***Engineering Economy and management- 3rd year Civil Engineering Dr. Khalil I. Wali***

***80 Questions for 1st &2nd Semesters:***

**Q.1:**

A local construction company producing concrete blocks. The variable cost per unit is $40 and the fixed cost that can be allocated to the production is negligible. The relationship between demand and price is approximately D = 36 – 0.20P, where D represents demand in units sold per week and P is price in dollars. Work out the complete solution by differential formula for profit to determine:

1. The optimum number of blocks should be produced in order to maximize profit per week?

2. Draw the curve of profit against a range of 2 to 20 units of blocks produced in step of 2.

**Q.2:**

A company produced and sells a product and seeking to maximize its net profit. It has concluded that the relationship between price and demand per month is approximately

D = 500 – 5P, where P is the price in dollars. The company’s fixed costs are $2000 per month and the variable costs are $40 per unit, by using differential formula for profit to determine the following:

1. The number of units should be produced and sold to maximize the net profit?

2. The breakeven point, total costs, total revenues and maximum profit?

3. Draw breakeven chart showing all parameters determined in 2 above on the chart?

 **Q.3:**

A company produces an electronic timing switch that is used in consumer and commercial products made by several other manufacturing firms. The fixed cost is $80000 per month, and variable cost is $80 per unit. The selling price per unit is determined by P = $180 – 0.02 D. for this situation determine:

1. The optimal volume for this product and confirm that a profit occurs (instead of loss) at this demand?

2. Find the volumes at which breakeven occurs and what is the domain of profitable demand?

3. Draw breakeven chart showing all parameters determined in 1 &2 above?

**Q.4:**

A company estimates as it increases its sales by decreasing the selling price of its product, the revenue changes in accordance with the following relationship:

Revenue = aD - bD² where D represents the units of demand per month. The company has fixed costs of $1000 per month, and the variable costs are $4 per unit. If a = $6 and b = $0.001, determine the sales volume for maximum profit and the maximum profit per month?

**Q.5:**

For a certain piece of equipment the maintenance expenditures are expected the amount of $100 for the first year, $200 for the second, $500 for the third year and $400 for each year from the fourth through the eighth year. Draw the cash flow diagram and calculate the equivalent of:

1. Present Worth, 2. Future Worth , and 3. Annual Worth.

If the annual interest rate is 20%?

**Q.6:**

A company produces an electronic timing switch that I used in consumer and commercial products made by several other manufacturing firms. The fixed cost (CF) is $73000 per month, and variable cost is $83 per unit. The selling price per unit is given as: P=$180- 0.02D, determine the following:

1. The optimal volume for this product and confirm that a profit occurs (instead of a loss) at this demand?.
2. Find the volumes at which breakeven occurs, and what is the domain of profitable demand?

**Q.7:**

A company produces and sells a product and seeking to maximize its net profit. It has concluded that the relationship between price and demand per month is approximately: D=500-5P, where P is the price in dollars. The company’s fixed costs are $1000 per month and the variable costs are $20 per unit, find the following:

(a): what number of units, D should be produced and sold to maximize the net profit?

(b): calculate; breakeven point, total costs, total revenues, and maximum profit?

(c): draw breakeven chart showing all parameters calculated in a and b?

**Q.8:**

A manufacturing plant operation has fixed cost of $2,000,000 per year and its output capacity is 100,000 electrical appliances per year. The variable cost is $40 per unit, and the product sells for $90 per unit find the following:

1. Compare annual profit when the plant is operating at 90% of capacity with the plant operating at 100% capacity?

 2. What is the percentage of change in breakeven point value if plant operated at 90% compared with that operated at 100%?

**Q.9:**

Inthedesign of columns of ground floor of a building, there are three alternatives design arrangements are available in accordance with the following data:

|  |  |  |  |
| --- | --- | --- | --- |
| Type of column design | Cross-section(m) | Reinforcement(Kg/m3) | Height of column(m) |
| 1. Square | 0.3 x 0.3 | 100 | 3.5 |
| 2. Rectangular | 0.3 x 0.4 | 90 | 3.5 |
| 3. Circular | 0.35(diameter) | 95 | 3.5 |

Determine the most economical design if the cost of the materials and labor as follows:

Cost of concrete supply and cast is $250/m3

Cost of wooden formwork for square and rectangular column is $50/m2

Cost of metal formwork for circular column is $75/m2

Cost of reinforcement, bent & fixing is $250/ton.

