

**Khulna University of Engineering & Technology**  
**Department of Industrial Engineering and Management**  
 B.Sc. Engineering 3<sup>rd</sup> Year 2<sup>nd</sup> Term Examination, 2017  
**IPE 3205**  
 Product Design- II

Full Marks: 210

Time: 3 hrs

**N.B.:** i) Answer any **THREE** questions from each section in separate scripts.  
 ii) Figures in the right margin indicate full marks.  
 iii) Assume reasonable data if missing any.

**SECTION-A**

1. (a) The link shown in figure 1 (a) is made of AISI C1020 annealed steel, with  $b = \frac{3}{4}$  in. and  $h = 1\frac{1}{2}$  in. Determine: 15

- i) What force will cause breakage?
- ii) What is the maximum allowable load based on ultimate strength and design factor of 4?
- iii) What is the allowable load based on yield strength, If,  $N = 2.5$ ?

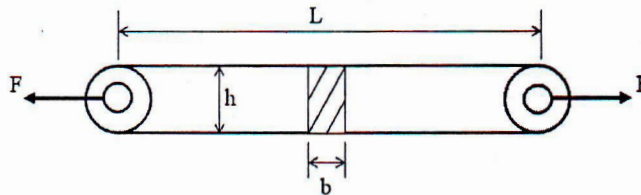


Fig. 1 (a)

- (b) A hollow circular column made of AISI C1020 structural steel as rolled is to support a load of 10,000 lb. Let  $L = 40$  in.  $D_i = 0.75D_o$ , and  $N = 3$ . Determine  $D_o$  by 20
- i) Using either Euler's or the parabolic equation.
  - ii) Using the straight line equation.
  - iii) What factor of safety is given by the Secant formula for the dimension found in (i)?

2. A machine part of uniform thickness  $t = \frac{b}{2.5}$  is shaped as shown in figure 2, and machined all over from AISI C1020, as rolled. The design is for indefinite life for a load repeated from 1750 to 3500 lb. Let  $d = b$ . Determine: 35

- i) For a design factor of 1.8 (Soderberg) what should be the dimensions of the part?
- ii) What the maximum tensile stress in the part is as designed?

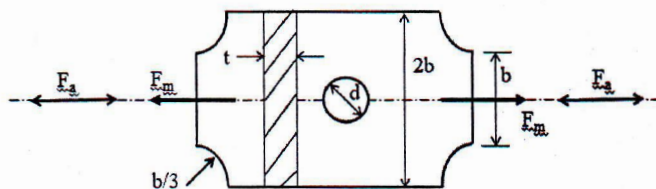


Fig. 2

3. A coil spring is to be used for the front spring of an automobile. The spring is to have a rate 400 lb/in., an inside diameter of  $4\frac{3}{64}$  in., and a free length of  $14\frac{1}{8}$  in., with squared and ground ends. The material is to be oil-tempered chrome-Vanadium steel. Decide upon the diameter of the wire and the number of free coils for a design load  $F = 1500$ . Be sure "Solid Stress" is all right. How much is the pitch angle? 35

4. A cold finished shaft, AISI 1141 is to transmit power that varies from 200 to 100 hp and back to 200 hp in each revolution at a speed of 600 rpm. The power is received by a 20-in. spur gear A and delivered by a 10-in. spur gear C. The tangential forces have each been converted into a force (A and C shown) and a couple (not shown). The radial component R of the tooth load is to be ignored in the initial design. Let  $N = 2$ , and considering varying stresses with the maximum shear theory, compute the shaft diameter.

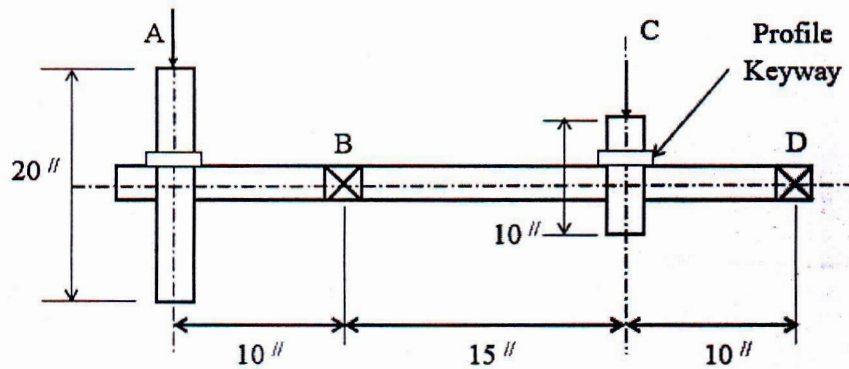


Figure 4.

