15 points)

Version #1

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. 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)

C. 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. There is no defined relation to the market value. (False)

D. The effective rate of interest is always greater than the nominal rate if the compounding period is less than one year, assuming a non-zero rate. (False)

E. In group decision–making, the number of possible communication interactions is not linearly proportional to the number of group members. If th e 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. (False)

Version #2

A. See C above.

B. See B above

C. See A above

D. See D above

E. See E above

Problem 6. (9 points)

Specification: target mean=2,600; LSL= 2,000 ; no USL;

Version #1:
Batch A
One batch of 10,000 inductors;
actual mean=2,800
standard deviation=400
Fraction of expected defects, Z((2,800-2,000)/400)=Z(2.0)

Batch B
One batch of 10,000 inductors;
actual mean=2,450
standard deviation=150
Fraction of expected defects, Z((2,450-2,000)/150)=Z(3.0)

Batch B has the least number of defects.

Number of defective inductors = .00135(10,000)=14

Batch A

USL=4,000

Cp = (USL – LSL) / (6 sigma) = (4,000 – 2,000) / (6)(400)

Cp = 0.833

Cpk = Cp (1 – k)

k = | Actual Mean – Target Mean | / ((USL – LSL) / 2) = | 2800 – 2600 | / ((4000 – 2000) / 2)=.2

Cpk = 0.833 (1 – .2)=.67

Cp less than one. Design not tolerant.

Version #2:
Batch A
One batch of 10,000 inductors;
actual mean=2,450
standard deviation=150
Fraction of expected defects, Z((2,450-2,000)/150)=Z(3.0)

Batch B
One batch of 10,000 inductors;
actual mean=2,800
standard deviation=400
Fraction of expected defects, Z((2,800-2,000)/400)=Z(2.0)

Batch A has the least number of defects.

Number of defective inductors = .00135(10,000)=14

Batch A

USL=4,000

Cp = (USL – LSL) / (6 sigma) = (4,000 – 2,000) / (6)(150)

Cp = 2.22

Cpk = Cp (1 – k)

k = | Actual Mean – Target Mean | / ((USL – LSL) / 2) = | 2450 – 2600 | / ((4000 – 2000) / 2)=.15

Cpk = 2.22 (1 – .15)=1.89

Cp greater than one. Design tolerant.