**Q.10:**

A manufacturing plant operation has fixed cost of $2,000,000 per year and its output capacity is 100,000 electrical appliances per year. The variable cost is $40 per unit, and the product sells for $90 per unit, find the following:

1. Compare annual profit when the plant is operating at 90% of capacity with the plant operating at 100% capacity?

 2. What is the percentage change in breakeven point value if plant operated at 90% compared with that operated at 100%?

**Q.11**: Consider the choice between using ordinary low-carbon steel and low alloy/high yield strength steel in an application where yield strength is the design criterion upon which the selection must be based. The properties of two materials are as follows:

|  |  |  |
| --- | --- | --- |
|  | Low –Carbon Steel | Low Alloy/High Strength Steel |
| Yield strength(psi) | 32000 | 52000 |
| Ultimate strength(psi) | 64000 | 75000 |
| Cost per pound | $0.24 | $0.30 |

**Q.12:** For production of small screws in considerable quantities on a high-speed turret lathe, using 1112 screw-machine steel costing $0.30 per pound. A study was made to determine whether it might be cheaper to use brass screw stock, costing **$1.40 per pound**. Since the weight of steel required per piece was 0.0353 pound and of brass was 0.0384 pound. However, when the manufacturing and standards departments were consulted, it was found that, although 57.1 parts per hour were being produced using steel, if brass were used, the output would be 102.9 parts per hour. Inasmuch as the machine operator was paid $7.50 per hour and the overhead cost for the turret lathe was $10.00 per hour. Compare on the basis of total often cost?

**Q.13:**

1. Drive the equation showing the breakeven point is equal to fixed cost divided by selling price minus variable cost?

2. A home owner purchased a home in year 2000 for $200,000. Ten years later the home was sold for $240,000. What compound annual interest rate was realized by the home owner?

3. If $5000 planned to be received at the end of 5 years at interest rate of 15% per year. What middle-of-year uniform amount would be equivalent to this future amount?

**Q.14:**

1. Drive the equation of single cash flow compound interest of F=P(1+i)n where F, P, i, n are future, present, interest, and year respectively?

2. A student is planning to have personal saving totaling $1,000,000 when he retires at age 65 years. He is now 20 years old, what equal end-of-year amount must he saves to accomplish his goal, if the average annual interest rate is 15%?

3. A student invests $1000 in an account that earns 15% interest compounded annually. How long will it take the amount to reach $5000?

**Q.15:**

The assembly of a certain component for television sets has been done by two skilled workers, each of whom is paid $5.0 per hour and can produce 10 units per hour (as group). Of the 10 units, one unit will be defective and will have to be discarded at a material loss of $2.50. It has been proposed that this operation could be done by three persons of lesser skill, who would be paid only $4.0 per hour, and who, as a group, could complete 13 units per hour. It is estimated that the number of defects per hour would not be changed if this alternative procedure is used. Which procedure would you recommend based on unit cost assessment?

**Q.16:**

Draw the cash flow diagram in order to find the equivalent value of Q from the cash flows values listed below, if the annual interest rate is 25%, using the gradient series method where applicable?

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| End of year | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Cash flows $ | -500 | -500 | 0 | 0 | Q | 2Q | 3Q |

**Q.17:**

 A construction Company estimates that the relationship between unit price and demand per month for a given product is estimated as (P =100 – 0.1 D). The Company’s fixed costs are $2000 per month and variable costs of $40 per unit. Calculate the following:

(a): The number of units, D should be produced and sold to maximize the net profit?

(b): The breakeven point, total costs, total revenues and maximum profit?

(c): Draw breakeven chart showing on all the parameters calculated in above (a) and (b)?

**Q.18:**

If $5000 is to be received at the end of 5 years when i=10% per year, what middle -of-year uniform amount would be equivalent to this future amount?

**Q.19:**

An automatic machine can be operated at three speeds with the following results:

|  |  |  |
| --- | --- | --- |
| Speed | Output(pieces per hour) | Time Between Tool Grinds(hr) |
| A | 400 | 15 |
| B | 480 | 12 |
| C | 540 | 10 |

A set of unsharpened tools costs $150 and can be grind 20 times. The cost of each grinding is $25. The time required to change and reset the tools is 1.5 hours, and such changes are made by a tool-setter who is paid $5.75 per hour. Overhead on the machine is charged at the rate of $3.75 per hour, including tool-change time. At which speed should the machine be operated to minimize total cost per piece?

