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# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

*(A constituent unit of MAHE, Manipal)*

**V SEMESTER B.TECH. (MECHATRONICS ENGINEERING)**
**END SEMESTER EXAMINATIONS, DECEMBER 2018**

SUBJECT: MANUFACTURING TECHNOLOGY [MTE 3101]

Time: 3 Hours MAX. MARKS: 50

**Instructions to Candidates:**

- Answer **ALL** the questions.
- Data not provided may be suitably assumed

**1A.** Compare between traditional and non-traditional machining process. **04**

**1B.** With sketch explain horizontal type centrifugal casting. List advantages and disadvantages of centrifugal casting. **03**

**1C.** With sketch, provide the detailed explanation of abrasive jet machining process and its applications. **03**

**2A** Aluminum metal composite (AMCs) materials have to be joined to get a but joint. It is observed that during the fusion welding process, SiC reinforcements particles are decomposed and formed aluminum carbide which degrades the strength of the composite. Select the type of welding process used to join the AMCs and explain the steps involved in the process. **04**

**2B** Develop a CNC Part program for the component shown in Figure 2B. The tool used for profile cut is dia 5 mm. Dia 10mm tool is used for the circular and rectangular pocketing. The maximum rotational speed of spindle is 6000 rpm and feed rate ranges from 100 to 450mm/min. All dimensions are in mm. **06**

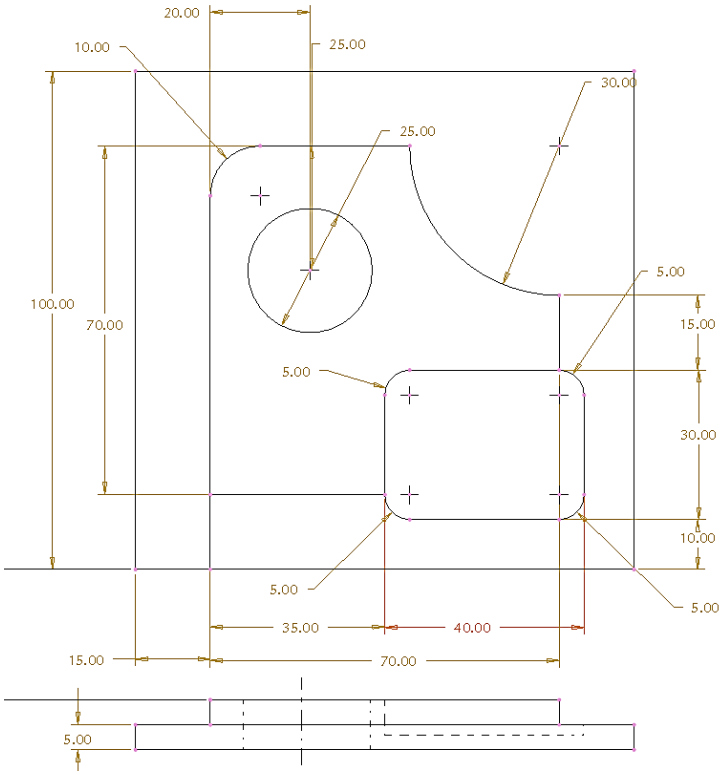


**Figure 2B Component**

**3A** Compare the types of dimensioning process used in CNC part programming with suitable example which is more convenient based on engineering drawing. **02**

**3B** Figure 3B is a supporting element for fixture assembly. Identify and select the appropriate process to build the CNC part program shown in the Figure 3B. All dimensions are in mm. **05**