### SECTION-B

5. A pair of commercially cut spur gears transmit 10 hp at 1750 rpm of the 25 tooth pinion. The teeth are  $20^\circ$  full depth with 6 pitch; material, cast iron, class 30; face width is  $1\frac{9}{16}$  in;  $N_g = 40$ . Allow for stress concentration.
- Compute the service factor for the teeth.
  - If the drive is for a single cylinder compressor, would carefully cut teeth be advisable? Show calculations.
6. Design the teeth for two herringbone gears for a single reduction speed reducer with  $m_w = 3.80$ . The capacity is 36hp at 3000 rpm of the pinion;  $\Psi = 30^\circ$ ; F.D. teeth with  $\phi_n = 20^\circ$ . Since space is at a premium, the initial design is for  $N_p = 15$  teeth and carburized teeth of AISI 8620; preferably  $b < 2D_p$ .
7. A pair of steel Zerol bevel gears is to transmit 25 hp at 600 rpm of the pinion;  $m_g = 3$ ; let  $N_p \approx 20$  teeth; highest reliability; the pinion is overhung, the gear straddle mounted. An electric motor drives a multicylinder pump. Decided upon the pitch, face width, diameters and steel (with treatment) for intermittent service.
8. A 50-hp motor turning at 1750 rpm is to deliver its power to a worm gear reducer, whose velocity ratio is to be, 20. The shell type worm is to be made of high-test cast iron; since a reasonably good efficiency is desired, use at least 4 threads, manganese-bronze gear.
- Decide upon  $D_w$  and  $\phi_n$ , and determine suitable values of the pitch and face width
  - Compute the efficiency
  - Compute the temperature rise of the lubricant. Estimate the radiating area of the case. Is special cooling needed?



**Khulna University of Engineering & Technology**  
**Department of Industrial Engineering and Management**  
 B.Sc. Engineering 3<sup>rd</sup> Year 2<sup>nd</sup> Term Examination, 2017  
**IPE 3217**  
 Operations Research

Full Marks: 210

Time: 3 hrs

- N.B.:** i) Answer any THREE questions from each section in separate scripts.  
 ii) Figures in the right margin indicate full marks.  
 iii) Assume reasonable data if missing any.

**SECTION-A**

1. (a) A financial institution, the BRAC BANK is in the process of formulating a loan policy involving a total of \$12 million. Being a full service facility, the bank is obligated to grant loans to different clientele. The following table provides the types of loans, the interest rate charged by the bank, and the probability of bad debts as estimated from past experience. 10

Types of loan	Interest rate	Probability of bad debts
Personal	0.140	0.10
Car	0.130	0.07
Home	0.120	0.03
Farm	0.125	0.05
Commercial	0.100	0.02

Bad debts are assumed unrecoverable and hence no interest revenue. Competition with other financial institutions in the area requires that the bank allocate at least 40% of the total funds to farm and commercial loans. To assist the housing industry in the region, home loan must equal at 50% of the personal, car and home loans. The bank also has a started policy specifying that the overall ratio for bad debts on all loans may not exceed 0.04. Formulate linear programming for the above described problem.

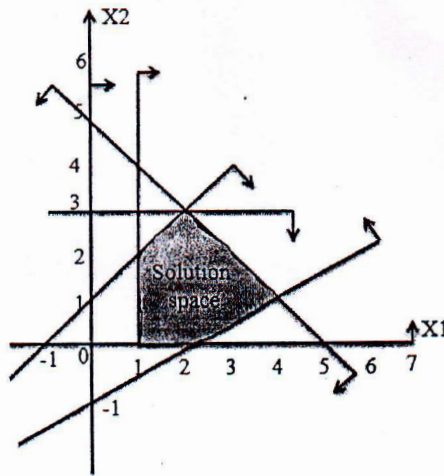
- (b) Solve the following problem by the revised simplex method: 25
- Maximize  $z = 3x_1 + 2x_2$   
 Subject to,  $x_1 + 2x_2 + x_3 = 6$   
 $2x_1 + x_2 + x_4 = 8$   
 $-x_1 + x_2 + x_5 = 1$   
 $x_2 + x_6 = 2$   
 $x_1, x_2, \dots, x_6 \geq 0$

