NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF ENGINEERING

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

Bachelors of Engineering in Industrial and Manufacturing Engineering

Manufacturing Systems II/ Manufacturing Systems III

EIE 5113/TIE 5101

First Semester Examination Paper

December 2024

This examination paper consists of 5 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: Statistical Tables and Graph Paper

Examiner's Name: S Mhlanga

INSTRUCTIONS

1. Answer any **five (5)** questions
2. Answer AT LEAST TWO QUESTIONS FROM EACH SECTION
3. Each carries 20 marks.
4. The use of calculators is permissible

Section A- FLEXIBLE MANUFACTURING SYSTEMS

Question 1

a) Discuss briefly two types of tool allocation policies. [6]

b) Eight-part types are being considered for production on a new machine. These parts are currently purchased. For each part type a decision will be made to either make all its units on the new machine or to continue to purchase all units. This is necessary to ensure quality consistency. Total estimated savings per month to make the product internally are (50, 75, 67, 213, 96, 88, 434, 26), respectively. The hours required per week to produce the product demand are (9, 22, 7, 32, 15, 19, 60, 3), respectively. If the machine is available 80hrs per week and overtime hours could be arranged at a cost of $10 per hour for up to 18hours per week, four weeks per month, what products should be made internally? [14]

Question 2

a) Discuss briefly two types of tool allocation policies. [6]

b) Table Q2.1 shows the following jobs are available for manufacture on an FMS. The FMS has one Coating Station and One Enameling machine. The coating can hold many parts but the Enameling can hold only three parts types. All parts that start with the same letter use the same tool head. Parts say V## parts could be done on the Enameling and require only one tool head. Machines are available 15 hours per day. Select the jobs to be run every T days. [14]

Table Q2.1: Data of Possible Jobs to be processed in the FMS Cell

			Unit Processing Hours	
Part Type	No. of Units	Due Date	Coating	Enameling
V45	20	2	0.4	0.10
V45	10	1	0.3	0.05
V65	5	3	1.0	0.05
W25	10	2	0.8	0.20
X67	10	3	0.5	
X67	20	2	0.5	
Y33	50	2	0.4	0.05
Y77	50	1	0.2	0.1
Z51	10	1	0.1	0.1

Question 3

a) Discuss briefly the applicability of FMS is in a Zimbabwean plant. [6]

b) A company manufactures four variants of the same product and in the final part of the manufacturing process there are assembly, polishing and packing operations. For each variant the time required for these operations are shown in Table 3.1 (in minutes) as is the profit per unit sold.

Table 3.1: Variants and time required per operation

Variant	Assembly	Polish	Pack	Profit ($)
1	2	3	2	1.50
2	4	2	3	2.50
3	3	3	2	3.00
4	7	4	5	4.50

Given the current state of the labour force the company estimate that, each year, they have 100000 minutes of assembly time, 50000 minutes of polishing time and 60000 minutes of packing time available. How many of each variant should the company make per year and what is the associated profit? [14]

SECTION B: MATERIAL HANDLING

Question 4

a) Describe the unit load concept in material handling and its two advantages. [4]

b) Briefly discuss three material handling principles. [6]

c) The Baobab Supply company is currently faced with an inventory rotation problem. This difficulty stems from the fact that some supplies must be used prior to a stated expiration date. Upon receipt, a new shipment of these perishable items must be stacked beneath the boxes that are currently in inventory. A substantial amount of time is consumed in restacking the items according to their expiration dates. The company would like to reduce the double and sometimes triple handling of items. How can this goal be achieved? Are there alternative solutions which might also be effective? [10]

Question 5

a) Discuss two types of material handling costs and two ways to reduce them. [4]

b) What are the six design steps to be followed in material handling design? [6]

c) Lemon Cream Company stores all its metal compressed gas containers in a warehouse. These long cylindrical metal tanks contain various gases used in manufacturing cans of spray paint. The gas tanks are delivered to the warehouse by truck. Two receiving dock workers unload the containers from the delivery trucks and place them on four wheel trucks. Two materials handlers are responsible for pushing the loaded trucks into the warehouse, unloading the tanks and setting them up on end. The two materials handlers spend a major portion of their day moving loads of the gas tanks into the warehouse and placing them into the proper storage locations. In total, there are five different types of gases that in equal proportion make up 98% of all gas handled.

Question: Management would like to identify a better way to handle these gas tanks. How can the handling operation be improved? [10]

Question 6

a) What are the factors that you would consider in selection of material handling equipment? [4]

b) Describe four characteristics of industrial trucks. [6]

c) Indanda operates a centrally located storeroom in their manufacturing complex. Every afternoon each craft foreman (Tin Shop, Electric Shop, Iron Workers, etc.) writes a requisition for common use items that will be required for the next day's work. These common use items include nuts, bolts, screws, washers, flashlight batteries, and gloves. All specialty items are ordered separately. During the night shift, storeroom personnel fill the orders of items requested by the craft foreman. Each morning, one or two workers from each department go to the storeroom with a four-wheel platform truck to pick up the filled order.

Question: Although studies have never been performed to determine the amount of time craftsmen spend waiting for supplies, it is the thoughts of the management that idle craft manpower is a problem resulting from this procedure. How can time spent traveling to and from the described storeroom be reduced, thus, eliminating or decreasing crafts' personnel travel time? [10]

Question 7

a) Briefly discuss two type of conveyors. [5]

b) Discuss citing examples how material handling can an area to improve productivity in the company where you were attached. [5]

c) The ABC Warehouse Company received a consignment of 6m lengths of 10mm diameter stainless steel pipes. ABC had never handled pipe as part of their warehousing operation. The forklift truck operator assigned to this job used the truck's forks as a ram to load, handle, and unload the pipe. Inspection of the pipe by the owners revealed that the forks were bending and damaging the pipe. Suggest several alternative methods for eliminating the problem of pipe damage. From a cost and ease in application standpoint, select one alternative solution for adoption. [10]

End of Examination Paper

