



COURSE OUTLINE: MAC307 - MACHINING CENTRE

Prepared: Peter Corbett

Approved: Corey Meunier, Chair, Technology and Skilled Trades

Course Code: Title	MAC307: MACHINING CENTRE CNC TECHNOLOGY
Program Number: Name	6347: GENERAL MACHINIST L3
Department:	MECHANICAL TECHNIQUES PS
Semesters/Terms:	20F, 21F, 22F
Course Description:	This course is designed to provide Level III General Machinist Apprentices the ability to describe numerically controlled machining centres techniques and demonstrate procedures for entering and verifying a program to perform linear and circular machining operations.
Total Credits:	6
Hours/Week:	3
Total Hours:	48
Prerequisites:	There are no pre-requisites for this course.
Corequisites:	There are no co-requisites for this course.
Course Evaluation:	Passing Grade: 50%, D A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation.
Other Course Evaluation & Assessment Requirements:	Other Course Evaluation Requirements: Smart watches, smart phones and similar devices are not allowed during tests or quizzes and must be removed. Grade Definition Grade Point Equivalent A+ 90 - 100% 4.00 A 80 - 89% B 70 - 79% 3.00 C 60 - 69% 2.00 D 50 - 59% 1.00 F (Fail) 49% and below 0.00 CR (Credit) Credit for diploma requirements has been awarded. S Satisfactory achievement in field /clinical placement or non-graded subject area. U Unsatisfactory achievement in field/clinical placement or non-graded subject area. X A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course. NR Grade not reported to Registrar's office. W Student has withdrawn from the course without academic penalty.
Books and Required Resources:	Technology Of Machine Tools by Steve F. Krar, Arthur R. Gill, Peter Smid, Robert J. Gerritsen Publisher: McGraw - Hill Edition: 8 ISBN: 9781260565782

In response to public health requirements pertaining to the COVID19 pandemic, course delivery and assessment traditionally delivered in-class, may occur remotely either in whole or in part in the 2020-2021 academic year.



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Course Outcomes and Learning Objectives:

Course Outcome 1	Learning Objectives for Course Outcome 1
1. Describe safe working procedures when setting up and operating CNC machining centres.	<p>1.1 Identify potential safety hazards which may occur during CNC machine set-up and operating procedures.</p> <p>Demonstrate safe working habits including:</p> <ul style="list-style-type: none"> - protective clothing - protective equipment and gear - good housekeeping - start-up procedures - shut-off procedures - securing workplace/cutting tools - stabilizing workplace/cutting tools - lubricants - fire protection
Course Outcome 2	Learning Objectives for Course Outcome 2
2. Describe operating principles of CNC machining centres. (2 hrs)	<p>2.1 Identify the capabilities, operating principles, and controls of CNC machining centres:</p> <ul style="list-style-type: none"> - types of equipment - editing capability - program path ability - processing power - high speed machining - CNC controls - tapeless controls - PC/DNC systems <p>Describe the major features and functions of CNC machining centres and the manufacturing process:</p> <ul style="list-style-type: none"> - CPU - input devices - work envelope - tool changer - holding devices - safety interlock - engineering drawing - CNC part program - input media - CNC machine tool - finished part - repeatability <p>Describe the common means of producing part program files:</p> <ul style="list-style-type: none"> - manual programming - CAM systems - conversational programming
Course Outcome 3	Learning Objectives for Course Outcome 3
3. Describe use of job documentation to determine job requirements. (2 hrs)	<p>3.1 Identify job documentation required to complete the job.</p> <p>Develop job set-up sheets by identifying:</p> <ul style="list-style-type: none"> - axis alignment

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	<ul style="list-style-type: none"> - locating points - workholding methods - program zero <p>Develop tooling list by identifying:</p> <ul style="list-style-type: none"> - tools - tool holders - type of tool material - set-up dimensions - tool numbers - tool offsets - cutter radius compensation register - workpiece materials
Course Outcome 4	Learning Objectives for Course Outcome 4
4. Describe the application of machining centres. (2 hrs)	4.1 Describe the methodology of programming parts as opposed to conventional machining: <ul style="list-style-type: none"> - differential - cam - helical - thread
Course Outcome 5	Learning Objectives for Course Outcome 5
5. Describe machining centre operations. (2 hrs)	5.1 Describe fixed cycles: <ul style="list-style-type: none"> - centre drilling - drilling - counterboring - reaming - tapping <p>Describe fixed cycle terms and sequences:</p> <ul style="list-style-type: none"> - initial level - R point level - Z level - machining increment - rapid approach - rapid retract - dwell time - feed rate directions <p>Describe the advanced additional specialized CNC techniques:</p> <ul style="list-style-type: none"> - HSM - thread milling - live tooling - 4th and 5th axis
Course Outcome 6	Learning Objectives for Course Outcome 6
6. Describe manual operating systems for CNC machining centres. (3 hrs)	6.1 Describe manual interruption on a machining centre: <ul style="list-style-type: none"> - single block operation - feedhold - emergency stop <p>Describe manual data input (MDI) on a machining centre:</p>

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	<ul style="list-style-type: none"> - line command execution - set-up applications <p>Describe program data override:</p> <ul style="list-style-type: none"> - rapid motion override - spindle speed override - feedrate override - dry run operation - manual absolute setting - practical applications <p>Describe interfacing to peripherals:</p> <ul style="list-style-type: none"> - RS-232C Interface - PC/DNC - USB - wireless
Course Outcome 7	Learning Objectives for Course Outcome 7
7. Describe circular interpolation on a machining centre. (2 hrs)	<p>7.1 Describe circular interpolation planes:</p> <ul style="list-style-type: none"> - X - Y plane - Z - X plane - Y - Z plane - arc centre modifiers <p>Describe circular interpolation commands:</p> <ul style="list-style-type: none"> - arc modifiers - radius - quadrants - circles - cutter radius compensation
Course Outcome 8	Learning Objectives for Course Outcome 8
8. Develop a plan for CNC machining centres. (10 hrs)	<p>8.1 Interpret documentation to determine:</p> <ul style="list-style-type: none"> - workpiece material specifications - method of routing instructions - special fixturing requirements <p>Plan sequence of machining by identifying:</p> <ul style="list-style-type: none"> - order of machining - tooling selection - workpiece set-up
Course Outcome 9	Learning Objectives for Course Outcome 9
9. Describe the setting up and application of workholding devices for CNC machining centre operations. (10 hrs)	<p>9.1 Describe the setting up of a vise or fixture on a machining centre:</p> <ul style="list-style-type: none"> - alignment to axis - locators for multiple parts - clamping pressures - establish program zero - part geometry considerations <p>Describe the use of dimensioning practices:</p> <ul style="list-style-type: none"> - raw stock pre-machining

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	<ul style="list-style-type: none"> - pre-machining - castings - locating points - clamping areas - multiple parts - fixture offsets - quantity of parts
Course Outcome 10	Learning Objectives for Course Outcome 10
10. Demonstrate procedures for entering and verifying programs for a CNC machining centre to perform linear and circular machining operations. (15 hrs)	<p>10.1 Demonstrate the use of preparatory commands (G-codes):</p> <ul style="list-style-type: none"> - modality of G-codes - recognize conflicting commands - order in a block <p>Demonstrate the use of M-codes:</p> <ul style="list-style-type: none"> - typical M-codes - M-codes in a block <p>Demonstrate the use of codes to specify word and block structures:</p> <ul style="list-style-type: none"> - program identification - block number - N-word - starting number - increments - end of block - block description - status block (safe block) - message block (program comments) - conflicting words - modal programming values - execution priority <p>Demonstrate the use of codes to specify dimensions:</p> <ul style="list-style-type: none"> - metric/inch selection - absolute/incremental selection - absolute data input - incremental data input - syntax - zero suppression and decimal point - leading and trailing zeros input <p>Demonstrate the use of codes to specify:</p> <ul style="list-style-type: none"> - tool number - tool length offset - tool radius offset <p>Demonstrate the use of codes to invoke speeds and feeds:</p> <ul style="list-style-type: none"> - spindle function - S-code - spindle rotation direction - spindle stop

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- spindle orientation
- spindle speed (RPM)
- feedrate control
- feedrate function
- feedrate per minute
- feedrate override and feedhold
- feedrate override and functions

Demonstrate the use of codes to establish reference points:

- machine reference point
- manufacturers' setting
- workpiece reference point
- program zero application
- position register command
- fixture offsets

Demonstrate the use of codes to execute rapid positioning:

- rapid traverse motion
- positioning mode
- tool path
- workpiece approach
- single axis motion
- multi-axis motion
- straight angular motion
- type of motion and time comparison
- rapid motion path
- axis motion completion

Demonstrate use of codes to establish zero return commands:

- zero return commands
- return to machine zero

Demonstrate the use of codes to create contouring programs:

- cutter path determination
- linear interpolation
- circular interpolation
- rough and finished shape
- helical circular interpolation

Describe cutter radius compensation:

- compensation right
- compensation left
- radius offset table
- radius wear offset
- radius setting

Demonstrate procedures to enter and verify a program to mill a workpiece that includes drilling and profiling.

Demonstrate downloading of a program that includes:

- feeds
- speeds
- overrides

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- axis selection
- mode selection

Evaluation Process and Grading System:

Evaluation Type	Evaluation Weight
Attendance, Participation and Attitude	5%
Final Test and Practical Project	50%
Mid term	25%
Quiz 1	10%
Quiz 2	10%

Date:

September 3, 2020

Addendum:

Please refer to the course outline addendum on the Learning Management System for further information.

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