2. (a) Show that the following LP problem is temporarily degenerated: 17
- Maximize,  $z = 3x_1 + 2x_2$   
 Subject to,  
 $4x_1 + 3x_2 \leq 12$   
 $4x_1 + x_2 \leq 8$   
 $4x_1 - x_2 \leq 8$   
 $x_1, x_2 \geq 0$

- (b) Consider the following set of constraints: 18
- $3x_1 + x_2 = 3$   
 $4x_1 + 3x_2 \geq 6$   
 $x_1 + 2x_2 \leq 4$   
 $x_1, x_2 \geq 0$
- Solve the problem by using M-technique, assuming that the objective function is given as follows: Minimize,  $z = 4x_1 + x_2$

3. (a) Consider the following LP allocation model: 20
- Maximize  $z = 3x_1 + 2x_2$  (Profit)  
 Subject to,  $4x_1 + 3x_2 \leq 12$  (Resource -1)  
 $4x_1 + x_2 \leq 8$  (Resource -2)  
 $4x_1 - x_2 \leq 8$  (Resource -3)
- i) Determine the Maximum value of z.  
 ii) Based on the unit worth of each resource, which resource should be given priority for an increase level.

- (b) Write the constraints associated with the solution space shown in the figure and identify all 15 redundant constraints.



4. (a) The MG Auto company has plants in Los Angeles, Detroit and New Orleans. Its major 10 distributions centers are located in Denver and Miami. The capacity of three plants during the next quarter are 1000, 1500 and 1200 cars, The quarterly demands at the two distributions centers are 2300 and 1400 cars. The train transportation cost per car per mile is approximately 8 cents. The mileage chart between the plants and distribution centers is as follows.

	Denver	Miami
Los Angeles	1000	2690
Detroit	1250	1350
New Orleans	1275	850

Transform the transportation model into LP model.

- (b) Solve the following transportation model using least cost method. Show only one iteration for 25 optimal solution.

		← Destination →							
		A	B	C	D				
↑ Source ↓	R	5	10	10	0	20	11	15	
	Q	12	5	7	15	9	5	20	25
	P	0	14			16	5	18	5
		5	15	15	10			← Demand →	

Here the numerical values confined in the small box of each cell defines the transportation cost from source to destination.

### SECTION-B

5. (a) What are meant by decision under risk and decision under uncertainty? Explain with example. 08
- (b) An oil drilling company is considering that purchase of mineral rights on a property of BDT 100 lakhs. The price includes tests to indicate whether the property has type A geological formulation or type B geological formulation. The company will be unable to tell type of geological formulation until the purchase is made. It is known however, that 40% of the land in the area has type A formulation and 60% type B formulation. If the company decides to drill on the land it will cost BDT 200 lakh. If the company does drill it may hit an oil well, gas well or a dry hole. Drilling experience indicates that the probability of striking an oil well is 0.4 on type A and 0.1 on type B formulation. Probability of hitting gas is 0.2 on type A and 0.3 on type B formulation. The estimated discounted cash value from an oil well is BDT 1000 Lakh and from a gas well is BDT 500 Lakh. This includes everything except the cost of mineral rights and cost of drilling. Use the decision-tree approach and recommended whether the company should purchase the mineral rights? 13
- (c) A soft drink company calculated the market share of two product against its major competitors having three products and found out the impact of additional advertisement in any one of its products against the other. 14

		Company B		
		1	2	3
Company A	1	6	7	15
	2	20	12	10

What is the best strategy for the company as well as the competitor? What is the pay-off obtained by the company and the competitor in the long run? Use graphical method to obtain the solution.