**Q.20:**

The following tables represent two cash flows with i%=10% per year:

Draw the two cash flows diagrams and determine the value of K which makes the two cash flows equivalent, using gradient method:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| End of year | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Amount $ | 0 | 100 | 200 | 300 | 400 | 500 | 600 |
| End of year | 1 | 2 | 3 | 4 | 5 |
| Amount $ | 0 | 0 | 0 | K | K |

**Q.21:** lumber put through the planer increased in value by 0.02 per board foot. When the planer was operated at a cutting speed of 5000ft/min., the blades had to be sharpened after 2 hours of operation, and lumber could be planed at the rate of 1000 board feet/hour. When the machine was operated at 6000ft/min., the blades had to be sharpened after 1.5 hours of operation, and the rate of planning was 1200 board feet/hour. Each time the blades were changed, the machine had to be shut down for 15 minutes. The blades, unsharpened, cost $5 per et and could be sharpened 10 times before having to be discarded. Sharpening cost $1 per set. The crew that operated the planer changed and reset the blades. At what speed should the planer be operated?

**Q.22:** Consider two methods that are available for processing a certain ore to recover the contained metal. The ore, as it comes from a certain mine, contains 22% of the metal. Two methods of treatment for the ore are available. Each uses the same equipment, but they involve the use of different chemicals and grinding to different degrees of fineness. To process a ton of ore by method A costs $14.35 and recovers 84% of the contained metal. Processing by method B costs $16.70 per ton of ore, and 91% of the metal is recovered. If the recovered metal can be solid for $0.06 per pound, which method of processing should be used?

**Q.23:** Consider the case of a product that was made by hand in a small factory. The workers were paid $0.4 per acceptable piece produced. If was found that if a worker produced 80 pieces per day, 5% would be rejected. If 90 pieces were produced per day, 10% would be rejected, and at a rate of 100 pieces per day, 20% would be rejected. The cost for materials was $0.50 per piece, and the materials n any rejected products had to be thrown away. There was a fixed overhead expense of $10 per day per worker, regardless of considerable change in output; three questions arose concerning the situation:

1. At which of the three outputs did the workers made the highest wages?
2. At which output did the factory achieve the lowest unit cost;
3. Was some adjustment in the wage-payment situation desirable?

**Q.24:**

 A plant has a capacity of 4100 hydraulic pumps/month. The fixed cost is $504,000 per month. The variable cost is $166 per pump, and the sales price is $328 per pump. Assume that sales equal output volume, and determine:

1. What is the breakeven point in number of pumps per month?

2. What percentage reduction will occur in the breakeven point if fixed costs are reduced by 18% and variable costs by 6%?

**Q.25:**

Fiber X has 40% greater heat insulating value than fiber Y. A particular design calls for a 6-inch thickness of fiber X or its equivalent. If fiber X costs $7.50 per cubic foot and fiber Y costs $5.00 per cubic foot. Which fiber is more economical? Remember to make the comparison on an equivalent basis.

**Q.26:**

A young woman 22 years old has just graduated from College. She accepts a good job and she desire to establish a personal saving account. She plans to deposit amount of $2000 at the end of each year into the saving account. The annual interest rate on the account is expected 12%. How old will she be when her saving account accumulated a value of $1,000,000?

**Q.27:**

A piece of new equipment has been proposed by engineers to increase the productivity of a certain manual welding operation. The initial investment is $25000 and the equipment will have a salvage value of $5000 at the end of expected life of 5 years. Increased productivity attributable to the equipment will amount to $8000/year after extra operating costs have been subtracted from the value of the additional production.

Evaluate the internal rate of return of the proposed equipment and determine whether the investment is good one? If M.A. R.R. is 20%.

**Q.28:**

In determining the best production rate for a new type of casting in steel casting factory and after experimenting with many combinations of hourly production rates and total production cost per hour, the engineer then talked to the firm’s marketing specialist, who provided these estimates of selling price per casting as a function of production output the summarized data was as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Total Cost/Hour | $1000 | $2600 | $3200 | $3900 | $4700 |
| Selling Price/Casting | $20 | $17 | $16 | $15 | $14.5 |
| Casting Produced/Hour | 100 | 200 | 300 | 400 | 500 |

Determine the production rate that you recommend to maximize total profit?

**Q.29:** A typical design selection may be found in the choice of wooden beams used to support a floor that will sustain a uniformly distributed load of 2200 pounds over a span length of 12 feet. Using structural-grade Douglas fir and limiting the deflection to 1/300 of the span, the analyst found that there are three common sizes that will meet the required conditions, 4 by 8 inches 3 by 10 inches, and 2 by 12 inches. Obviously, beams of these three sizes do not contain the same number of board feet of material. Also when the cost is determined, it is learned that these three sizes do not cost quite the same per board foot. The 4”x8” and 3”x10” sizes list at $175 per thousand board feet, and the 2”x12” size can be obtained for only $150 per thousand board feet. Determine the most advantageous beam?

