# INSTITUTE OF AERONAUTICAL ENGINEERING

**(Autonomous)**
Dundigal, Hyderabad -500 043

## AERONAUTICAL ENGINEERING

## COURSE DESCRIPTOR

| | | | | | |
|---|---|---|---|---|---|
| **Course Title** | **COMPUTER AIDED MANUFACTURING LABORATORY** | | | | |
| **Course Code** | AAE110 | | | | |
| **Programme** | B. Tech | | | | |
| **Semester** | VI | AE | | | |
| **Course Type** | Core | | | | |
| **Regulation** | IARE - R16 | | | | |
| **Course Structure** | **Theory** | | | **Practical** | |
| | **Lectures** | **Tutorials** | **Credits** | **Laboratory** | **Credits** |
| | - | - | - | 3 | 2 |
| **Chief Coordinator** | Mr. M. Vijay Kumar, Assistant Professor | | | | |
| **Course Faculty** | Mr. R. Suresh Kumar, Assistant Professor | | | | |

## I. COURSEOVERVIEW:

The aim of this course is to conduct experiments on basic principles of cnc machine and it is further extended to cover the application of aerospace domain in industrial applications. The aim is to understand concepts and developments in the machining process, and improve your understanding of a range of specialized subjects practically and global best practices. Learn how a modern machining process is important with current regulatory. The course deals with the different machining processes, like cnc milling and cnc turning etc. This course includes experiments deal with the study of materials and itsapplications.

## II. COURSEPRE-REQUISITES:

| Level | Course Code | Semester | Prerequisites | Credits |
|---|---|---|---|---|
| UG | AME001 | I | Engineering Drawing | 4 |
| UG | AME101 | I | Basic Work Shop | 2 |
| UG | AAE005 | IV | Aircraft materials and production. | 3 |

## III. MARKSDISTRIBUTION:

| Subject | SEE Examination | CIA Examination | Total Marks |
|---|---|---|---|
| Computer Aided Manufacturing Laboratory | 70 Marks | 30 Marks | 100 |

## IV. DELIVERY / INSTRUCTIONALMETHODOLOGIES:

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

## V. EVALUATIONMETHODOLOGY:

Each laboratory will be 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 for 20 marks for the day to day performance and 10 marks for the final internal lab assessment.

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

The emphasis on the experiments 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 calculations and graphs related to the concern experiment. |
| 20 % | To test the results and the 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 lab assessment during day to day performance, 10 marks for final internal lab assessment.

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 exams shall be conducted at the end of the 16$^{th}$week of the semester. The CIE exam is conducted for 10 marks of 3 hoursduration.

| **Preparation** | **Performance** | **Calculations and Graph** | **Results and Error Analysis** | **Viva** | **Total** |
|---|---|---|---|---|---|
| 2 | 2 | 2 | 2 | 2 | 10 |

## VI. HOW PROGRAM OUTCOMES AREASSESSED:

| 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. | 2 | Calculations of the observations |
| PO 2 | **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, andenvironmental considerations. | 2 | Term observations |
| PO 3 | **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. | 2 | CAD Programming |

**3 = High; 2 = Medium; 1 = Low**

## VII. HOW PROGRAM SPECIFIC OUTCOMES AREASSESSED:

| Program Specific Outcomes (PSOs) | | Strength | Proficiency assessed by |
|---|---|---|---|
| **PSO 1** | **Professional skills:** Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products | 2 | Videos |
| **PSO2** | **Problem-solving Skills:** Imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problems of components to complete the challenge of airworthiness for flight vehicles. | -- | -- |
| **PSO 3** | **Practical implementation and testing skills:** Providing different types of in house and training and industry practice to fabricate and test and develop the products with more innovative technologies | 2 | Presentation on real-world problems |
| **PSO 4** | **Successful career and entrepreneurship:** To prepare the students with broad aerospace knowledge to design and develop systems and subsystems ofaeronautical/aerospace allied systems to become technocrats. | -- | -- |

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## VIII. COURSE OBJECTIVES:

| | |
|---|---|
| I | Gain knowledge about software equipment, tools and machines associated withcomputer aided manufacturing. |
| II | Execute simple operations using computer numerical control codes |
| III | Identify parameters and tools suitable for manufacturing a component on computer numerical control machines |
| IV | