COURSE OUTLINE: MAC307 - MACHINING CENTRE

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Course Code: Title	MAC307: MACHINING CENTRE CNC TECHNOLOGY
Program Number: Name	6347: GENERAL MACHINIST L3
Department:	MECHANICAL TECHNIQUES PS
Semesters/Terms:	21F, 22W, 22F
Course Description:	This course is designed to provide Level III General Machinist Apprentices the ability to 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.
Vocational Learning Outcomes (VLO's) addressed in this course: **Please refer to program web page for a complete listing of program outcomes where applicable.**	**6347 - GENERAL MACHINIST L3** VLO 1 General Machinist - L3
Essential Employability Skills (EES) addressed in this course:	EES 1 Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience. EES 2 Respond to written, spoken, or visual messages in a manner that ensures effective communication. EES 3 Execute mathematical operations accurately. EES 5 Use a variety of thinking skills to anticipate and solve problems. EES 6 Locate, select, organize, and document information using appropriate technology and information systems. EES 8 Show respect for the diverse opinions, values, belief systems, and contributions of others. EES 9 Interact with others in groups or teams that contribute to effective working relationships and the achievement of goals. EES 10 Manage the use of time and other resources to complete projects.
Course Evaluation:	Passing Grade: 50%, D A minimum program GPA of 2.0 or higher where program specific standards exist is required for graduation.

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 2021-2022 academic year.

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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

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.	1.1 Identify potential safety hazards which may occur during CNC machine set-up and operating procedures. Demonstrate safe working habits including: - 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)	2.1 Identify the capabilities, operating principles, and controls of CNC machining centres: - types of equipment - editing capability - program path ability - processing power - high speed machining - CNC controls - tapeless controls - PC/DNC systems Describe the major features and functions of CNC machining

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centres and the manufacturing process:
- CPU
- input devices
- work envelope
- tool changer
- holding devices
- safety interlock
- engineering drawing
- CNC part program
- input media
- CNC machine tool
- finished part
- repeatability

Describe the common means of producing part program files:
- 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)	3.1 Identify job documentation required to complete the job. Develop job set-up sheets by identifying: - axis alignment - locating points - workholding methods - program zero Develop tooling list by identifying: - 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: - 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: - centre drilling - drilling - counterboring - reaming - tapping

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	Describe fixed cycle terms and sequences: - initial level - R point level - Z level - machining increment - rapid approach - rapid retract - dwell time - feed rate directions Describe the advanced additional specialized CNC techniques: - 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: - single block operation - feedhold - emergency stop Describe manual data input (MDI) on a machining centre: - line command execution - set-up applications Describe program data override: - rapid motion override - spindle speed override - feedrate override - dry run operation - manual absolute setting - practical applications Describe interfacing to peripherals: - 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)	7.1 Describe circular interpolation planes: - X - Y plane - Z - X plane - Y - Z plane - arc centre modifiers Describe circular interpolation commands: - arc modifiers - radius - quadrants - circles - cutter radius compensation

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Course Outcome 8	Learning Objectives for Course Outcome 8
8. Develop a plan for CNC machining centres. (10 hrs)	8.1 Interpret documentation to determine: - workpiece material specifications - method of routing instructions - special fixturing requirements Plan sequence of machining by identifying: - 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)	9.1 Describe the setting up of a vise or fixture on a machining centre: - alignment to axis - locators for multiple parts - clamping pressures - establish program zero - part geometry considerations Describe the use of dimensioning practices: - raw stock pre-machining - 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)	10.1 Demonstrate the use of preparatory commands (G-codes): - modality of G-codes - recognize conflicting commands - order in a block Demonstrate the use of M-codes: - typical M-codes - M-codes in a block Demonstrate the use of codes to specify word and block structures: - program identification - block number - N-word - starting number - increments - end of block - block description - status block (safe block) - message block (program comments)

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- conflicting words
- modal programming values
- execution priority

Demonstrate the use of codes to specify dimensions:
- metric/inch selection
- absolute/incremental selection
- absolute data input
- incremental data input
- syntax
- zero suppression and decimal point
- leading and trailing zeros input

Demonstrate the use of codes to specify:
- tool number
- tool length offset
- tool radius offset

Demonstrate the use of codes to invoke speeds and feeds:
- spindle function
- S-code
- spindle rotation direction
- spindle stop
- 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

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- 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
- 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:	August 13, 2021
Addendum:	Please refer to the course outline addendum on the Learning Management System for further information.

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