

Programme Name/s : Mechanical Engineering

Programme Code : ME

Semester : Fourth

Course Title : CNC PROGRAMMING

Course Code : 314018

I. RATIONALE

Today's manufacturing needs like productivity, accuracy, consistency, flexibility, quality and finally performance of the product is prime importance. The course will impart knowledge & skills necessary for working in modern manufacturing demands. This course will help the student to operate CNC machines for manufacturing various jobs as per need of industry requirements.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Develop CNC program to manufacture different industrial components using CNC machines.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Develop manual part program for CNC lathe and milling machine.
- CO2 - Simulate the part program using simulation software.
- CO3 - Produce job on CNC lathe and milling machine.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme				Credits	Paper Duration	Assessment Scheme						Based on SL	Total Marks			
				Actual Contact Hrs./Week			SLH	NLH		Theory			Based on LL & TL							
				CL	TL	LL				FA-TH		SA-TH	Total	FA-PR	SA-PR	SLA				
										Max	Max	Max	Min	Max	Min	Max	Min			
314018	CNC PROGRAMMING	CNC	SEC	-	-	4	-	4	2	-	-	-	-	25	10	25#	10	- - 50		

Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs. * 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Identify different axes and their nomenclature. TLO 1.2 Apply tool offsetting and presetting before program execution on CNC machines. TLO 1.3 Use of word address format for programming. TLO 1.4 Explain stepwise procedure for programming.	Unit - I Fundamentals of CNC programming 1.1 Definition- program, programmer and programming . 1.2 Axes identification and nomenclature for CNC lathe and CNC milling machines. 1.3 Concept of tool offsetting and presetting. 1.4 Terminology used for program in Word Address Format (WAF). 1.5 Stepwise procedure for programming- study the given part drawing, set of instructions to the machine, problem definition, sequence of machining operation and process sheet, decide- material & stock size, work zero, unit, coordinate system (Absolute & Incremental), tool, cutting parameters and coordinate points.	Demonstration Lecture Using Chalk-Board
2	TLO 2.1 Explain linear and circular path operations. TLO 2.2 Calculate of cutting parameters according to job nature. TLO 2.3 Select appropriate G & M codes. TLO 2.4 Develop program as per given job drawing. TLO 2.5 Simulate on software and test dry run- on machine.	Unit - II Linear & circular path programming 2.1 Concept- Linear, circular path operations in lathe and milling machine. 2.2 Calculation of Cutting parameters, address parameters I, J, K, co-ordinates. 2.3 Respective G and M codes. 2.4 CNC part program as per given job drawing. 2.5 Concept of simulation and DRY-Run test.	Demonstration Lecture Using Chalk-Board

