INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**COMPUTER AIDED NUMERICAL CONTROL LABORATORY**				
Course Code	AME115				
Programme	B Tech				
Semester	VII	ME			
Course Type	Core				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	-	-	-	3	2
Chief Coordinator	Mr. M Prashanth Reddy, Assistant Professor				
Course Faculty	Dr. K. Raghu Ram Mohan Reddy, Professor Mr. M Prashanth Reddy, Assistant Professor				

I. COURSE OVERVIEW:

In this laboratory the students learn the fundamentals of numerical control (NC) technology, programming of computer numerical control (CNC) machines in NC codes and APT language and with CAD/CAM systems. Students also gain experience in NC postprocessors and distributed numerical control, operation of CNC lathe and milling machines, and programming and machining complex engineering parts.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AME010	V	Machine Tools and Metrology Lab	2

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Computer Aided Numerical Control Laboratory	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✘	Assignments	✘	MOOCs
✔	LCD / PPT	✘	Seminars	✘	Mini Project	✔	Videos
✔	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

Semester End Examination (SEE):

Each laboratory is evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done 20 marks for day to day performance and 10 marks for the final lab assessment.

Semester End Examination (SEE): The semester end lab examination for 70 marks shall conducted by two examiners, one of them being internal examiners and other being External Examiner both nominated by the principal from the panel of experts recommended by chairman BOS.

The emphasis on the questions is broadly based on the following criteria:

20 %	To test the preparedness for the experiment.
20 %	To test the performance in the laboratory.
20 %	To test the calculation and graph related to the concern experiment.
20 %	To test the results and error analysis of the experiment.
20 %	To test the subject knowledge through viva-voce

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 20 marks for Continuous Internal Examination (CIE), 05 marks for Quiz and 05 marks for Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	**Laboratory**		**Total Marks**
Type of Assessment	Day to day performance	Final internal lab assessment	
CIA Marks	20	10	30

Continuous Internal Examination (CIE):

One CIE examination shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Preparation	**Performance**	**Calculations and Graph**	**Results and error analysis**	**Viva**	**Total**
2	2	2	2	2	10

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Exercise, Discussion and Seminars
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Lab Experiments
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Lab Experiments

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	1	Experiments, Discussion and Seminars
PSO 2	**Software Engineering Practices:** An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	-	-
PSO 3	**Successful Career and Entrepreneurship:** To build the nation, by imparting technological inputs and managerial skills to become technocrats.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Understand the features and specifications of CNC and 3D printing machines.
II	Develop the process planning sheets and tool layouts.
III	Use the CAM software and prepare CNC part programs.
IV	Execute the part program and machine the component as per the production drawing

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Understand the features and specifications of CNC and 3D printing machines.	CLO 1	Understand the concept of numerical control and advantages of CNC machine tools.
		CLO 2	Know the various types of CNC machine tools and CNC machining centers.
		CLO 3	Understand Basic fundamentals of CNC milling and familiarization of machine control panel.
CO 2	Develop the process planning sheets and tool layouts	CLO 4	Understand Fundamentals of CNC programming, Part programming and interpolation techniques
		CLO 5	Performance of Machining practice on CNC milling
		CLO 6	Generation of part programming through CAM software.
CO 3	Use the CAM software and prepare CNC part programs.	CLO 7	Generation of CAM-CNC programming and execution.
		CLO 8	Understand various Work piece setting methods and tool setting methods
		CLO 9	Practice on CNC turning and exercises on machine.
CO 4	Execute the part program and machine the component as per the production drawing.	CLO 10	Understand CNC programming and execution on milling and turning machines.
		CLO 11	Prepare simple prototype models using 3D Printing.
		CLO 12	Perform Practice session at industry

X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AME115.01	CLO 1	Understand the concept of numerical control and advantages of CNC machine tools.	PO 1	3
AME115.02	CLO 2	Know the various types of CNC machine tools and CNC machining centers.	PO 2	2
AME115.03	CLO 3	Understand Basic fundamentals of CNC milling and familiarization of machine control panel.	PO 1	3
AME115.04	CLO 4	Understand Fundamentals of CNC programming, Part programming and interpolation techniques	PO 1	3
AME115.05	CLO 5	Performance of Machining practice on CNC milling	PO 2	2
AME115.06	CLO 6	Generation of part programming through CAM software.	PO 2	2
AME115.07	CLO 7	Generation of CAM-CNC programming and execution.	PO 2	2
AME115.08	CLO 8	Understand various Work piece setting methods and tool setting methods	PO 2	2
AME115.09	CLO 9	Practice on CNC turning and exercises on machine.	PO 4	1
AME115.10	CLO 10	Understand CNC programming and execution on milling and turning machines.	PO 4	1
AME115.11	CLO 11	Prepare simple prototype models using 3D Printing.	PO 2	2
AME115.12	CLO 12	Perform Practice session at industry	PO 2	2