6. (a) Solve the following game graphically. 15

		B			
		4	-4	-5	6
A		-3	-4	-9	-2
		6	7	-8	-9
		7	3	-9	5

- (b) Consider the following integer linear programming problem; 20

$$\begin{aligned} \text{Maximize, } z &= 3x_1 + 4x_2 \\ \text{Subject to, } x_1 + 2x_2 &\leq 11 \\ 7x_1 + x_2 &\leq 21 \end{aligned}$$

$x_1$  and  $x_2$  are nonnegative integers. The optimal simplex tableau obtaining after incorporating the first cutting plane is given by-

Basic	$X_1$	$X_2$	$S_1$	$S_2$	$S_3$	Solution
z	0	0	1	0	1	24
$X_2$	0	1	1	0	-1/2	117/26
$X_1$	1	0	-1	0	1	2
$S_2$	0	0	6	1	-13/2	5/2

Construct the second cutting plane and find out the optimal integer solution.

7. (a) Define queue. Mention some managerial applications of queuing theory. 09
- (b) Telephone calls arrive at an office with two operators. If both operators are busy, the calls are automatically held on queue to be answered on a first-come first-serve basis. The time spent by each operator in taking the call is exponentially distributed with a mean service time of 6 minutes. The calls have exponentially distributed inter-arrival time and occur at a mean rate of 15 per hour. 13
- i) What is the expected numbers of calls held waiting for service?
  - ii) What is the expected time an arriving call will spend in the queuing system taking into account both waiting and service time?
  - iii) What fraction of time are both operators busy?
- (c) Assume that two different tools C and D can be leased for use in repairing machines at the rate of BDT 35 and BDT 100 per hour. The rate of breakdown necessitating repair is poisson distributed with a mean of 3 per hour. Assume also that the downtime on a machine costs the company BDT 40 per hour for the period of time the machine is out of service. The tools repairs machine at an exponentially distributed rate having a mean of 4 per hour for the tool C and 6 per hour for the tool D. Which of the two tools should be leased by the company? 13
8. (a) A student must select 10 electives from four different departments with at least one course from each department. The 10 courses are allocated to the four departments in a manners that maximizes "knowledge". The student measure knowledge on a 100-point scale and comes up with the following chart. 15

		No. of Courses					
Department	1	2	3	4	5	6	$\geq 7$
I	25	50	60	80	100	100	100
II	20	70	90	100	100	100	100
III	40	60	80	100	100	100	100
IV	10	20	30	40	50	60	70

How should the student select the courses?

- (b) Write short notes on: 06
- i) Limiting Value
  - ii) Ergodic System
  - iii) Absorbing State
- (c) Each year a man trades his car for a new car. If he has a Chrysler he trades for a Plymouth. If he has a Plymouth he trades it for a Ford. However, if he has a Ford, he is just as likely to trade it for a Chrysler or a Plymouth. In 1977 he bought his first car which was Ford. 14
- i) Find the probability that he has a Plymouth in 1980 and Ford in 1979.
  - ii) In the long run how often will he have a Ford?

**Khulna University of Engineering & Technology**  
**Department of Industrial Engineering and Management**

B.Sc. Engineering 3<sup>rd</sup> Year 2<sup>nd</sup> Term Examination, 2017

**IPE 3219**

Production Systems Design

Full Marks: 210

Time: 3 hrs

- N.B:** i) Answer any **THREE** questions from each section in separate scripts.  
 ii) Figures in the right margin indicate full marks.  
 iii) Assume reasonable data if missing any.

**SECTION-A**

1. (a) Define system. Describe the basic characteristics of the following systems: i) A multinational manufacturing company (ii) A community hospital. 10
- (b) What reasons usually prompt an existing organization to seek a new location? How can management avoid the problem of considering a new location? 10
- (c) Alom Co. Ltd. Plans to set up a new aluminum-products plant and has selected three sites with the following characteristics ( for projected 75 percent capacity utilization equal to 300,000 tons/year): 15

Site	Annual fixed costs (million)	Variable costs/ton
A	8.2	\$ 452
B	10	\$290
C	7.5	\$530

Relative subjective factors	Rating, $R_{ij}$			Relative importance Index
	A	B	C	
Housing	0.25	0.50	0.25	0.50
Community attitudes	0.25	0.25	0.50	0.25
Services	0.50	0.25	0.25	0.25

Determine the optimum location site if objective factors weigh twice as much as subjective factors. Also prepare a diagram showing how the location preference changes for different values of k.

