UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 6 Examination in Engineering: September 2023

Module Number: ME6302 **Module Name: Computer Aided Manufacturing**

[Three Hours]

[Answer **all questions**, each question carries twelve marks]

This paper contains 5 questions on 8 pages.
Clearly state any assumptions that you may make.
In order to get full marks, make sure to use standard notations and SI units.

Q1. a) Describe briefly at least three (03) different Computer Aided Manufacturing (CAM) software tools which are widely used in the local manufacturing sector.

[03 Marks]

b) Discuss briefly giving examples, at least five (04) areas where Computer Aided Design (CAD) is involved in modern day engineering designs.

[04 Marks]

c) If you are asked to prepare a development plan for an existing manufacturing organization of your choice, what are the factors you would consider in preparing the plan? Give them in a priority order placing the most important factor first.

[05 Marks]

Q2. a) Illustrate with neat sketches the work cycles of a conventional machine and a fully automated machine.

[03 Marks]

b) A certain manufacturing organization, having its branch offices located at geographically different locations, finds it difficult to manage the day-to-day activities. As a conceptual proposal, what would you suggest them to improve the situation?

[06 Marks]

c) How would you classify manufacturing systems? Illustrate your answer with neat sketches and giving an example each.

[03 Marks]

Q3 The part shown in **Figure Q3** needs to be machined on a 3-axis CNC machining centre. The workpiece has been previously machined on conventional machines and has only 0.2 mm left for finish machining. Required G codes and M codes are given in **Appendix 1**. You may assume any missing code after indicating it in your answer script. Units are in mm.

a) Proposed a suitable method of clamping the workpiece on the machine bed.

[01 Mark]

b) Clearly indicate a suitable point for part zero, Z-zero level, program start point, clearance level and the orientation of the coordinate axes on a sketch. Also indicate tool type(s) and the diameter(s), spindle speed and feed rates used. Marks will be given for neatness of the sketch too.

[03 Marks]

c) Write down a suitable part program to machine only the finishing cut of the outer profile of the part. Program number, settings in the header and the footer must be clearly include in the part program. If you wish, tool compensations can be used.

[08 Marks]

Q4 a) Briefly describe the philosophy of Group Technology (GT).

[02 Marks]

b) If you have an option to select between Production Flow Analysis (PFA) and parts Classification and Coding systems in GT what will be your choice? Give at least three (03) reasons for your choice.

[03 Marks]

c) The following part-machine incident matrix has been derived from existing process plans of a certain organization. Perform a PFA on the matrix and identify the following. Use the tables given in the **Appendix 2** and attach it with your answer script.

i) Possible part families (machines and parts).

[05 Marks]

ii) If it is not straight forward, what are your suggestions to make part families and manufacturing cells?

[02 Marks]

	P01	**P02**	**P03**	**P04**	**P05**	**P06**	**P07**	**P08**	**P09**	**P10**
M01	x				x		x			
M02						x		x		
M03		x	x							x
M04			x	x						x
M05				x		x		x		
M06		x	x							
M07	x				x				x	
M08				x		x				
M09		x	x							x
M10	x						x			
M11				x				x		

Q5 The stepped shaft shown in **Figure Q5** needs to be machined on a conventional lathe machine with a material stock of diameter 90 mm and a length of 185 mm. The standard machining times for various operations on a lathe machine are given in the table below. Take the facing of the right-hand face and the machining of centre hole have been previously completed. Units are in mm.

a) List down only the key machining steps necessary to complete the shaft in the correct order.

[02 Marks]

b) Estimate the approximate machining time required and the cost. Clearly state the assumptions you made if there is any.

[06 Marks]

c) Why do you need Computer Aided Process Planning (CAPP) in modern day manufacturing? Give at least four (04) reasons.

[04 Marks]

Standard machining data

Operation	**Time (sec/mm^3)**	**Cost (Rs. /mm^3)**	**Remarks**
Rough turning	0.5	100.00	
Facing	0.4	75.00	
Taper turning	1.2	200.00	
Finish turning	0.8	125.00	Maximum depth of cut < 0.1 mm

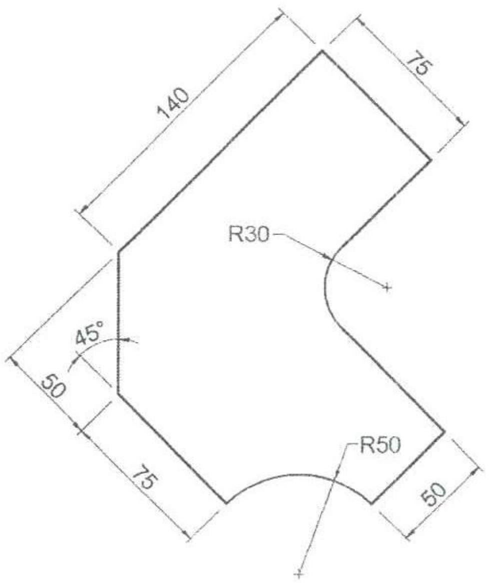

Figure Q3 (All the units are in mm)

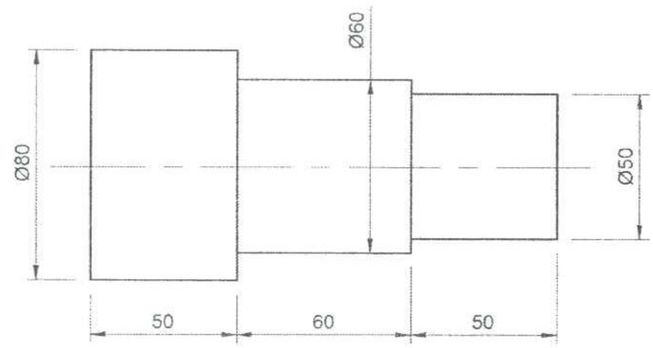

Figure Q5 (All the units are in mm)

Appendix 1

G - Codes

G00	Rapid Traverse (positioning mode)
G01	Linear Interpolation
G02	Circular Interpolation CW
G03	Circular Interpolation CCW
G04	Dwell Mode
G17	XY Plane Selection
G18	ZX Plane Selection
G19	YZ Plane Selection
G20	Input in inch
G21	Input in mm
G27	Reference Point Return Check
G28	Return to Reference Point
G29	Return from Reference Point
G40	Cutter Compensation Cancel
G41	Cutter Compensation Left
G42	Cutter Compensation Right
G43	Tool Length Compensation +ve
G44	Tool Length Compensation –ve
G49	Tool Length Compensation Cancel
G54	Work Coordinate System 1
G55	Work Coordinate System 2
G56	Work Coordinate System 3
G57	Work Coordinate System 4
G58	Work Coordinate System 5
G59	Work Coordinate System 6
G81	Drilling Cycle, spot boring
G82	Drilling Cycle, counter boring
G83	Peck Drilling Cycle
G84	Tapping Cycle
G85	Boring Cycle
G90	Absolute command
G91	Incremental command

M-codes

M00	Program Stop
M01	Optional Program Stop
M02	End of Program
M03	Spindle on CW
M04	Spindle on CCW
M05	Spindle Stop
M06	Tool Change
M07	Mist Coolant On
M08	Flood Coolant On
M09	Coolant Off
M19	Spindle Orient
M30	End of Program, Rewind

Appendix 2

Attach this sheet with the Answer Script – For Q4

Index No.:	**Module Code:** *ME6302*	**Date:** *04.10.2023*

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Index No.:	Module Code:	ME6302	Date:	*04.10.2023*

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End of Paper