3= High; 2 = Medium; 1 = Low

XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

Course Outcomes (COs)	Program Outcomes (POs)			
	PO 1	PO 2	PO 4	PSO1
CO 1	3	2		1
CO 2		2	1	
CO 3	3	2		1
CO 4	3	2		1

3 = High; 2 = Medium; 1 = Low

XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2		2													
CLO 3	3												1		
CLO 4	3												1		
CLO 5		2													
CLO 6		2													
CLO 7		2													
CLO 8		2													
CLO 9				1											
CLO 10				1											
CLO 11		2											1		
CLO 12		2											1		

3 = High; 2 = Medium; 1 = Low

XIII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO4,PSO1	SEE Exams	PO1, PO2, PO4,PSO1	Assignments	-	Seminars	PO1, PO2, PO4,PSO1
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO1, PO2, PO4,PSO1						

XIV. ASSESSMENT METHODOLOGIES - INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS

LIST OF EXERCISES	
Week - 1	**INTRODUCTION TO COMPUTER NUMERICAL CONTROL**
Numerical control, functions of a machine tool, concept of numerical control, historical development, definition, advantages of CNC machine tools.	
Week - 2	**INTRODUCTION TO COMPUTER NUMERICAL CONTROL**
Evolution of CNC, advantages of CNC, limitations of CNC, features of CNC, machine control unit (MCU) for CNC, classification of CNC machine tools; CNC machining centers: classification, features of CNC machining centers	
Week - 3	**CNC MILLING**
Basic fundamentals of CNC milling, familiarization of machine control panel.	
Week - 4	**CNC MILLING**
Fundamentals of CNC programming, Part programming and interpolation techniques.	
Week - 5	**CNC MILLING**
Machining practice on CNC milling.	
Week - 6	**CAM SOFTWARE**
Generation of part programming through CAM software package.	
Week - 7	**CAM SOFTWARE**
CAM-CNC programming and execution.	
Week - 8	**CNC TURNING**
Work piece setting methods, tool setting methods.	
Week - 9	**CNC TURNING**
Practice on CNC turning and exercises on machine.	
Week - 10	**CAM SOFTWARE**
Generation of part programming through the CAM software package, CAM-CNC programming and execution on milling and turning machines.	

Week - 11	3D PRINTING
Prepare simple prototype models.	
Week - 12	**INDUSTRY–INSTITUTE INTERACTION**
Practice session at industry	

Text Books:

1. Kundra T. K., Rao P. N. and Tewari M. K., ―Numerical Control and Computer Aided Manufacturing‖, Tata McGraw-Hill, 1st Edition, 1999
2. Groover M.P., ―Automation, Production Systems & Computer Integrated Manufacturing.‖, Prentice Hall, 1st Edition, 1989
3. Elanchezhian C, Selwyn Sunder T, Shanmuga Sundar G., ―Computer Aided Manufacturing‖, Laxmi Publications, New Delhi, 1st Edition, 2006
4. Rao P N., ―CAD/CAM Principles and Applications‖, Tata McGraw-Hill, 1st Edition, 2006.

Reference Books:

1. FANUC and SIEMENS part programming manuals.
2. 3D printing manual – ULTIMAKE

XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Understand Numerical control, its function and advantages.	CLO 1	T2:26.3
2	Understand Evolution of CNC and classification of CNC machine tools	CLO 2	R2:21.48
3	Understand Basic fundamentals of CNC milling, familiarization of machine control panel.	CLO 3	T2:26.6 R2:21.50
4	Fundamentals of CNC programming, Part programming and interpolation techniques.	CLO 4	T2:26.7 R2:21.51
5	Machining practice on CNC milling.	CLO 5	T2:155-160
6	Generation of part programming through CAM software package.	CLO 6	T2:161-174
7	CAM-CNC programming and execution.	CLO 7	T2:175-208
8	Work piece setting methods, tool setting methods.	CLO 8	T2:224-226
9	Practice on CNC turning and exercises on machine.	CLO 9	T4:321-353
10	Generation of part programming through the CAM software package, CAM-CNC programming and execution on milling and turning machines.	CLO 10	T4:368-390
11	Prepare simple prototype models.	CLO 11	T4:368-390
12	Practice session at industry	CLO 12	T4:321-353

XVII. GAPS IN THE SYLLABUS-TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	For the better understanding can go through the addition of computer numerical control.	Seminars	PO 1	PSO 1
2	Understand the CNC Milling and Turning.	Seminars / NPTEL	PO 4	PSO 1
3	Introduce of 3D printing	Industrial Visit	PO 2	PSO 1

Prepared by:
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