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	<p>TLO 3.1 Distinguish between canned cycle and Sub routine call.</p> <p>TLO 3.2 Develop part program for canned cycle.</p> <p>TLO 3.3 Develop part program for Subroutine call.</p> <p>TLO 3.4 Identify respective G&M code for canned cycle and subroutine call.</p>	<p>Unit - III Canned & Sub-routine call programming</p> <p>3.1 Concept- canned cycle, subroutine call.</p> <p>3.2 Facing, step and taper turning canned cycle, respective G & M codes, procedure to write canned cycle program, its importance.</p> <p>3.3 Concept of sub-routine call, respective G & M code, procedure of sub-routine call to write program, its importance.</p>	Demonstration Lecture Using Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
<p>LLO 1.1 Choose appropriate G & M codes for linear interpolation function on CNC lathe.</p> <p>LLO 1.2 Develop manual part program for linear interpolation function for given job.</p>	1	* Facing operation on CNC lathe by Linear interpolation function.	2	CO1
<p>LLO 2.1 Simulate prepared part program of linear interpolation function and take corrective action (if required).</p> <p>LLO 2.2 Use of an appropriate simulation software for part programming.</p>	2	* Verify part program of linear interpolation function prepared in Practical No.1 by using suitable simulation software.	2	CO2
<p>LLO 3.1 Perform DRY run-on CNC lathe machine.</p> <p>LLO 3.2 Verify tool path in DRY run activity.</p>	3	Conduct DRY run of Practical No.1 on CNC lathe machine.	2	CO3
<p>LLO 4.1 Perform linear interpolation function on CNC lathe.</p> <p>LLO 4.2 Check the finished job using suitable measuring instrument.</p>	4	* Execution of part program prepared in Practical No.1 on CNC lathe machine.	4	CO3
<p>LLO 5.1 Choose appropriate G & M codes for linear interpolation function on CNC milling.</p> <p>LLO 5.2 Develop manual part program for linear interpolation function.</p>	5	* Slotting operation on CNC milling by Linear interpolation function.	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Simulate prepared part program of linear interpolation function and take corrective action (if required). LLO 6.2 Use of an appropriate simulation software for part programing.	6	* Verify part program of linear interpolation function prepared in Practical No.5 by using suitable simulation software.	2	CO2
LLO 7.1 Perform DRY run-on CNC milling machine. LLO 7.2 Verify tool path in DRY run activity.	7	Conduct DRY run of Practical No.5 on CNC milling machine.	2	CO3
LLO 8.1 Perform linear interpolation function on CNC milling. LLO 8.2 Check the finished job using suitable measuring instrument.	8	* Execution of part program prepared in Practical No.5 on CNC milling machine.	4	CO3
LLO 9.1 Choose appropriate G & M codes for circular interpolation function on CNC lathe. LLO 9.2 Develop manual part program for circular interpolation function.	9	* Circular path operation on CNC lathe by circular interpolation function.	2	CO1
LLO 10.1 Simulate prepared part program of circular interpolation function and take corrective action(if required). LLO 10.2 Use of an appropriate simulation software for part programing.	10	* Verify part program of circular interpolation function prepared in Practical No.9 by using suitable simulation software.	2	CO2
LLO 11.1 Perform DRY run-on CNC lathe machine. LLO 11.2 Verify tool path in DRY run activity	11	Conduct DRY run of Practical No.9 on CNC lathe machine.	2	CO3
LLO 12.1 Perform circular interpolation function on CNC lathe. LLO 12.2 Check the finished job using suitable measuring instrument.	12	* Execution of part program prepared in Practical No.9 on CNC lathe machine.	4	CO3
LLO 13.1 Choose appropriate G & M codes for circular interpolation function on CNC milling. LLO 13.2 Develop manual part program for circular interpolation function.	13	* Circular path operation on CNC milling by circular interpolation function.	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 14.1 Simulate prepared part program of circular interpolation function and take corrective action (if required). LLO 14.2 Use of an appropriate simulation software for part programing.	14	* Verify part program of circular interpolation function prepared in Practical No.13 by using suitable simulation software.	2	CO2
LLO 15.1 Perform DRY run-on CNC milling machine. LLO 15.2 Verify tool path in DRY run activity.	15	Conduct DRY run of Practical No.13 on CNC milling machine.	2	CO3
LLO 16.1 Perform circular interpolation function on CNC milling. LLO 16.2 Check the finished job using suitable measuring instrument.	16	* Execution of part program prepared in Practical No.13 on CNC milling machine.	4	CO3
LLO 17.1 Choose appropriate G & M codes for canned cycle on CNC lathe. LLO 17.2 Develop manual part program for canned cycle given job.	17	Facing, step and taper turning operation by canned cycle.	2	CO1
LLO 18.1 Simulate prepared part program of canned cycle and take corrective action (if required). LLO 18.2 Use of an appropriate simulation software for part programing.	18	Verify part program of canned cycle prepared in Practical No.17 by using suitable simulation software.	2	CO2
LLO 19.1 Perform DRY run-on CNC lathe machine. LLO 19.2 Verify tool path in DRY run activity.	19	Conduct DRY run of Practical No.17 on CNC lathe machine.	2	CO3
LLO 20.1 Perform Facing, step and taper turning operation by canned cycle on CNC lathe. LLO 20.2 Check the finished job using suitable measuring instrument.	20	Execution of part program prepared in Practical No.17 on CNC lathe machine.	4	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 21.1 Choose appropriate G & M codes for subroutine call on CNC milling. LLO 21.2 Develop manual part program for subroutine call.	21	Slotting operation on CNC milling by subroutine call.	2	CO1
LLO 22.1 Simulate prepared part program of subroutine call and take corrective action (if required). LLO 22.2 Use of an appropriate simulation software for part programming.	22	Verify part program of subroutine call prepared in Practical No.21 by using suitable simulation software.	2	CO2
LLO 23.1 Perform DRY run for subroutine call on CNC milling machine. LLO 23.2 Verify tool path in DRY run activity.	23	Conduct DRY run of Practical No.21 on CNC milling machine.	2	CO3
LLO 24.1 Perform subroutine call on CNC milling. LLO 24.2 Check the finished job using suitable measuring instrument.	24	Execution of part program prepared in Practical No.21 on CNC milling machine.	4	CO3