**Q.30:**

Windows Manufacturing Company produces typical windows, there are two processes are possible for manufacturing with following parameters:

|  |  |  |
| --- | --- | --- |
|  | Process 1 | Process 2 |
| Production  | 35 windows/hour | 15 windows/hour |
| Daily production Time | 4 hours/day | 6 hours/day |
| Defected windows | 20% | 10% |

Find the best process that maximizes profit per day if each completed window is made for $4 worth of materials and can be sold of $30, and variable overhead cost is charged at the rate of $40 per hour. Considering that the defected products cannot be sold.

**Q.31:**

In the design of an automobile engine part, an engineer has a choice of either a steel casting or an aluminum alloy casting. Either material provides the same service. However, the steel casting weighs 8 ounces as compared with 5 ounces for the aluminum casting. The steel casting costs $3.2 per pound while the aluminum alloy can be cast for $7.4 per pound. Machining costs per casting are $5.0 for steel and $4.2 for aluminum. Which material should the engineer select, and what is the difference in unit costs?

**Q.32:** Two currently owned machines are being considered for the production of a part. The capital investment associated with the machines is about the same and can be ignored for purposes of this example. The important differences between the machines are their production capacities (production rate x available production hours) and their reject rates (percentage of parts produced that cannot be sold). Consider the following table:

|  |  |  |
| --- | --- | --- |
|  | Machine A | Machine B |
| Production rate | 100 parts/hr | 130 parts/hr |
| Hours available for production | 7 hr/day | 6 hr/day |
| Percent parts rejected | 3% | 10% |

The material cost is $6.00 per part, and all defect-free parts produced can be sold for $12 each. (Rejected parts have negligible scrap value). For either machine, the operator cost is $15.00 per hour and the variable overhead rate for traceable costs is $5.00 per hour.

(a): Assume that the daily demand for this part is large enough that all defect-free parts can be sold. Which machine should be selected?

(b): What would the percent of parts rejected have to be for Machine B to be as profitable as Machine A?

**Q.33:** if a certain machine undergoes a major overhaul now, its output can be increased by 20%, which translates into additional cash flow of $20000 at the end of each year for five years. If i =15% per year, how much can we afford to invest to overhaul this machine?

**Q.34:** An enterprising student is planning to have personal savings totaling $1,000,000 when she retires at age 65. She is now 20 years old. If he annual interest rate will average 7% over the next 45 years on her savings account, what equal end-of-year amount must she save to accomplish her goal?

**Q.35:** If $1500 is to be received at the end of 5 years when i=15% per year, what middle-of-year uniform amount would be equivalent to this future amount?

**Q.36:** The following data depicts series of year-end cash flows extending over 8 years. The amounts are $100 for the first year, $200 for the second, $500 for the third year, and $400 for each year from the fourth through the eighth. These could represent something like the expected maintenance expenditures for a certain piece of equipment or payments into a fund. It is desired to find the equivalent; (a): present worth, (b): future worth,

(c): annual worth of these cash flows if the annual interest rate is 20%.

**Q.37:**

Consider the situation in which an individual deposited $1000 in a saving account that paid interest at an annual compounding rate of 5% for the first three years, 6% for the next four years, and 7% for the next two years. How much was in the fund at the end of the ninth year?

**Q.38:**

Suppose that there are two options to manufacture 100 concrete blocks according to the shape of moulds, with following manufacturing data for 100 blocks:

|  |  |  |
| --- | --- | --- |
|  | Solid type | Hollow type |
| Cement | 400 kg | 350kg |
| Aggregate | 1.25m3 | 1.2m3 |
| Labor and overhead costs | $200 | $200 |
| Number of rejected blocks | 5 | 6 |

 The cost of 1 ton of cement is $250, and the cost of 1m3 of aggregate is $10. Determine:

1. The most economical type based on unit cost?
2. The most profitable type, if each acceptable block sold at $15?

**Q.39:**

Suppose if you are now 20 years age, and you decided to save from now $1 each day for the rest of your life to become a millionaire. Let’s assume that you live to age 80 years, and the annual interest rate is 10%. Calculate the future compound amount at the end of your life?

**Q.40:**

 Maintenancecosts for a new bridge with an expected 50-years life are estimated to be $1000 each year for the first 5 years, followed by $10000 expenditure in the fifteenth year and a $15000 in year 30. If i=10% per year, what is the equivalent uniform annual cost over the entire 50-year period?

