**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(END SEMESTER EXAMINATION)**

**CLASS: ME** **SEMESTER : II**
**BRANCH: PRODUCTION** **SESSION : SP/17**

**SUBJECT: MPE2003-INTEGRATED MANUFACTURING & RESOURCE PLANNING**

**TIME: 03:00** **FULL MARKS: 60**

**INSTRUCTIONS:**
**1. The question paper contains 7 questions each of 12 marks and total 84 marks.**
**2. Candidates may attempt any 5 questions maximum of 60 marks.**
**3. The missing data, if any, may be assumed suitably.**
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
**5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**
**6. Nothing should be written on front or back of the question paper except tick marking.**

---

Q.1(a) Discuss briefly integration of design and manufacturing. [2]
(b) Explain the conditions that have led to the necessity of the applications of CIM in modern manufacturing industries. [4]
(c) Explain the concept of CIM by means of wheel. What are the benefits of CIM? [6]

Q.2(a) Explain briefly FMS data files and reports. [2]
(b) Explain briefly about production flexibility and routing flexibility in FMS? [4]
(c) State the conditions under which you will recommend your organisation to implement FMS. Describe the elements of FMS. [6]

Q.3 An FMS consists of four stations. Station 1 is a load/unload station with one server. Station 2 performs milling operations with three servers (three identical CNC milling machines). Station 3 performs drilling operations with two servers (two identical CNC drill presses). Station 4 is an inspection station with one server that performs inspections on a sampling of the parts. The stations are connected by a part handling system that has two work carriers and whose mean transport time = 3.5 min. The FMS produces four parts, A, B, C, and D. The part mix fractions and process routings for the four parts are presented in the table below. Note that the operation frequency at the inspection station ($f_{4jk}$) is less than 1.0 to account for the fact that only a fraction of the parts are inspected. Determine: (a) maximum production rate of the FMS; (b) corresponding production rate of each part; (c) utilization of each station in the system; and (d) the overall FMS utilization. [12]

| Part $j$ | Part Mix $p_j$ | Operation $k$ | Description | Station $i$ | Process Time $t_{ijk}$ (min) | Frequency $f_{ijk}$ |
|---|---|---|---|---|---|---|
| A | 0.1 | 1 | Load | 1 | 4 | 1.0 |
| | | 2 | Mill | 2 | 20 | 1.0 |
| | | 3 | Drill | 3 | 15 | 1.0 |
| | | 4 | Inspect | 4 | 12 | 0.5 |
| | | 5 | Unload | 1 | 2 | 1.0 |
| B | 0.2 | 1 | Load | 1 | 4 | 1.0 |
| | | 2 | Drill | 3 | 16 | 1.0 |
| | | 3 | Mill | 2 | 25 | 1.0 |
| | | 4 | Drill | 3 | 14 | 1.0 |
| | | 5 | Inspect | 4 | 15 | 0.2 |
| | | 6 | Unload | 1 | 2 | 1.0 |
| C | 0.3 | 1 | Load | 1 | 4 | 1.0 |
| | | 2 | Drill | 3 | 23 | 1.0 |
| | | 3 | Inspect | 4 | 8 | 0.5 |
| | | 4 | Unload | 1 | 2 | 1.0 |
| D | 0.4 | 1 | Load | 1 | 4 | 1.0 |
| | | 2 | Mill | 2 | 30 | 1.0 |
| | | 3 | Inspect | 4 | 12 | 0.333 |
| | | 4 | Unload | 1 | 2 | 1.0 |

**PTO**

Q.4 The Cylinder Manufacturing Company has received orders for type A, B, C, and D cylinders on day 10 on the production schedule calendar at a finishing workstation in that order. The orders are coded as A, B,C, and D for ease of presentation in this example. The following data are available: [12]

| Job Types | Due Date | Remaining Process Time | Number of Remaining Operations |
|---|---|---|---|
| A | 17 | 4 | 8 |
| B | 29 | 18 | 18 |
| C | 27 | 8 | 16 |
| D | 26 | 12 | 2 |

Determine the order in which the jobs should be processed according to the FCFS, EDD, SPT, LS, SPO, and CR rules. Also determine the means completion time and average job lateness for SPT priority rule.

Q.5(a) What are the various guidance methods available for automated guided vehicle? [2]

(b) Johnson and Johnson (JJ) is planning to integrate the AGVS and AS/RS with their FMS.JJ is interested is estimating the number of AGVs required to satisfy the needs of the manufacturing system, that means the system must be capable of making 51 deliveries per hour. JJ has already decided to install a laser guide path system and the unit load AGVs adequately servers the company needs. The following data have been collected: [4]
Vehicle speed = 180 m/min. Average loaded travel distance/delivery = 540 m.
Average empty travel distance/delivery = 360 m, Pickup time = 0.50 min.
Drop-off time = 0.50 min., Traffic factor =0.85

(c) What are the various types of material handling and/or transportation systems used in FMS? Describe their individual domains (areas) of applications for which they are used with their relative advantages and disadvantages, if any. [6]

Q.6 Design and draw neat sketch of AS/RS system assume suitable data with the following requirements. The unit load sizes are 0.6 m (width) X 0.5 m (length) X 0.5 m (height). The height clearance required is 0.20 m, the length clearance is 0.15 m, the width clearance is 0.10 m and the number of unit loads per storage unit (u) is 2. The average cycle time of the operation of the S/T machine is 1 minute. The system has total number of storage spaces equal to 10000. The system throughput expected is 420 operations (either storage or retrieval) per hour. Take the desired system height to be less than 20 m. Take centre-to-centre rack support as 0.10 m, bay side support allowance as 0.10 m, clearance for the crane run-out as 3m, clearance for the pickup/deposit area as 5 m, and aisle width as 2 m. [12]

Q.7(a) What are the objectives of material requirement planning? [2]

(b) What are the methods used for forming cell in group technology ? Briefly explain with suitable example. [4]

(c) Consider the following matrix of ten parts and five machines, form machine cells using ROC algorithm. [6]

| Machine | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| | COMPONENTS | | | | | | | | | |
| M1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 |
| M2 | | 1 | 1 | 1 | | | | | 1 | 1 |
| M3 | 1 | | | | 1 | 1 | 1 | | | |
| M4 | | 1 | 1 | 1 | | | | 1 | 1 | 1 |
| M5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | |