Menoufia University Faculty of Engineering, Shebin El-kom Production Engineering And Mechanical Design Department Final Exam, 2019-2020 Date of Exam: 13/8/2020	Subject: Advanced Topics in Machining Code: PRE 607 Year: 2019-2020 Time Allowed: 3 Hours Total Marks: 100 Marks

Tables and charts: None

Answer the Following Questions: (Illustrate your answers with good drawings).

Question 1 **(29 degrees)**

a. Define machinability. What are the criteria by which machinability is commonly assessed in a production machining operation? Illustrate some of the important mechanical and physical properties that affect the machinability of a work material. Explain how to improve machining performance for steel. (8)

b. A machinability rating is to be determined for a new work material using the cutting speed for a 60 min tool life as the basis of comparison. For the base material (B1112 steel), test data resulted in Taylor equation parameter values of n = 0.29 and C = 500, where speed is in m/min and tool life is min. For the new material, the parameter values were n= 0.21 and C= 400. These results were obtained using cemented carbide tooling. (a) Compute a machinability rating for the new material. (b) Suppose the machinability criterion were the cutting speed for a 10 min tool life rather than the present criterion. Compute the machinability rating for this case. (c) What do the results of the two calculations show about the difficulties in machinability measurement? (8)

c. What are the basic factors that affect surface finish in machining? Illustrate the parameters that have the greatest influence in determining the ideal surface roughness (R_i) in a turning operation? Name some of the steps that can be taken to reduce or eliminate vibrations in machining. (8)

d. A part to be turned in an engine lathe must have a surface finish of 1.6 mm. The part is made of a free machining aluminium alloy. Cutting speed= 150 m/ min, and depth of cut = 4.0 mm. The nose radius on the tool = 0.75 mm. Determine the feed that will achieve the specified surface finish. Take the ratio r_{ai} = 1.0 (5)

Question 2 **(21 degrees)**

Explain briefly the properties, types and applications for the following tool materials:

a. Cast cobalt alloys. (7)

b. Cemented carbides, cermets, and coated carbides. (7)

c. High-speed steel. (7)

Question 3 **(28 degrees)**

a. Explain how to select the cutting conditions in a machining operation. (6)

b. Describe the following for cutting tool: i) the two principal aspects of cutting-tool technology, ii) the three modes of tool failure in machining, iii) What is the physical interpretation of the parameter C in the Taylor tool life equation, iv) In addition to cutting speed, what other cutting variables are included in the expanded version of the Taylor tool life equation?, v) What are some of the tool life criteria used in production machining operations? (10)

c. Three tool materials are to be compared for the same finish turning operation on a batch of 120 steel parts: high-speed steel, cemented carbide, and ceramic. For the high-speed steel tool, the Taylor equation parameters are: n = 0.130 and C= 80 (m/min). The price of the HSS tool is $22 and it is estimated that it can be ground and reground 15 times at a cost of $2 per grind. Tool change time is 3 min. Both carbide and ceramic tools are in insert form and can be held in the same mechanical tool holder. The Taylor equation parameters for the cemented carbide are: n = 0.30 and C = 650 (m/min); and for the ceramic: n = 0.6 and C = 3,500 (m/min). The cost per insert for the carbide is $8 and for the ceramic is $10. There are six cutting edges per insert in both cases. Tool change time is 1.0 min for both tools. The time to change a part is 2.5 min. The feed is 0.30 mm/rev, and depth of cut is 3.5 mm. The cost of machine time is $40/hr. The part is 80.0 mm in diameter and 300 mm in length. Setup time for the batch is 2.0 hr. For the three tooling cases, compare: (a) cutting speeds for minimum cost, (b) tool lives, (c) cycle time, (d) cost per production unit, (e) total time to complete the batch and production rate. (f) What is the proportion of time spent actually cutting metal for each tooling? Use of a spreadsheet calculator is recommended. (12)

Question 4. **(22 degrees)**

a. Explain the surface texture produced in the following machining operations:
1) Turning and 2) Electrodischarge (EDM). (8)

b. Describe the Factors Influencing Surface Integrity in:
1) Grinding operation and 2) Electrochemical machining (ECM). (8)

c. Illustrate the Microstructural Effects (White Layer Formation) in the following processes: 1) Drilling. 2) EDM. (6)

Best wishes

			This exam measures the following ILOs				
Question Number	Q2-b Q4-a	Q4-b	Q3-b Q1-a	Q1-d Q2-a	Q1-c Q3-d	Q3-c Q1-b	Q3-a Q4-c Q2-c
Skills	a1-1	a2-1	a6-1	b1-1	b5-1	c1-1	c2-1
	Knowledge &Understanding Skills			Intellectual Skills		Professional Skills	