2. (a) State the criteria used for classifying production processes and list the basic types for each criterion. 08
- (b) Why are energy considerations important during process design? Discuss some approaches that might be used in process design to cope with increased energy costs and demand. 10
- (c) Describe information contained in the following graphic aids for process design: (i) Operation chart (ii) Process chart. 08
- (d) Prepare a flow process chart for processing an auto insurance claim for an accident. 09
3. (a) What methods are employed to measure water pollution? How can water pollution be treated? 10
- (b) Why recycling is important? How is the depletion rate of a nonrenewable resources affected by recycling? Also discuss limitations of recycling. 10
- (c) ABC co. manufactures small gears used for special office equipment. Production of these gears requires processing in two departments, stamping and grinding with the respective capacities of 48,000 and 52,000 units. Current demand is 41,000 units/year, rising at the rate of 3,000 units /year. The lead time for adding new capacity is 2 years. 15
- i) Plot a graph showing the trend line for annual demand and indicate the existing capacity limits.
- ii) Determine when each department will run out of capacity, if present trend continues.
- iii) Estimate the net capacity increases needed to satisfy annual demand for the next 6 years.



4. (a) Explain the meaning of capacity for a productive system. What measures of capacity would you suggest for (give reasons): (i) An Engineering consulting firm (ii) A private high-prestige college. 10
- (b) Explain the steps followed when preparing and implementing a plan to change design capacity. 10
- (c) Is there is difference in capacity planning between single stage and multiple stage operations systems? Discuss. 05
- (d) Enlist efficiency measure factors. The operating data of ABC company are shown in below. 10

Process characteristics	Department	
	Stamping	Grinding
Working hour per day	16	16
Processing time, mint/part	3	5
Average daily downtime , min	115	130
Average daily setup time, min	40	54
Defective output, %	7	8

All defectives are rejected as scrap. The company operates 250 working days per year. Annual demand is currently 65,000 parts, Due to preventive maintenance program the down time in each department was reduced by ten percent but setup time was increased by two percent, Determine the efficiency and equipment requirements for each department.

#### SECTION-B

5. (a) Define work study. What are the components of work study? 05
- (b) What constitutes excess work content? What are the roles of the workers for conducting a successful work study? 15
- (c) Explain the significance and applications of the following recording techniques: 15
- (i) Flow process chart (ii) Multiple activity chart.
6. (a) What is meant by methodology? What are its purposes? 07
- (b) How is the job selected for method study? Specify the principles of motion economy. 08
- (c) What are the differences between cycle graph and Chrono-cycle graph? 10
- (d) Define the followings and drawn some symbols of therbligs: 10
- i) SIMO chart ii) Therbligs
7. (a) What are some of the criticisms of work measurement, in general, and time study, specially, that have caused its popularity to wane in recent years? 10
- (b) For what type of jobs are learning curves most useful? What does a learning curve specially measure? Discuss some of the uses and limitations of learning curves. 15
- (c) A time technician for the company has conducted a time study of the job for 20 cycles and accumulated for the following elemental times and assigned performance ratings: 10

Element	$\sum t$	$R_f$
1	3.15	1.10
2	8.67	1.05
3	14.25	1.10
4	11.53	1.00
5	6.91	0.95
6	5.72	1.05
7	5.38	1.05

Determine the standard time for this job using an allowance factor of 12 percent.

8. (a) Why is the problem of designing a process layout more complex than for product layout? 07
- (b) Write short notes on: (i) ALDEP (ii) CRAFT 08
- (c) Explain the suitability of fixed position layout. 10
- (d) What are the difference between Travel chart and REL chart? Mention some applications of both chart. 10



**Khulna University of Engineering & Technology**  
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 B.Sc. Engineering 3<sup>rd</sup> Year 2<sup>nd</sup> Term Examination, 2017  
**IPE 3221**  
 Quality Management

Full Marks: 210

Time: 3 hrs

- N.B:** i) Answer any **THREE** questions from each section in separate scripts.  
 ii) Figures in the right margin indicate full marks.  
 iii) Assume reasonable data if missing any.

