## Question 1

1. What is FMS?
2. List six type of Flexibilities could be provided by FMS.
3. Discuss briefly the FMS classification.
4. Discuss briefly the concepts of the upper and lower boundary approaches.
5. Explain briefly the types of transefer mechanism of production flow line**.**
6. What is the equipment used which feed components to assembly machine automatically?

**Question 2**

12-station flow line performs processing operations with cycle time of 1.0 minute. Each station operats 225 cycle and then fails. During the observed period, fuilure occurred on the average 10 times with average repair time 15 cycles.Determine the following:

1. The period of observation ***(2 .5 marks)***
2. The number of parts completed ***(2.5 marks)***
3. Failure and repair rate of stations ***(6 marks)***
4. Frequency of line stop per cycle ***(4 marks)***
5. If the system operate 75% under upper bound approach and 25% under lower bound approach:- Find (1) Production rate; (2) Line efficiency; (3) Acceptable number of parts; (4) Defect parts., (5) cost of the line, if the operating cost is equal 50 SR/hr and ignoring other costs. ***(10 marks)***
6. If the line is to be divided to 2, 3 & 4 stages, find the cost if the buffer cost is 900 SR/hr for parts produced during the studied period of production. Explain what the trend of the cost and efficiency values ***(10 marks)***

**Question 3**

* 1. An FMS consists of 2 turning center and 3 machining centers. The system will run 12 hr/day, 6 days/week, and the machines are available are 90% of the time. Machines will cost 150 SR/hr to operate. Using the data in table below, determine the set of part families to be produced on the FMS. **(25 marks)**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Part Family | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Weekly Demand | 22 | 25 | 30 | 50 | 30 | 15 | 14 | 18 | 20 | 30 |
| Subcontracting cost SR/unit | 800 | 620 | 700 | 1200 | 900 | 750 | 500 | 400 | 800 | 850 |
| Material cost SR/unit | 125 | 100 | 180 | 400 | 350 | 200 | 150 | 110 | 130 | 450 |
| Turning time, hr | 0.0 | 0.7 | 1.2 | 0.0 | 3.0 | 1.3 | 1.5 | 2.5 | 1.4 | 2.3 |
| Machining Center, hr | 2.0 | 1.2 | 1.7 | 1.6 | 0.0 | 1.6 | 1.5 | 0.0 | 2.2 | 2.2 |

* 1. 12 parts are to be manufactured in a FMS. Find the minimum number of batches and the product type for each batch according the data given in table below. The tool magazine capacity is 8 slots. . **(10 marks)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Part Type | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 | P11 | P12 |
| Tool Type requirement | T1(1), T5(1) | T2(1) | T1(1), T3(1) | T3(1) | T1(1), T4(1) | T1(1), T2(1) | T3(1), T5(1) | T6(2), T7(1) | T1(1), T4(1), T7(2) | T1(1),T6(1) | T2(1), T4(2) | T3(1),T5(1) |

**Question 4**

1. Formulate the loading problem for FMS. **(10marks)**
2. A FMS consists of three stations is used to manufacturer three parts. The relative data is given in Table (3). Solve the loading of the stations in the FMS. **(20 marks)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Table (3)** | | | | | | |
| Part | Weekly Demand | Operation | Machine Processing time, min | | | Tool type |
| A | B | C |
| a | 75 | 1 | 20 | 20 | - | T1 |
|  |  | 2 | 24 | 34 | 20 | T2 |
|  |  | 3 | - | - | 30 | T3 |
| b | 80 | 1 | - | 30 | 25 | T4 |
|  |  | 2 | 35 | - | - | T3 |
|  |  | 3 | 25 | - | 30 | T2 |
| c | 125 | 1 | 16 | 20 | 22 | T1 |
|  |  | 2 | - | 20 | 16 | T7 |
| Number of machines | | | 2 | 1 | 2 |  |
| Number of tool’s slot | | | 2 | 2 | 2 |  |
| Available time, hr/day | | | 12 | | |  |