**Q.41:**

For the cash flow diagram given in Figure (1), determine whether the project is acceptable using E.R.R.R. method, if e = 15% =M.A.R.R.?

**Q.42:**

 Determine the amount of G in the following diagram given in Figure (2), so that the two cash flow diagrams are equivalent when the interest rate is 10% per year, using Arithmetic Gradient method when required?

$16000

$12000

$8000 A=$4000 Salvage=$10000

$4000

0 1 2 3 4 5 6 7 8

$4000

$5000

$7000 **Figure (1)**

$30000

 $1000

 $800

 G G G G $600

 $100 $400

 Equivalent $200

 0 1 2 3 4 5 0 1 2 3 4 5 year

 **Figure (2)**

**Q.43:**

The following data have been estimated for two investment alternatives, A and B, for which revenues and costs are known. Show which project is more economically recommended, using B/C Ratio method if M.A.R.R. = 10%.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Alternative | Investment  | Annual revenue | Annual costs | Useful life | Salvage value |
| A | $3500 | $1900 | $645 | 4 years | $0 |
| B | $5000 | $2500 | $1383 | 8 years | $0 |

**Q.44:**

Suppose that a father, on the day his son is born, wishes to provide payments of $4000 on each of the son’s 18th, 19th, 20th and 21st birthdays. Determine the following:

1. Lump amount would have to be deposited into an account bearing interest at 15%?

2. Equivalent worth of the four payments of $4000 if the son decided to redeposit them immediately in an account bearing interest of 15%, to be withdrawn on his 25th birthday?.

**Q.45:**

 A construction Company estimates that the relationship between unit price and demand per month for a given product is estimated as (P =100 – 0.1 D). The Company’s fixed costs are $2000 per month and variable costs of $40 per unit. Calculate the following:

(1): The number of units, D should be produced and sold to maximize the net profit?

(2): The breakeven point, total costs, total revenues and maximum profit?

(3): Draw breakeven chart showing on all the parameters calculated in above (1) and (2)?

**Q.46:**

For a construction job a contractor can haul gravel either by means of an ordinary 10m3dump truck or he can use a double rig truck, where a 10m3 truck also pulls an 8m3 trailer.

The total equivalent operating cost including fuel, maintenance and driver cost is $12.5 per hour for the dump truck and $17.5 per hour for the double rig truck.

For the required 10km haul, the loading, unloading, hauling and return times as follows:

|  |  |  |
| --- | --- | --- |
| Activity | Ordinary Truck (minute) | Double Rig Truck (minute) |
| Loading | 3 | 5 |
| Unloading | 4 | 10 |
| Hauling | 24 | 28 |
| Return | 20 | 24 |

**Q.47:**

Find the equivalent value of Q in following cash flow diagram when annual interest rate is25%?

 3Q

 2Q

 Q

 0 1 2 3 4 5 6 7 year

 $500 $500

**Q.48:**

1. Drive the equation showing the breakeven point is equal to fixed cost divided by selling price minus variable cost?

2. A home owner purchased a home in year 2000 for $200,000. Ten years later the home was sold for $240,000. What compound annual interest rate was realized by the home owner?

3. If $5000 planned to be received at the end of 5 years at interest rate of 15% per year. What middle-of-year uniform amount would be equivalent to this future amount?

**Q.49:**

For a construction job a contractor can haul gravel either by means of an ordinary 10m3dump truck or he can use a double rig truck, where a 10m3 truck also pulls an 8m3 trailer. The total equivalent operating cost including fuel, maintenance and driver cost is $12.5 per hour for the dump truck and $17.5 per hour for the double rig truck. For the required 10km haul, the loading, unloading, hauling and return times as follows:

|  |  |  |
| --- | --- | --- |
| Activity | Ordinary Truck (minute) | Double Rig Truck (minute) |
| Loading | 3 | 5 |
| Unloading | 4 | 10 |
| Hauling | 24 | 28 |
| Return | 20 | 24 |

1. Determine which type of trucks will be more economical? Compare on unit cost basis.

2. If hauling and return times are directly proportional to the haul distance for what length of haul distance would the two types of trucks provide equal costs, based on speed comparison?

**Q.50:**

1. Drive the equation of single cash flow compound interest of F=P(1+i)n where F, P, i, n are future, present, interest, and year respectively?

2. A student is planning to have personal saving totaling $1,000,000 when he retires at age 65 years. He is now 20 years old, what equal end-of-year amount must he saves to accomplish his goal, if the average annual interest rate is 15%?

3. A student invests $1000 in an account that earns 15% interest compounded annually. How long will it take the amount to reach $5000?

**Q.51:**

**(A):** Suppose that a father, on the day his son is born, wishes to provide payments of $4000 on each of the son’s 18th, 19th, 20th and 21st birthdays. Determine the following:

1. Lump amount would have to be deposited into an account bearing interest at 15%?

2. Equivalent worth of the four payments of $4000 if the son decided to redeposit them immediately in an account bearing interest of 15%, to be withdrawn on his 25th birthday?

**Q.52:**

In the design of an automobile engine part, an engineer has a choice of either a steel casting or an aluminum alloy casting. Either material provides the same service. However, the steel casting weighs 8 ounces as compared with 5 ounces for the aluminum casting. The steel casting costs $3.2 per pound while the aluminum alloy can be cast for $7.4 per pound. Machining costs per casting are $5.0 for steel and $4.2 for aluminum. Which material should the engineer select, and what is the difference in unit costs?

**Q.53:**

Suppose if you are now 20 years age, and you decided to save from now $1 each day for the rest of your life to become a millionaire. Let’s assume that you live to age 80 years, and the annual interest rate is 10%. Calculate the future compound amount at the end of your life?

**Q.54:**

Suppose that one has payments as follows:

End of year: 1 2 3 4

Payment: $8000 $7000 $6000 $5000

Draw cash flow diagram and find present worth at interest rate of 15% using arithmetic gradient interest formula?

**Q.55:**

A construction company intended to invest of $200,000 on a project that will produce uniform annual revenue of $100,000 for 5 years and then have a salvage value of $50,000, the annual disbursements for operation and maintenance costs are $60,000 each year. The company is willing to accept any project that will earn 10% or more as a minimum attractive rate of return. **Draw the cash flow diagram and then determine whether this is a desirable investment or not,** by using the following methods?

(1): The Annual Worth Method based on calculating the capital recovery.

(2): The Internal Rate of Return Method.

(3): The External Rate of Return Method.

(4): The conventional B/C ratio method.

**Q.56:**

It is desired to compare independently between three public investment projects, A, B, and C, to select the most economical project, by using **modified benefit cost ratio method**, if the minimum attractive rate of return is 10% , and the details of the investment is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Items | **Project A** | **Project B** | **Project C** |
| Investment capital- $ | 10,000 | 16,000 | 28,000 |
| Salvage Value -$ | Nil | Nil | 4000 |
| Annual net benefits to user- $ | 2000 | 5000 | 6000 |
| Annual net (O+M) expenses to user -$ | 800 | 1600 | 2000 |
| Useful Life (year) | 6 | 8 | 10 |

**Q.57:**

An investment of $10,000 can be made in a project that will produce uniform annual revenue of $5300 and annual operation and maintenance costs of $3000 and then have a salvage value of $2000 after 5 years. The company willing to accept any project that will earn 10% or more. Determine whether it is justified the investment on this project or not, using the Internal Rate of Return (I.R.R.) method?.

**Q.58:**

An engineering consulting firm measures its output in a standard service hour unit, which is a function of the personnel grade levels in professional staff. The variable cost is $60 per standard service hour. The charge-out rate (i.e. selling price, p) is $85/hour. The maximum output of the firm is 160,000 hours per year, and its fixed cost is $2,024,000 per year. For this firm determine:

1. What is the breakeven point in standard service hours and in percentage of total capacity?

2. What is the percentage reduction in the breakeven point if fixed costs are reduced 10%?

**Q. 59:**

There are seven alternatives as shown in following Table. Select the **best alternative** by using comparison of mutually exclusive alternatives method, ***and state the reasons that you recommend for such selection assuming that the capital is not limited***:

|  |  |  |  |
| --- | --- | --- | --- |
| Alternative  | Annual Benefits x1000$ | Annual Costs x1000$ | B/C |
| A | 700 | 500 | 1.40 |
| E | 900 | 600 | 1.50 |
| C | 1,600 | 800 | 2.00 |
| B | 1,660 | 850 | 1.95 |
| D | 1,200 | 900 | 1.33 |
| F | 1,825 | 1,000 | 1.83 |
| G | 1,875 | 1,100 | 1.70 |

**Q.60:**

A piece of new equipment has been proposed by engineers to increase the productivity of a certain manual welding operation. The initial investment is $25000 and the equipment will have a salvage value of $5000 at the end of expected life of 5 years. Increased productivity attributable to the equipment will amount to $8000/year after extra operating costs have been subtracted from the value of the additional production.

Evaluate the proposed equipment by using the **Internal Rate of Return Method** to determine whether the investment is good one, if M.A R.R. is 20%?

