



MACHAKOS UNIVERSITY

University Examinations For 2023/2024

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FIFTH YEA SECOND SEMESTER EXAMINATIONS FOR

BACHELOR OF SCIENCE IN MECHANICAL AND MANUFACTURING
ENGINEERING

EMM 508:FLEXIBLE MANUFACTURING SYSTEMS

DATE: _____ **TIME:** _____

INSTRUCTIONS TO CANDIDATES

This paper contain five questions, answer question one and any other two questions.

QUESTION ONE [COMPULSORY] 30 MARKS

- a) a) (i) How are conflicts handled under supervisory control of FMS (1 mark)
- (ii) What key role does diagnostics play in manufacturing systems (1½ marks)
- (iii) Briefly explain the major difference between flexible systems and rigid systems (2½ marks)
- b) (b) A company intends to buy a machine having capacity to produce 198 000 parts per annum. The machine constitutes part of a FMS of a production line. The system efficiency of the production line is 90%. (i) Find the system capacity, (ii) If the time required to produce each part is 100 seconds, and the machine works for 2 200 hours per year, and if the utilization of the machine is 65% with efficiency of the machine being 85%, (i) determine number of units produced per hour, (ii) compute the output of the machine, (iii) calculate the number of machines required. (7½ marks)

- c) (c)What is quality control in manufacturing and why is it necessary (4 marks)
- d) List components of expert system and briefly explain the function of each of them (5 marks)
- e) Consider an operation of unit load AS/RS, which uses an S/R machine for each aisle of the system. The length of storage aisle is 300 m and its height is 50 m. Horizontal and vertical speeds of S/R machine are 400 m/min. and 75m/min. respectively. The S/R require 30 seconds to accomplish pickup and delivery. Determine the single and dual command cycle times. (8½ marks)

QUESTION TWO 20 MARKS

- a) Explain optimization of FMS routing and also describe load balancing as well as real time adaptation as key aspects of optimizing FMS routing (6 marks)
- b) The following are the data of AGV system: Vehicle Velocity = 45 m/min, Average distance traveled/delivery = 135m, Pick up time = 45 sec, Drop off time = 45sec., Average distance traveling empty = 90 m, Traffic factor = 0.9. Determine the number of vehicles required to satisfy the delivery demand if the delivery demand is 40 deliveries per hour. Also determine the handling system efficiency. (10 marks)
- c) Differentiate the following tool strategies in FMS; (i) mass exchange, (ii) tool sharing (4 marks)

QUESTION THREE 20 MARKS

- a) Calculate the number of machines required to produce the three types of components from the information given in the table 3 below. Assume that the plant works on a single shift per day of 8 hours each for 25 days in a month. (13 ½ marks)

S/No	Relevant information	Component A	Component B	Component C
1	Set up time per batch in min	25	55	45
2	Operation time per piece in min	1.75	3	2.1
3	Batch size	350	550	575
4	Production per month	2450	4400	2875

- b) Give key functions of simulation in FMS and highlight ten rules for determining when the technique is not appropriate (6½ marks)

QUESTION FOUR 20 MARKS

- a) Briefly explain the five flexibilities for a FMS and the factors upon which they depend; Machine flexibility, Product flexibility, Mix flexibility, product flexibility and routing flexibility. (12½ marks)
- b) Briefly explain Human Resource / Labour as a fourth component in FMS highlighting seven functions which human labour performs in such a production set up. (4½ marks)
- c) List six types of manufacturing systems (3 marks)

QUESTION FIVE 20 MARKS

- a) A manufacturing company has a product line consisting of five workstations in series. The individual workstation capacities are given. The actual output of the line is 500 units per shift. Calculate; (i) System capacity, (ii) Efficiency of the production line. (5½ marks)

Work station	A	B	C	D	E
Capacity per shift	600	650	650	550	600

- b) The oval of a top-driven carousel track has a length = 50m and width = 4m. The speed of the carousel = 75 m/min. There are 100 carriers around the carousel and each carrier has 5 bins suspended from it. For a single direction carousel and a bidirectional carousel, compare how long it take it takes to retrieve 20 parts from the carrier if each part is in different storage bin and random storage is used in the carousel. Also determine the spacing between carriers and carousel. The handling time associated with retrieval is 20 seconds. (8½ marks)
- c) With the aid of a neat sketch show fms structure as well as data and communication commands flow (6 marks)