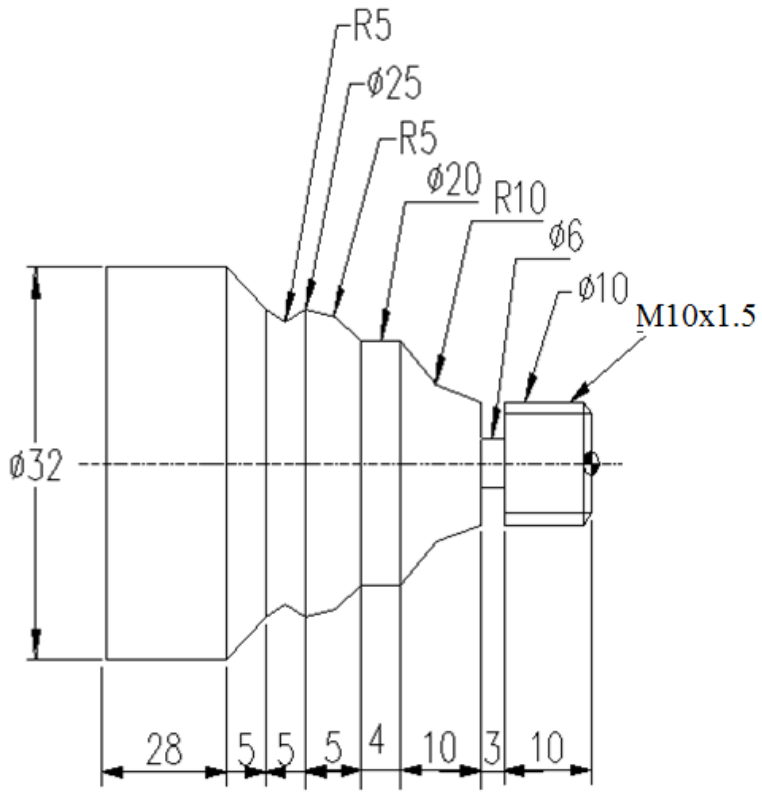


**Figure 3B Component**

**3C** Explain the syntax with suitable example for peck drilling cycle, tapping cycle and sub programming concepts used in CNC machining center. **03**

**4A** Write a syntax for box turning and face turning cycle with suitable example, and justify the use of canned cycle as compared to simple turn and simple facing operation. **04**

**4B** Your company is seeking proposals for an automated storage/retrieval system that will have a throughput rate of 300 storage/retrieval transactions/hour during the one 8-hour shift per day. The request for proposal indicates that the number of single command cycles is expected to be four times the number of dual command cycles. The first proposal received is from a vendor who specifies the following: ten aisles, each aisle 150 ft long and 50 ft high; horizontal and vertical speeds of the S/R machine = 200 ft/min and 66.67 ft/min, respectively; and pick and deposit time = 0.3 min. As the responsible engineer for the project, you must analyze the proposal and make recommendations accordingly. One of the difficulties you see in the proposed AS/RS is the large number of S/R machines that would be required - one for each of the 10 aisles. This makes the proposed system very expensive. Your recommendation is to reduce the number of aisles from 10 to 6 and to select a S/R machine with horizontal and vertical speeds of 300 ft/min and 100 ft/min, respectively. Although each high speed S/R machine is slightly more expensive than the slower model, reducing the number of machines from 10 to 6 will significantly reduce total cost. Also, fewer aisles will reduce the cost of the rack structure even though each aisle will be somewhat larger since total storage capacity must remain the same. The problem is that throughput rate will be adversely affected by the larger rack system. (a) Determine the throughput rate of the proposed 10-aisle AS/RS and calculate its utilization relative to the specified 300 transactions/hour. (b) Determine the length and height of a six-aisle AS/RS whose storage capacity would be the same as the proposed 10-aisle system. (c) Determine the throughput rate of the 6-aisle AS/RS and calculate its utilization relative to the specified 300 transactions/hour. (d) Given the dilemma now confronting you, what other alternatives would you analyze and recommendations would you make to improve the design of the system? **06**

**5A** Apply the rank order clustering technique to the part-machine incidence matrix in Table 5A to identify logical part families and machine groups. Parts are identified by letters, and machines are identified numerically. **05**

**Table 5A** Part-machine incidence matrix

| | Parts | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Machines | A | B | C | D | E | F | G | H | I |
| 1 | | | 1 | 1 | 1 | | | | |
| 2 | 1 | 1 | | | | | 1 | 1 | 1 |
| 3 | | | | | | 1 | 1 | 1 | |
| 4 | 1 | 1 | | 1 | | | | | |
| 5 | | | 1 | | 1 | | | | |
| 6 | | 1 | | | | | | 1 | 1 |
| 7 | 1 | | 1 | 1 | | | | | |
| 8 | | 1 | | | | 1 | | 1 | 1 |

**5B** A flexible manufacturing cell consists of two machining workstations plus a load/unload station. The load/unload station is station 1. Station 2 performs milling operations and consists of one server (one CNC milling machine). Station 3 has one server that performs drilling (one CNC drill press). The three stations are connected by a part handling system that has one work carrier. The mean transport time is 2.5 min. The FMC 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 $fijk$ = 1.0 for all operations. Determine (a) maximum production rate of the FMC, (b) corresponding production rates of each product, (c) utilization of each machine in the system, and (d) number of busy servers at each station. **05**

**Table 5B** Part mix fractions and process routings

| Part $j$ | Part mix $p_j$ | Operation $k$ | Description | Station $i$ | Process time $t_{ijk}$ |
|---|---|---|---|---|---|
| A | 0.2 | 1 | Load | 1 | 3 min |
| | | 2 | Mill | 2 | 20 min |
| | | 3 | Drill | 3 | 12 min |
| | | 4 | Unload | 1 | 2 min |
| B | 0.3 | 1 | Load | 1 | 3 min |
| | | 2 | Mill | 2 | 15 min |
| | | 3 | Drill | 3 | 30 min |
| | | 4 | Unload | 1 | 2 min |
| C | 0.5 | 1 | Load | 1 | 3 min |
| | | 2 | Drill | 3 | 14 min |
| | | 3 | Mill | 2 | 22 min |
| | | 4 | Unload | 1 | 2 min |