**Q.61 :**

Based on drawing the bar chart for the following runway project, which consists of five major activities with completion time of 10 weeks:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. | Activity | Hours | Started at beginning of week:  | Completed at end of week: | Scheduled weekly progress |
| 1. | Stripping | 800 | 1 | 2 | 50% |
| 2.  | Drainage | 200 | 2 | 3 | 50% |
| 3. | Sub-grade | 4000 | 3 | 7 | 20% |
| 4. | Base course | 4500 | 5 | 8 | 25% |
| 5. | Paving | 8000 | 6 | 10 | 20% |

Draw the scheduled cumulative progress curve?

**Q.62:**

The following data have been estimated for two investment alternatives, A and B, for which revenues and costs are known. Show which project is more economically recommended, using modified B/C Ratio method if M.A.R.R. = 10%.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Alternative | Investment  | Annual revenue | Annual costs | Useful life | Salvage value |
| A | $3500 | $1900 | $645 | 4 years | $0 |
| B | $5000 | $2500 | $1383 | 8 years | $0 |

**Q.63:**

There are seven alternatives as shown in following Table. Select the best alternative by using comparison of mutually exclusive alternatives method:

|  |  |  |  |
| --- | --- | --- | --- |
| Alternative  | Annual Benefits $000 | Annual Costs $000 | B/C |
| A | ------- | 500 | ----- |
| E | 900 | 600 | 1.50 |
| C | 1,600 | 800 | 2.00 |
| B | 1,660 | 850 | 1.95 |
| D | 1,200 | 900 | 1.33 |
| F | 1,825, | 1,000 | 1.83 |
| G | 1,875 | 1,100 | 1.70 |

**Q. 64:**

An investment of $150,000 can be made in a project that will produce uniform annual revenue of $100,000 for 5 years and then have a salvage of $50,000, the annual disbursements for operation and maintenance costs are $60,000 each year. The company is willing to accept any project that will earn 10% or more as a minimum attractive rate of return. Draw the cash flow diagram and then determine whether this is a desirable investment or not, by using the following methods?

(1): The Internal Rate of Return Method?

(2): The External Rate of Return Method?

**Q.65:**

A construction company intended to invest of $200,000 on a project that will produce uniform annual revenue of $100,000 for 5 years and then have a salvage value of $50,000, the annual disbursements for operation and maintenance costs are $60,000 each year. The company is willing to accept any project that will earn 10% or more as a minimum attractive rate of return. **Draw the cash flow diagram and then determine whether this is a desirable investment or not,** by using the following methods?

(1): The Annual Worth Method based on calculating the capital recovery.

(2): The Internal Rate of Return Method.

(3): The External Rate of Return Method.

(4): The conventional B/C ratio method.

**Q.66:**

It is desired to compare independently between three public investment projects, A, B, and C, to select the most economical project, by using **modified benefit cost ratio method**, if the minimum attractive rate of return is 10% , and the details of the investment is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| Items | **Project A** | **Project B** | **Project C** |
| Investment capital- $ | 10,000 | 16,000 | 28,000 |
| Salvage Value -$ | Nil | Nil | 4000 |
| Annual net benefits to user- $ | 2000 | 5000 | 6000 |
| Annual net (O+M) expenses to user -$ | 800 | 1600 | 2000 |
| Useful Life (year) | 6 | 8 | 10 |

**Q.67:** You are advising your board of directors about the investment in one of two alternative projects. Project(A) involves a capital outlay of $260,000 and it is estimated that it will bring a return of $80,000 each year for the next 25 years. Against this must be set expected expenditures of $ 50,000/year.

Project (B), which involves an initial capital investment of $360,000 is expected to result in annual receipts of $100,000 against an annual expenditures of $60,000.

The salvage value of both projects at the end of 25 years is estimated to be 50,000.

If the minimum attractive rate of return is 10%, make the necessary calculations to support a firm recommendation to the board whether to invest in one of the projects. Give the reasons for your decision by calculation using the External Rate of Return-E.R.R. method and compare the results with the Explicit Reinvestment Rate of Return- E.R.R.R. method?

**Q.68:**

Draw the cash flow diagram for following project and determine whether it is economically justified or not? By using E.R.R., E.R.R.R., and conventional B/C ratio methods:

Initial cost = $12,000 Annual Benefits = $2500 Project life = 6 years Salvage Value = $1200, if M.A.R.R. = 8%.

**Q.69:**

Consider a machine or other asset that will cost $ 10,000, last 5 years, i is 10%, and have a salvage value of 2000, calculate depreciation and capital recovery?

