

SUBJECT: MANUFACTURING TECHNOLOGY [MTE 3101] (19/11/2018)

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

- ✤ Answer ALL the questions.
- ✤ Data not provided may be suitably assumed.
- 1A. Plan the sand casting steps involved in manufacturing the parts as shown in Figure 1A with 04 appropriate sketch.



Figure Q1A Machine drawing part.

- **1B.** MIG welding process is used to weld titanium alloys. Identify its advantages and **03** disadvantages as compared to other welding process.
- 1C. Determine the appropriate punch and die sizes, and blanking force required for a blanking 03 operation. The operation is to be performed on 2.0 mm thick cold rolled steel (half hard=0.075). The part is circular with diameter = 75.0 mm. The steel has a shear strength of 350 MPa.
- 2A Design a PLC program for the Electro-Hydraulic system shown in Figure 2A to automate the 04 deep drawing machine. They have developed hydraulic circuit for the system. The working of the machine is as follows: The hydraulic circuit must operate at two different absolute pressures. Initial operation is drawing at low pressure (Pressure 10 bar). When piston reaches to its half of the cylinder stroke, the system must switch over to high pressure with the help of proximity sensor. The return stroke of cylinder is initiated by the pressure sensor after it reaches to preset pressure of 40 bar.



2B Develop a CNC Part program for the component shown in Figure 2B. The tool used for 06 profile cut is dia 3mm. 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.



Figure Q2B Component

- **3A** Construct the ladder diagram program for the double arm tool changing mechanism and **05** explain the working of mechanism with sketch.
- **3B** Identify and select the appropriate process to build a component, and also develop CNC part **05** program shown in the Figure 3B. All dimensions are in mm.



4A Explain with sketch different types of zero points and its purpose used in the CNC machine. 04



Figure 4B (b) component

Table 4B Optiz Form code

Digit 1 Digit 2						Digit 3				Digit 4			Digit 5				
	Part class			External shape, external shape elements				Internal shape, internal shape elements				Plane surface machining			Auxiliary holes and gear teeth		
0		$L/D \le 0.5$	0		Smooth, no shape elements		0			No hole, no breakthrough	0	No surface machining		0		No auxiliary hole	
1		0.5 < L/D < 3	1	end		No shape elements		1	pped	No shape elements		1	Surface plane and/or curved in one direction, external		1		Axial, not on pitch circle diameter
2	tal parts	L/D ≥ 3	2	bed to one	Thread	Thread		2	oth or step o one end	Thread		2	External plane surface related by graduation around the circle		2	eth	Axial on pitch circle diameter
3	Rotation		3	Stepi	or em	5 Functional groove		3	Smo	Functional groove		3	External groove and/or slot		3	No gear te	Radial, not on pitch circle diameter
4			4	ends		No shape elements		4	ends	No shape elements		4	External spline (polygon)		4	~	Axial and/or radial and/or other direction
5			5 though the second sec			Thread			ed to both	Thread		5	External plane surface and/or slot, external spline		5		Axial and/or radial on PCD and/or other directions
6			6	Steppe		Functional groove		6	Steppe	Functional groove		6	Internal plane surface and/or slot		6		Spur gear teeth
7	nal parts	nal parts			Functional cone		,	7	Functional cone			7	Internal spline (polygon)		7	cth	Bevel gear teeth
8	onrotatic		8		0	perating thread		8	0	perating thread		8	Internal and external polygon, groove and/or slot		8	th gcar to	Other gear teeth
9			9 All others			9		All others		9	All others		9	M	All others		

[MTE 3101]

- **4C** Determine the throughput rate (loads moved/hour) of an automated storage/retrieval **04** system. The work-in-process has five aisles. The storage racks in each aisle are 10 m high and 50 m long. The S/R machine for each aisle travels at a horizontal speed of 2.0 m/s and a vertical speed of 0.4 m/s. Pick and deposit time = 15 s. Assume that the number of single command cycles per hour is equal to three times the number of dual command cycles per hour and that the system operates at 90% utilization.
- 5A Apply the rank order clustering technique to the part-machine incidence matrix in Table 5A to 05 identify logical part families and machine groups. Parts are identified by letters, and machines are identified numerically.

					Parts				
Machines	Α	В	С	D	E	F	G	Н	Ι
1	1								1
2		1					1		
3			1		1			1	
4		1				1	1		
5			1					1	
6						1	1		
7	1			1					
8			1		1				

Table Q5A. Part-machine incidence matrix

5B A FMS consists of three stations plus a load/unload station. Station 1 loads and unloads parts **05** using two servers (material handling workers). Station 2 performs horizontal milling operations with two servers (identical CNC horizontal milling machines). Station 3 performs vertical milling operations with three servers (identical CNC vertical milling machines). Station 4 performs drilling operations with two servers (identical drill presses). The machines are connected by a part handling system that has two work carriers and a mean transport time = 3.5min. The FMS produces four parts, A, B, C, and D, whose part mix fractions and process routings are presented in Table 5B. The operation frequency *fijk* = 1.0 for all operations. Determine (a) maximum production rate of the FMS, (b) utilization of each machine in the system, and (c) average utilization of the system, (d) number of busy server at each station. Table 5B Part mix fractions and process routings

Part j	Part mix p_j	Operation k	Description	Station i	Process time t _{ijk}			
А	0.2	1	Load	1	4 min			
		2	H. Mill	2	15 min			
		3	V Mill	3	14 min			
		4	Drill	4	13 min			
		5	Unload	1	3 min			
В	0.2	1	Load	1	4 min			
		2	Drill	4	12 min			
		3	H. Mill	2	16 min			
		4	V. Mill	3	11 min			
		5	Drill	4	17 min			
		6	Unload	1	3 min			
С	0.25	1	Load	1	4 min			
		2	H. Mill	2	10 min			
		3	Drill	4	9 min			
		. 4	Unload	1	3 min			
D	0.35	1	Load	1	4 min			
		2	V. Mill	3	18 min			
		3	Drill	4	8 min			
		4	Unload	1	3 min			