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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester-Final Examination

Summer Semester: 2022 - 2023

Course Number: IPE 4603

Full Marks: 150

Course Title: Manufacturing Planning and Control

Time: 3.0 Hours

There are 6 (six) questions. Answer all of them. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Assume reasonable value for any missing data. Questions do not have equal mark distribution. The *MRP sheet* is provided separately.

1. a) Company "X" is looking to produce a small collection of 4 wristwatches (Analog, digital, smart, and Swiss). Meanwhile, company "Y" is going forward with their plan to assemble and manufacture a Boeing 737 passenger turbojet. (2+8=10)
(CO1)

Identify the two distinct type of facility layouts from the above scenario. Mention their relative advantages and disadvantages over each other. (PO1)

- b) DBS is a manufacturing plant that produces automotive components. The plant has been facing challenges such as long lead times, high inventory levels, and inconsistent quality. To address these issues and improve the overall efficiency, the management decided to implement lean manufacturing techniques, which includes introduction of deliberate employee participation events, a visual signal system for parts replenishment and maintaining a clean and organized environment. (9)
(CO1)
(PO1)

From the above scenario, identify and explain the distinct lean manufacturing techniques.

- c) Alif Shoerforaz, an HR representative of a renowned paper company is looking to hire some security, warehouse, and distribution van personnels for the next fiscal year. So, he, in collaboration with his manager employed some *job analysis methods* for systematic study of job data for these posts. (6)
(CO1)
(PO1)

Briefly explain the job analysis methods that Alif may have undertaken.

2. a) A business industry procures items at C price/unit to meet an annual demand of D units. The orders are of equal size and are placed at periodical intervals t . The items against an order are not provided instantaneously due to shortage of stock. Instead, it is assumed that the order will be satisfied later. Thus, the maximum inventory held in period t_1 is Q_1 and the maximum stockout accrued in period t_2 is Q_2 . If the ordering cost/order is C_o , the carrying cost/unit/year is C_c , and the shortage cost/unit/period is C_s , then derive an expression for the optimum order quantity that minimizes the total inventory cost. (12+3=15)
(CO2)
(PO2)

Carlo industrial and enterprise ltd. estimates that they will sell 10,000 units of their product for the forthcoming year 2025. The ordering cost is \$ 300 per order and the carrying cost per unit per year is 20% of the purchase price per unit. The purchase price per unit is \$ 20. They are also forced to deal with a shortage cost of \$ 25/unit annually. Determine the optimal order quantity.

- b) An item has yearly demand of 2000 units for XYZ company. Annual carrying cost/item/year is 20% of the item cost. The various costs corresponding to purchase and manufacture inventory models are as follows:

	Purchase	Manufacturing
Item cost/unit (BDT)	6.00	5.90
Procurement cost/order (BDT)	8.00	-
Setup cost/setup	-	40.00
Production rate/year	-	6000 units
Shortage cost/item/year	-	-

(10)
(CO2)
(PO2)

Choose an appropriate deterministic inventory model for the company based on minimum total inventory cost.

3. a) A company is planning on expanding and building a new plant in one of three countries. Chris Ellis, the manager charged with making the decision, has determined that five key success factors can be used to evaluate the prospective countries. Ellis used a rating system of 1 (least desirable country) to 5 (most desirable) to evaluate each factor.

Key Success Factor	Weight	Scores (Out of 100)		
		Country X	Country Y	Country Z
Technology	0.2	4	5	1
Level of education	0.1	4	1	5
Political and legal aspects	0.4	1	3	3
Social and cultural aspects	0.1	4	2	3
Economic factors	0.2	3	3	2

(7+3
=10)
(CO3)
(PO11)

Answer the following –

- Select the most preferable country using Weighted-factor method.
 - Sudden illiteracy causes the level of education in countries X and Z to drop to a score of 2 and 3 respectively. Explain whether this drop of score changes the conclusion of question no. i.
- b) Tom's Direct, a major TV sales chain headquartered in New Orleans, is about to open its first outlet in Mobile, Alabama, and wants to select a site that will place the new outlet in the center of Mobile's population base. Tom examines the seven census tracts in Mobile, plots the coordinates of the center of each from a map, and looks up the population base in each to use as a weighting. The information gathered appears in the following table.

