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

Semester: Mid-Term Examination   Winter Semester: 2022 - 2023
Course Code: IPE 4715   Full Marks: 75
Course Title: Material Handling and Maintenance   Time: 1.5 Hours
Management

There are 4 (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.

1. a) Write down the difference between material handling and maintenance   (5 Marks)
      management.   (PO 1)
                                                                                 (CO 1)

   b) Identify the three application areas of Fixed-Aisle Automated   (5 Marks)
      Storage/Retrieval Systems (AS/RS).   (PO 1)
                                                                                 (CO 1)

   c) A planned fleet of forklift trucks has an average travel distance per   (15 Marks)
      delivery = 500 ft loaded and an average empty travel distance = 350 ft.   (PO 3)
      The fleet must make a total of 60 deliveries per hour. Load and unload   (CO 2)
      times are each 0.5 min and the speed of the vehicles = 300 ft/min. The
      traffic factor for the system = 0.85. Availability = 0.95, and worker
      efficiency = 90%. Determine (a) The ideal cycle time per delivery, (b)
      The resulting average number of deliveries per hour that a forklift truck
      can make, and (c) How many trucks are required to accomplish the 60
      deliveries per hour.

2. a) Explain why the angle of repose, bulk weight, lump size, moisture   (10 Marks)
      content, and flowability of particles are crucial characteristics when   (PO 1)
      dealing with bulk material in material handling.   (CO 1)

   b) A closed-loop overhead conveyor must be designed to deliver parts   (15 Marks)
      from one load station to one unload station. The specified flow rate of   (PO 3)
      parts that must be delivered between the two stations is 300 parts/hr.   (CO 2)
      The conveyor has carriers spaced at a center-to-center distance that is to
      be determined. Each carrier holds one part. Forward and return loops
      will each be 90 m long. Conveyor speed = 0.5 m/sec. Times to load and
      unload parts at the respective stations are each = 12 sec. Is the system

feasible and if so, what is the appropriate number of carriers and spacing between carriers that will achieve the specified flow rate?

3. a) What are the different categories of materials handling equipment used in manufacturing and warehouse facilities and explain briefly the different types of industrial trucks available with an appropriate diagram.

(10 Marks)
(PO 1)
(CO 1)

b) A recirculating conveyor has a total length of 700 ft and a speed of 90 ft/min. Spacing of part carriers = 14 ft. Each carrier holds one part. Automated machines load and unload the conveyor at the load and unload stations. The time to load a part is 0.10 min and the unload time is the same. To satisfy production requirements, the loading and unloading rates are each 2.0 parts per minute. Evaluate the conveyor system design with respect to the three principles developed by Kwo.

(15 Marks)
(PO 3)
(CO 2)

FORMULA SHEET

$$WL = R_f T_c$$

$$AT = 60AF_t E_w$$

$$n_c = \frac{WL}{AT} = \frac{R_f}{R_{ds}}$$

$$T_c = T_L + \frac{L_d}{v_c} + T_U + \frac{L_e}{v_c}$$

$$R_f = R_L = \frac{v_c}{s_c} \le \frac{1}{T_L}$$

$$n_c = \frac{L_d + L_e}{s_c}; \quad N_p = \frac{n_p L_d}{s_c} = \frac{n_p n_c L_d}{L_d + L_e}; \quad R_f = \frac{n_p v_c}{s_c} \le \frac{n_p}{T_L}; \quad s_c = v_c T_L$$

$$\frac{n_p v_c}{s_c} \ge Max\{R_L, R_w\}; \quad \frac{v_c}{s_c} \le Min\left\{\frac{1}{T_L}, \frac{1}{T_U}\right\}; \quad \frac{n_p v_c}{s_c} \ge R_f$$