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	CNC Turning 250 with standard accessories and multi controller changing facility with simulated control panel and related software. Training or Productive type minimum diameter 25 mm, Length 120 mm with ATC along with essential accessories.	1,3,4,9,11,12,17,19,20
2	CNC Simulation software and control pads (CAMLAB CNC Software, MasterCAM/NXCAM/, DONC CNC machine simulator, PRO, SWANSOFT, CAPSMILL and CAPSTURN IN cam software, DONCMILL AND DONCTURN software), CutViewer Turn& Mill, Sinewave Turn& Mill or equivalent simulation software.	2,6,10,14,18,22
3	Windows 10 Home Intel Core i5 HDD Capacity 500 GB RAM 8 GB DDR3 18.5 inch Display, Dedicated Graphic Memory 512 MB, USB 1x3.0 Front 6 Back.	2,6,10,14,18,22

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
4	CNC Milling 250 with standard accessories and multi controller changing facility with simulated control panel and related software. Training or Productive type-X axis travel - 225 mm, Y axis travel - 150 mm, Z axis travel - 115 mm, with ATC along with essential accessories.	5,7,8,13,15,16,21,23,24

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table) : NOT APPLICABLE

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Term Work

Summative Assessment (Assessment of Learning)

- Practical

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	2	2	-	-	3			
CO2	3	2	-	2	-	-	3			
CO3	3	-	-	2	-	-	3			

Legends :- High:03, Medium:02, Low:01, No Mapping: -

*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	P. M. Agrawal And V. J. Patel	CNC Fundamentals and Programming	Charotar Publishing House Pvt. Limited.ISBN:9788185594989 ,Edition-2009
2	Pawan Negi, Mangey Ram, Om Prakash Yadav	Basics of CNC Programming	River Publishers.ISBN:9781000792911,Edition-2022
3	Kaushik Kumar, Chikesh Ranjan, J. Paulo Davim	CNC Programming for Machining	Springer International Publishing.ISBN:9783030412791,Edition-2020.

Sr.No	Author	Title	Publisher with ISBN Number
4	Binit Kumar Jha	CNC Programming Made Easy	Vikas Publishing House.ISBN: 9788125911807,Edition-2003
5	Ibrahim Zeid	CAD/CAM Theory and Practice	McGraw Hill Education.ISBN:0070151342,Edition-2009
6	Pabla B. S. & M. Adithan	CNC Machines	New Age International Private Limited.ISBN:978-9388818445,Edition-2023.

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.youtube.com/watch?v=ih4Q8TJOI5I	How to create your first turning program in CNC Simulator
2	https://www.youtube.com/watch?v=m_FVE4Q59gU	CNC Milling Simulator
3	https://www.youtube.com/watch?v=_5r2XR1h1aQ	CNC programming
4	https://www.youtube.com/watch?v=PN_tGm5Gip4	CNC machines and Interpolation
5	https://www.youtube.com/watch?v=B7MM5M7DzpM	Introduction to CNC machines
6	https://www.youtube.com/watch?v=Gi42gKGiCl0	Introduction to CNC machines.
7	https://www.youtube.com/watch?v=YpQMUpWOgbE&t=2s	Programming a CNC Lathe to make a bush - part 1 G71 roughing cycle
8	https://www.youtube.com/watch?v=wYebU4JSkGQ	Step Turning With Simulation

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students