

EXAM # 1 SUMMER 2004

Name: KEY

Student #: _____

Problem 1. (26 points)

A company is considering various options for purchasing a new piece of manufacturing equipment. The price of the equipment is \$50,000. It is estimated that the equipment will be worthless after 10 years of service. Compute the best monetary value for the company for each option listed below. Assume an interest rate of 8%.

Hints: See supplied frequently asked question sheet or engineering economy formulas.

Option #1: Pay \$10,000 down now, and a final payment of \$40,000 at the end of year 2.

Formulas used for option #1 (3 pts) $(P/F, 8\%, 2)$

$$\begin{aligned} \text{Present value for option \#1 (3 pts)} &= \$10,000 + \$40,000(P/F, 8\%, 2) \\ &= \$10,000 + \$40,000(0.8573) \\ &= \underline{\underline{\$44,292}} \end{aligned}$$

Option #2: No payments until the end of year 6, and then make a payment of \$10,500 each year for a total of 5 years.

Formulas used for option #2 (3 pts) $(P/A, 8\%, 5), (P/F, 8\%, 5)$

$$\begin{aligned} \text{Present value for option \#2 (3 pts)} &= \$10,500(P/A, 8\%, 5)(P/F, 8\%, 5) \\ &= \$10,500(3.9927)(0.6806) \\ &= \underline{\underline{\$28,533}} \end{aligned}$$

Option #3: Pay for the equipment in two installments of \$25,000. The first payment of \$25,000 is due at the end of year 2, and a last payment of \$25,000 is due at the end of year 4.

Formulas used for option #3 (3 pts) $(P/F, 8\%, 2) + (P/F, 8\%, 4)$

$$\begin{aligned} \text{Present value for option \#3 (3 pts)} &= \$25,000[(P/F, 8\%, 2) + (P/F, 8\%, 4)] \\ &= \$25,000[(0.8573) + (0.735)] \\ &= \underline{\underline{\$39,808}} \end{aligned}$$

Option #4: Make an initial down payment of \$6,000 and 7 annualized payments of \$6,150.

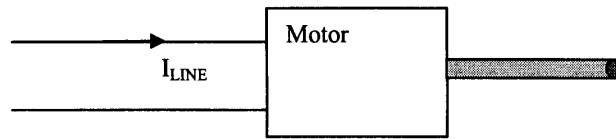
Formulas used for option #4 (3 pts) $(P/A, 8\%, 7)$

$$\begin{aligned} \text{Present value for option \#4 (3 pts)} &= \$6,000 + \$6,150(P/A, 8\%, 7) \\ &= \$6,000 + \$6,150(5.2064) \\ &= \underline{\underline{\$38,019}} \end{aligned}$$

Best Option (2 pts) #2

Problem 2. (18 points)

For this problem an interest rate of 6% is appropriate. The ac single phase motor operates at a line voltage of 440 volts, a constant output power of 50 KW, a power factor of 0.85 lagging and an efficiency of 80%. The purchase price of the motor is \$25,000.



- A. (4 points) Determine the cost of power for one year for the motor, assuming that it operates 312 days per year, 20 hours per day, and at a cost of power of \$.05 per KW-hr.

$$P_{in} = P_{out}/\text{eff} = \frac{50\text{KW}}{0.8}$$

$$\text{Cost} = \underline{\$19,500}$$

$$\$/\text{yr} = \frac{\$0.05}{\text{KW-hr}} \cdot \frac{20\text{hr}}{\text{day}} \cdot \frac{312\text{days}}{\text{yr}} \cdot \frac{50\text{KW}}{0.8}$$

- B. (4 points) Determine the line current required to produce this constant output power of 50 KW.

$$P_{in} = \frac{P_{out}}{0.8} = |V| |I| \text{PF}$$

$$\text{Line Current} = \underline{167.1 \text{ amps}}$$

$$|I| = \frac{50,000}{0.8} \frac{1}{440(0.85)} = 167.1 \text{ amps}$$

$$|I| = \frac{P_{out}}{0.8} \frac{1}{|V| \text{PF}}$$

- C. (4 points) Determine the new value of line current, assuming the same motor terminal voltage and output power, but a power factor of 0.7 lagging and an efficiency of 90%.

$$\text{New Line Current} = \underline{180.4 \text{ amps}}$$

$$|I| = \frac{50,000}{.9} \cdot \frac{1}{440(0.7)} = 180.4 \text{ amps}$$

- D. (6 points) It is proposed that the purchase price of the motor be paid over 10 years with 20 equal payments, i.e. one payment due every 6 months. Assume that the nominal yearly interest rate is 6%. Determine the amount of each payment. Assume the first payment is due at the end of the first 6 months.

$$\text{Payment Amount (4 pts)} = \underline{\$1680.45}$$

$$25,000 = A \cdot (P/A, 3\%, 20) = A(14.877)$$

$$A = \$25000/14.877 = \$1,680.45$$

Problem 3. (12 points)

Answer the following multiple choice questions by circling the letter in front of the most appropriate response.

- A. The primary advantage of CPM over Gantt Charts diagrams for project scheduling is that
- (a) CPM charts clearly show the chronological (time) relations among the various activities
 - (b) CPM charts show the logical precedence relations more clearly than do Gantt charts
 - (c) CPM more clearly illustrate parallel design processes than do Gantt charts
 - (d) CMP charts add probability estimates for the time to complete various tasks
 - (e) CMP charts are more widely used and understood by high level managers
- B. For all car models, the door panels are redesigned by Ford motor company to permit use of the same door locking mechanism. The new design is wireless and lock codes are electronically programmable. This is an example of
- (a) hierarchy in design
 - (b) modularity in design
 - (c) partitioning in design
 - (d) prototyping in design
- C. A utility customer usually increases the power factor of an electric motor
- (a) in order to make it operate more efficiently.
 - (b) by adding an inductor in series with the motor.
 - (c) to reduce power company line losses, and therefore purchase power at a lower rate.
 - (d) to increase the line current.
- D. The speed was recorded for 20,000 automobiles traveling on a freeway. The mean speed traveled was 68 mph, and the standard deviation was 2.67 mph. For a traffic rate of 500 cars per hour, what is the mean time that a police officer would have to wait to catch a speeder, i.e. car traveling equal to or greater than 76 mph? Assuming a normal distribution, which answer below best represents the answer?

- (a) 24 minutes
- (b) 48 minutes
- (c) 1 hour and 17 minutes
- (d) 1 hour and 29 minutes
- (e) 3 hours and 15 minutes

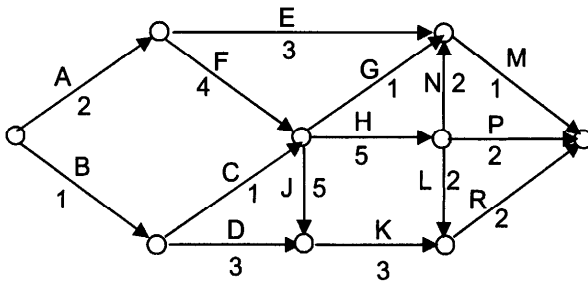
$$z = \frac{76 - 68}{2.67} = 2.996 \approx 3.0$$
$$\text{Prob}(x > 3.0) = 0.00135$$

or 1.35%

$$0.00135 (500) \text{ cars per hr are speeding} = 0.675$$
$$\left(\frac{\text{Wait Time}}{1 \text{ car}} \right) = \left(\frac{60 \text{ minutes}}{0.675 \text{ cars}} \right) \approx 89 \text{ min}$$

Problem 4. (20 points)

A. (8 points) Determine the critical path, and its duration, for the following CPM chart. State the path in terms of activity letters in order from start to finish. Example: AEM, duration = ~~6~~ **16**



LIST PATHS

- AEM = 6
- AFGM = 8
- AFHNM = 14
- AFHP = 13
- AFJKR = 16
- AFHLR = 15

- BCGM = 4
- BCHNM = 10
- BCHP = 9
- BCHLR = 11
- BCJKP = 12
- BDKR = 9

Critical Path and Duration AFJKR, 16

B. (6 points) Determine the float for

(i) Activity G

(CRIT PATH) - (LONGEST TIME WITH G)
 Float G = 8 $16 - 8 = 8$

(ii) Activity J

Float J = 0 ON CRITICAL PATH,

C. (6 points) Assume that, for a slightly different diagram, a PERT chart, the project duration is 18 months and the standard deviation is 6 months. Determine the probability that the project will require greater than 15 months to complete.

Compute Prob (<15m)

$z = \frac{15-18}{6} = -0.5$

Prob(x < z) = 0.3085

Probability = 0.6915 (69.15%)

$\therefore \text{Prob}(x > z) = 1 - \text{Prob}(x < z) = 1.0 - 0.3085 = 0.6915$

Problem 5. (9 points)

For each of the sentence pairs below, select the sentence (#1 or #2) that is **incorrect**, by either word usage, spelling, or content (do not consider punctuation).

- A. #1 In the design process, one of the major advantages of partitioning is that, since there are more divisions, it is easier to manage the project.
#2 In the design process, one of the major advantages of partitioning is the ability to work on multiple tasks in parallel, leading to shorter calendar time to completion.
- B. #1 For a large group, the number of possible communication interactions is approximately proportional to the square of the number of group members.
 #2 For a large group, the number of possible communication interactions is approximately proportional to the factorial of the number of group members.
- C. #1 A semiannual payment can mean a payment due approximately every two years.
#2 A biannual payment can mean a payment due approximately every two years.

Problem 6. (15 points)

For each of the following statements, circle either TRUE or FALSE.

- A. For the MACRS method of depreciation, the salvage value is treated the same as the straight line depreciation method. TRUE FALSE
- B. The effective rate of interest is usually less than the nominal rate for a given calculation. TRUE FALSE
- C. Designing for modularity often decreases the cost of a prototype. TRUE FALSE
- D. The book value of a piece of capital equipment should always = market value (selling price). TRUE FALSE
- E. For a series of 30 annual payments such that each payment is 8% greater than the previous payment, then the tenth payment is greater than twice the first payment of the series. TRUE FALSE

$$\text{Payment \#10} = (1.08)^9 = 1.999 \times \text{First payment}$$