**Q.70**: when e= 15% and M.A.R.R. = 20%; determine whether the project whose cash flow diagram appears below is acceptable using E.R.R. method?

 6000 6000 6000 6000 6000

 0 1 2 3 4 5 6

 5000 1000 1000 1000 1000 1000

 10000

**Q.71 :**

Considering the following project to determine whether it is justified using the E.R.R. method, assuming that funds can be reinvested at M.A.R.R. = 10%

 5310 5310 5310 5310 5310

 2000

 1 2 3 4 5

 3000 3000 3000 3000 3000

 10000

**Q.72:** Mr. Brown has an opportunity to purchase an apartment house that has just been completed. It is located in the suburban area of a medium –size city that contains a fair amount of industrial plants. It also is within walking distance of a large university. The apartment house is in the process of being rented and now is more than 80% occupied, with prospects of being fully rented within a few weeks. The purchase price would be $125000 of which $50000 represents the value of the land. The building consists of 10 four-room apartments, a small apartment for a caretaker and garage space for 11 automobiles. From a study of similar apartment buildings, Mr. Brown estimates that each apartment can be rented for $325 per month, with at least 95% average occupying at all times. Heat and water are included in the rental. The operating costs are estimated to be as follows:

Caretaker costs $400 per month, plus his apartment

Fuel costs $2000 per year Water costs $150 per year

Maintenance & repair equal to one month’s rental on each rental unit/year

Taxes equal $4 per $100 of assessed value (assessed value will be approximately 30% of cost of building and land).

Insurance equal 0.5% of first cost of building per year.

Agent’s commission equal 2.5% of gross rental revenue.

At present Mr. Brown’s capital is invested in bonds hat yield approximately 12% before income taxes and he feels that a project of this risk should earn at least 15% before income taxes. He estimates that the economic life of the apartment house will be at least 40 years and that the $50000 for land will be the only salvage value at the end of that time. Is the project is worthy investment by using I.R.R. Method?

**Q.73:**

A small pumping plant has a useful life of 30 years. The initial investment at the beginning of the first year is $1000. The O+M is $20 per year and the benefit is $126 per year. Is this plant acceptable economically if i%= 5%, using B/C basis on A.W. and P.W. methods?

**Q.74:**

**(1):** Describe in detail, how the project manager aims to achieve his mission?

 **(2):** State the main causes of construction project failure?

**(3):** Describe the process of bid preparation?

**(4):** State the principle steps of bidding procedure?

**(5):** Describe the methods of specification writing in construction works?

**Q.75:**

1. Describe the principal and secondary objectives of construction manager?

2. Explain the types of cost-plus-fee contracts?

3. Describe the conditions of variations in works that the engineer can make?

4. Describe the procedure of disputes settlement during the construction of project?

5. State six events that the employer entitled to forfeiture the contract?

**Q.76:**

1. Describe the types of cost-plus-fee contracts?

2. Describe the procedure of disputes settlement in construction of project?

3. State five events that the employer entitled to forfeiture the contract?

4. Describe the importance of shop drawings and samples in construction work?

5. Describe the differences between a method and performance specifications?

**Q.77:**

1. State the principal steps of bidding procedure.

2. Define the term of “Day Work” as stated in the General Conditions of Contracts, and describe how the project manager can deal with such work?

3. List the usefulness of using the schedules during the construction period?

4. What are the principles of scheduling?

5. State the events of contract termination as described in General Conditions of Contracts?

**Q.78:**

1. Calculate the amount of performance bond required for the contract amount of 100 million Iraqi Dinars, in accordance with the terms of General Conditions of Contracts?

2. Describe the conditions of payments on executed works and payments on materials and equipment in accordance with terms of General Conditions of Contract?

3. List the usefulness of using the schedules before starting construction, and after completion of construction works?

4. Describe the procedure of disputes settlement during the construction of project?

5. Describe the duties and powers of Engineer’s Representative?

**Q.79:**

 1): State the major steps of construction project development process?

(2): Describe the process of bid preparation?

(3): State the types of construction contracts and explain only one type?

(4): State the principle steps of bidding procedure?

(5): Describe the conditions of variations in works that the engineer can make?

**Q.80:**

1. What are the types and benefits of construction contracts?

2.Describe the types of contract documents involved in construction contracts?

3. Describe the principle types of bonds utilized in construction contracts?

4. Why the cost-plus percentage of cost contracts is seldom used in construction industry? And describe the case and condition in which the cost-plus contracts could be utilized?

5. State the motivations for bid submitting?