**SECTION-A**

1. (a) Define quality. Describe the different aspects of quality that are valued by the customers. 12  
 (b) What are the costs of quality? Compare Juran model with alternative view to determine the optimum quality cost. 13  
 (c) Define internal customer. Write only their names. Discuss 5W2H question. 10
2. (a) What is the warning and action limit of control chart? Why are they used? 12  
 (b) Explain with a suitable example, why the smaller sample size has wider control limit. 10  
 (c) A plastic door company produces PVC doors of different sizes. A door may be considered non-conforming for many reasons. The number of non-conformities on 10 samples produced in December, 2016 are recorded in the following table 2(c). What would be the recommended center line and control limit. Note that there are 5 pieces in each unit. 13

Table 2(c)

Sample No.	1	2	3	4	5	6	7	8	9	10
No. of defects	12	10	20	16	10	13	11	18	12	09

3. (a) Explain process capability and process capability index with necessary illustrations. 05  
 (b) Draw and explain process capability for the following conditions- 10  
     i) Process variation exceeds the specification.  
     ii) Process variation is less than the specification.  
     iii) Process marginally meets specification.  
 (c) A process is being controlled with a fraction non-conforming control chart. The process average has been shown to be 0.07. Three sigma control limits are used and the procedure calls for taking daily samples of 400 items. 20  
     i) Calculate the upper and lower control limits.  
     ii) If the process average suddenly shift to 0.01, what is the probability that the shift would be detected on the first subsequent sample?  
     iii) What is the probability that the shift in part (ii) would be detected on the first and second sample taken after the shift?
4. (a) Differentiate between  $3\sigma$  and  $6\sigma$ . Why six sigma is robust considering the mean shift? 12  
 (b) What is DMAIC? Explain with diagram how the process can be improved by using DMAIC. 13  
 (c) How will you improve your academic result by using the concept of PDCA cycle? 10

**SECTION-B**

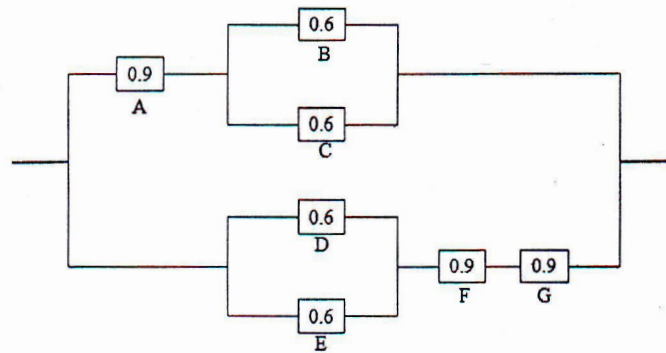
5. (a) What is TQM philosophy? Describe any three basic concepts of TQM principle. 08  
 (b) What is QFD? Discuss the methodology used in QFD? 09  
 (c) Define house of quality (HOQ). Construct a HOQ for a new upcoming I-Phone to the market. 18
6. (a) Define common terminology used in acceptance sampling plans. 13  
 (b) A company and its customers agreed to follow a double sampling plan with the following parameters : Lot size  $N=3000$ ;  $n_1 = 40$  ;  $n_2 = 60$  ;  $C_1 = 2$  ;  $C_2 = 3$   
 Construct a typical OC curve for P value 0.01 and 0.05. 17



(c) Write short notes on military and ANSI standards. 05

7. (a) What is meant by 5S? Explain 5S principles. 13

(b) An electrical system consists of seven components as illustrated in the following figure. Assume that, each component work independently and the reliability of each component is also shown in figure. What is the system reliability? 10



(c) Describe different tools for failure analysis. 12

8. (a) What is Design of Experiment (DOE)? What are the objectives of an experiment? 12

(b) Define ISO 9000 QMS. What are the criticisms of ISO 9000 QMS? 08

(c) What is meant by certification and accreditation in ISO? Explain "ISO is not a product or process standards, it is a management standards". 15

**Khulna University of Engineering & Technology**  
**Department of Industrial Engineering and Management**  
 B.Sc. Engineering 3<sup>rd</sup> Year 2<sup>nd</sup> Term Examination, 2017  
**IPE 3223**  
 Material Handling and Maintenance Management

Full Marks: 210

Time: 3 hrs

**N.B:** i) Answer any THREE questions from each section in separate scripts.  
 ii) Figures in the right margin indicate full marks.  
 iii) Assume reasonable data if missing any.

