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Program: B. Sc. Engg (IPE)
Semester: 8th Semester

Date: 08 March, 2024
Time: 02:30 pm – 04:00 pm

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

Mid-Semester Examination
Course Number: IPE 4813
Course Title: Computer Integrated Manufacturing (CIM)

Summer Semester: 2022-2023
Full Marks: 75
Time: 1.5 Hours

There are **3 (THREE)** questions. Answer **3 (THREE)** questions. The symbols have their usual meanings. Marks of each question and the corresponding CO and PO are written in brackets. A formula sheet is provided at the end of this question paper. Show all steps and calculations.

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1. a) In virtually all modern CIM and automation systems, most of the actual processing and assembly work is accomplished by machines or with the aid of tools. Briefly explain with appropriate diagrams on the following production machines: (i) Manually operated, (ii) Semi-automated, and (iii) Fully automated. **(15 Marks) (CO 1) (PO 1) (K4)**

b) Elaborate on significant of manufacturing system that is a component of production system to overall performances in production. **(10 Marks) (CO 1) (PO 1) (K4)**

2. a) Illustrate the scope of CAD/CAM and CIM in a single diagram. Explain the concept of CIM with appropriate example. **(10 Marks) (CO 1) (PO 1) (K4)**

b) Briefly describe Group Technology and Cellular Manufacturing. State the benefits and limitations of the implementation of Group Technology in a manufacturing organisation. **(15 Marks) (CO 1) (PO 1) (K4)**

3. a) A total of 800 parts must be produced in the lathe section of the machine shop during a particular week. Each shaft is identical and requires a machine cycle time, T_c=11.5 min. How many lathes must be devoted to shaft production during the given week, if there are 40 hours of available time on each lathe? **(5 Marks) (CO 2) (PO 2) (K4,P1,P3)**

b) A small electrical appliance is to be produced on a single-model assembly line. The work content of assembling the product has been reduced to the work elements listed in Table 1. The table also lists the times for each element and the precedence order in which they must be performed. The line is to be balanced for an annual demand of 100,000 units/yr. The line will operate 50 wk/yr, 5 shifts/wk, and 7.5 hr/shift. There will be one worker per station. Previous experience suggests that the uptime efficiency for the line will be 96%, and repositioning time lost per cycle will be 0.08 min. **(CO 2) (PO 2) (K4,P1,P3)**

Solve for:

i. Total work content time. **(2 Marks)**
ii. Hourly production rate. **(2 Marks)**
iii. Cycle time. **(2 Marks)**
iv. Theoretical minimum number of workers required on the line. **(2 Marks)**
v. Service time. **(2 Marks)**

Table 1: Work elements

No.	Work Element Description	T_{ek} (min)	Must be Preceded By
1	Place frame in work holder and clamp	0.2	–
2	Assemble plug, grommet to power cord	0.4	–
3	Assemble brackets to frame	0.7	1
4	Wire power cord to motor	0.1	1, 2
5	Wire power cord to switch	0.3	2
6	Assemble mechanism plate to bracket	0.11	3
7	Assemble blade to bracket	0.32	3
8	Assemble motor to brackets	0.6	3, 4
9	Align blade and attach to motor	0.27	6, 7, 8
10	Assemble switch to motor bracket	0.38	5, 8
11	Attach cover, inspect, and test	0.5	9, 10
12	Place in tote pan for packing	0.12	11

c) A machine tool builder submits a proposal for a 25-station transfer line to machine a certain component currently produced by conventional methods. The proposal states that the line will operate at a production rate of 75 pieces per hour at 100% efficiency. On similar transfer lines, the probability of station breakdowns per cycle is equal for all stations 0.003 breakdowns per cycle. It is also estimated that the average downtime per line stop will be 6.0 min. The starting casting that is to be machined on the line costs $5.00 per part. The line operates for $85.00/hr. The 25 cutting tools (one tool per station) last for 75 parts each, and the average cost per tool is $2.50 per cutting edge. **(CO 2) (PO 2) (K4,P1,P3)**

Solve for:

i. Production rate. **(5 Marks)**
ii. Line efficiency. **(2 Marks)**
iii. Cost per piece produced on the line. **(3 Marks)**

FORMULA SHEET

$$F = \sum_{i=1}^{n} p_i \qquad T_p = T_c + FT_d \qquad w^* \geq T_{wc} / T_c \qquad WL = Q / T_c$$

$$R_p = 1 / T_p \qquad E = T_c / T_c + FT_d \qquad T_s = Max\{T_{si}\} \leq T_c - T_r \qquad n = WL / AT$$

$$C_{pc} = C_m + C_o T_p + C_t \qquad T_c = 60E / R_p \qquad R_p = D_a / 50 S_w H_{sh}$$