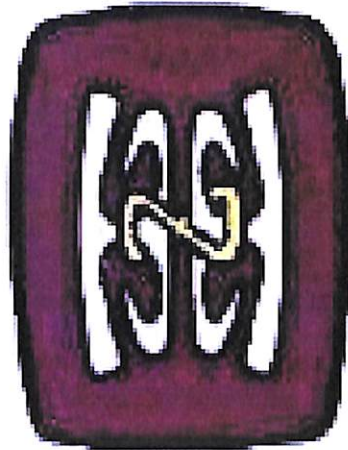


**PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING**

EXAMINATION QUESTION PAPERS



**ME 414
FLEXIBLE MAUFACTRING SYSTEM**

SEMESTER ONE – 2024

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY
SCHOOL OF MECHANICAL ENGINEERING – 4th YEAR DEGREE

FIRST SEMESTER EXAMINATIONS - 2024

ME 414 – FLEXIBLE MANUFACTURING SYSTEMS

TIME ALLOWED: 2.5 HOURS

INSTRUCTIONS:

1. You have 10 minutes to read the paper. You **must not** begin writing this time.
2. Answer **All** the questions.
3. Use **only ink**. Do not use pencil for writing except for drawings and sketches.
4. Start each question on a new page and show all your calculations in the answer book provided. No other written will be accepted.
5. Write down your **FULL NAME** and **STUDENT NUMBER** clearly on the front page.
6. Calculator is permitted in the examination room. Notes, textbooks or smart phones are not allowed.
7. Any candidate cheating the examinations will be disqualified.

MARKING SCHEME:

Subject Learning Outcomes (SLOs)		Marks
1	Distinguish between different automation strategies and economically evaluate conventional and automated manufacturing system	6
2	Analyze automated production flow lines and design automated assembly systems.	8
3	Apply group technology concepts for the analysis and design of flexible manufacturing systems FMS.	10
4	Analyze and design automated materials handling systems.	10
5	Determine the requirement for numerically controlled production system and design and implement NC part programming.	6
Total		40

Question No. 1

- (a) A Geneva with six slots is used to operate the worktable of a dial-indexing machine. The slowest workstation on the dial-indexing machine has an operation time of 2.5 sec, so the table must be in a dwell position for this length of time. What is the indexing time for each cycle? [2]
- (b) How coding is essential for part's design and manufacturing attributes in group technology? [2]
- (c) What is the composite part concept, as the term is applied in group technology? [2]
- (d) How does material handling fit within the scope of logistics? [2]
- (e) What features distinguish laser-guided vehicles from conventional AGVs? [2]

Question No. 2

[6]

Define the various aspects of FMS layout configurations with neat sketch

Question No. 3

[6]

Explain the typical hardware components of a workstation parts delivery system with neat sketch. How the part feeding system putting significant impact in automated assembly systems?

Question No. 4 (Answer any one)

[6]

- (a) A GT cell consists of 5 machines. The from-to data for the machines are as follows.

		To				
		1	2	3	4	5
From	1	0	10	80	0	0
	2	0	0	0	85	0
	3	0	0	0	0	0
	4	70	0	20	0	0
	5	0	75	0	20	0

- (i) Determine the logical sequence of machines according to/from ratios.
 - (ii) Construct a flow diagram.
 - (iii) Where do the parts enter cell and exit the cell? How many parts in each place?
- (b) A flexible machining system consists of a load/unload station and two machining workstations. Station 1 is the load/unload station with one server (human worker). Station 2 performs milling and consists of three identical CNC milling machines. Station 3 performs drilling and consists of two identical CNC drill presses. The stations are connected by a part-handling system that has two carriers. The mean transport time is 2.5 min. The FMS produces three parts, A, B, and C. The part-mix fractions and process routings for the three parts are presented in the table below. The operation frequency $f_{ijk} = 1.0$ for all $i, j,$ and k .

Determine; (a) maximum production rate of the FMS, (b) corresponding production rates of each product, (c) utilization of each station, (d) average utilization of the processing stations, and (e) number of busy servers at each station.

Part j	Part Mix p_j	Operation k	Description	Station i	Process Time T_{cjk} (min)
A	0.4	1	Load	1	4
		2	Mill	2	25
		3	Drill	3	10
		4	Unload	1	2
B	0.35	1	Load	1	4
		2	Mill	2	20
		3	Drill	3	15
		4	Unload	1	2
C	0.25	1	Load	1	4
		2	Mill	2	15
		3	Unload	1	2

Question No. 5 (Answer any one)

[6]

(a) Following are the data of AGV system:

- Vehicle Velocity = 45 m/min.
- Average distance travelled/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.

(b) A unit load AS/RS is being designed to store 1,000 pallet loads in a distribution center located next to the factory. Pallet dimensions are: $x = 1,000$ mm, $y = 1,200$ mm; and the maximum height of a unit load = 1,300 mm. The following is specified: (1) the AS/RS will consist of two aisles with one S/R machine per aisle, (2) length of the structure should be approximately five times its height, and (3) the rack structure will be built 500 mm above floor level. Using the allowances $a = 150$ mm, $b = 200$ mm, and $c = 250$ mm, determine the width, length, and height of the AS/RS rack structure.

Question No. 6

[6]

The worktable of a positioning system is driven by a ball screw whose pitch = 6.0 mm. The screw is connected to the output shaft of a stepper motor through a gearbox whose ratio is 5:1 (five turns of the motor to one turn of the screw). The stepper motor has 48 step angles. The table must move a distance of 250 mm from its present position at a linear velocity = 500 mm/min. Determine (a) how many pulses are required to move the table the specified distance and (b) the required motor speed and pulse rate to achieve the desired table velocity.