SECTION-A

1. (a) What is meant by material handling? Explain system principle and simplification principles of material handling. 11
- (b) Write short notes on : i) Idlers ii) Take up unit iii) Belt cleaner 09
- (c) Deduce the relation,  $Q = \frac{Gz}{1000}$  tons per hour. Where, G is the weight of the load in kg and z is hourly capacity in pieces per hour. 15
  
2. (a) Discuss briefly the physical and mechanical properties of bulk load. 12
- (b) Briefly describe the working principle of pneumatic conveyor. 10
- (c) Draw the typical flight shapes, What are the comparative advantages of flight conveyor over belt conveyor. 13
  
3. (a) Why banking is necessary? Explain different types of banking methods with figure. 10
- (b) Write down the arguments in favour of biodegradable materials as packaging. Briefly explain the hazard impact test for packaging. 12
- (c) The storage of food and beverage company receives daily a loads of item A from the manufacturer plant and shipments are made once a week. The company is considering purchasing 3 tarcktor truck or a hand truck for use in transporting. The information about item (A), equipments are given below by table. The loading and unloading cost includes not only the cost for loading and unloading but also for making the return trip to pick up another load, Determine the least expensive method for transporting. 13

Material characteristics

Item	Volume (L*W*H) inch <sup>3</sup>	Distance to shipping (ft)	Distance from receiving (ft)	Unit received per week	Average units shipped per day
A	6*4*3	158	420	125	120

Equipment Specifications

Equipment	Maximum volume, inch <sup>3</sup>	Loading and Unloading cost (\$)/trip	Cost/foot (\$)
Tractor Truck	29*12*13	2.40	0.03
Hand truck	30*12*16	0.03	0.007

4. (a) Define Automated guided vehicles (AGV'S). Write down the method of navigation and path selection in AGV sensors. 10
- (b) A manufacturing company wishes to store a unit on 36// × 48// × 24// pallet having a weight of 3000 pounds and 75 single cycles per hour. The total storage is 2000 unit loads. The height of the building is 80 ft and the rack support are needed 6 inches. Determine the followings: 13
  - i) The no. of stacks.
  - ii) The no. of cranes needed.
  - iii) The no. of bays required.
  - iv) The storage dimensions.



- (c) A plant produces 75 units/hr of an item with dimensions of 0.5\*0.5\*0.1 foot. The management wishes to store a 1-week supply in containers measuring 7\*7\*4 feet. A minimum of 3 inches of space is required between adjacent units in each direction for packaging and handling. Determine the number of containers needed. If these containers can be stacked two high, determine the floor space required. 12

**SECTION-B**

5. (a) Define maintenance. Explain the duties and responsibilities of maintenance department. 14  
 (b) What are the factors that should be taken into consideration during implementation of PPM? Explain briefly. 14  
 (c) Write down the advantages of condition based maintenance. 07
6. (a) "Motivation in maintenance can enhance the labor performance"-Justify. 10  
 (b) What is Job card system? Discuss about the computer aided maintenance. 13  
 (c) What are the points should be considered while setting up a maintenance organization? 12
7. (a) Annual surveys are performed on equipment whose operating cost per week after survey or replacement is in the following form:  $C(t) = A - B \exp[-kt]$  15  
 Where,  $A = 500$ ;  $B=40$ ;  $k= 0.15$  and cost of replacement  $C_r=\$100$ . Determine the optimal replacement time between surveys.
- (b) Given, 20

i) The operation cost per period of four machine

Age of the machine since last replaced, a	0	1	2	$\geq 3$
Operating cost/period C(a), Tk	100	200	250	300

ii) Cost of replacement, Tk 120.

iii) Total cost matrix for equipment being of age I at the start of a period and finishing with age J at the end of the period is

I/J	0	1	2	3
0	$\infty$	100	$\infty$	$\infty$
1	$\infty$	200	200	$\infty$
2	$\infty$	220	$\infty$	250
3	$\infty$	220	$\infty$	350

Determine the replacement policy to be adopted if equipment in new now and there are 3 periods of time to go to complete the production plan.

8. (a) What are the basic differences between repair and overhaul decision? 06  
 (b) Construct a model of optimal inspection frequency for minimizing downtime. 12  
 (c) What is TPM? What are the difference between TPM and TQM? 08  
 (d) While using drums containing lubricants, what kind of precautions must be taken to consider? 09