Census Tract	Population in Census Tract	(x, y) coordinate
101	2000	(25, 45)
102	5000	(25, 25)
103	10000	(55, 45)
104	7000	(50, 20)
105	10000	(80, 50)
106	20000	(70, 20)
107	14000	(90, 25)

(7+3
=10)
(CO3)
(PO11)

Answer the following questions –

- Determine the center of gravity and graph the result relative to all the locations in a graph paper.
- The population Census Tract 104 is expected to grow quickly to 15,000. How does this effect the center of gravity, and where should the new outlet be located?

4. a) A Furniture Company manufactures tables based on **Bill of Material (BOM)** shown below:



At the present time, **inventories of parts** and **lead times** are as follows:

Parts	On hand	Scheduled Receipts (2 nd week)	Lead time (weeks)
Assemble table	40		01
Finish leg assembly	90		01
Purchase legs	140		02
Purchase short rails	40		01
Purchase long rails	0	90	01
Purchase top	40	50	02

(2+5+
18=25)
(CO4)
(PO3)

According to the **Master Production Schedule (MPS)**, the gross requirements for tables are 220 and 140 on the 5th and 6th week respectively.

Answer the following –

- Re-draw the BOM with low level code.
 - Draw the time-phased product structure.
 - Construct an MRP sheet.
- b) Mr. A, an adviser and one of the chief executives of ABC Corporation manages all manufacturing functions of the company using a closed-loop MRP system. However, due to recent market changes as well as the availability of cloud-based database software like Metafresh ERP, SAP ERP etc., he has decided to implement an ERP system within ABC Corporation. This planning system not only links 'Customer chain and Supplier chain' to the planning dept. but also provides real time data to monitor all the other departments including accounting, finance, marketing etc. Additionally, this cloud database system provides day-to-day inventory records.

(10)
(CO4)
(PO3)

Suggest the design of an ERP flow diagram that would integrate all the aforementioned core departments altogether for ABC Corporation.

5. Honda wants to develop a precedence diagram for an Internal combustion (IC) engine that requires a total assembly/task time of 28 minutes using a product layout. Based on the precedence diagram and activity times given, Honda determines that there are 360 productive minutes of work available per day. Moreover, the production schedule requires that 45 units of the IC engine be completed as output from the assembly line each day. They now want to group the tasks into workstations.

Task	Assembly Time (minutes)	Task that must precede
A	5	--
B	3	A
C	4	B
D	3	B
E	6	C
F	1	C
G	4	D, E, F
H	2	G

(5+12+
1.5+
+1.5
=20)
(CO3)
(PO11)

Answer the following –

- Draw the precedence diagram for the assembly line of IC engine.
- Find the balance that minimizes the no. of workstations using assignment rules (e.g., task with most followers, task with longest operation time etc.). Assess whether the determined no. of actual workstations meet the balance efficiency of 85%.
- Determine the theoretical minimum number of workstations.
- Determine the total idle time for the balanced assembly line.

6. a) Kohinoor Group produces a wide range of printing products (i.e. inks and other chemicals). Although the whole production process is largely diversified, the packaging stage is standardized by the following tasks: labelling the bag, loading, cleaning, and paperwork. The allowances for tasks such as this are personal, 7%; fatigue, 10%; and delay, 3%. A recent time study shows the following observations:

Element	Observations (Seconds)					Performance Rating (%)
	1	2	3	4	5	
Labelling the bag	95	123	132	99	106	90
Loading	226	198	215	210	190	100
Cleaning	150	143	170	165	139	110
Paperwork	120	135	146	132	118	90

(10+5
=15)
(CO4)
(PO3)

Answer the following-

- Based on these observations, formulate a proper standard time for the complete printing process.
 - Determine the correct sample size for the elements "Loading" and "Paperwork". Accuracy is to be within 3% and confidence level at 95.45% (assume corresponding z-value is 2.00).
- b) Brad Williams, the production planner at Allianz Products, needs to develop a capacity plan for a work center. He has the production orders shown below for the next 6 days. There are 13 hours available in the work cell each day. The parts being produced require 01 hour each.

Day	1	2	3	4	5	6
Orders	10	16	18	10	16	11

(10)
(CO4)
(PO3)

Prepare the new production schedule and comment on the production planner's action for each day.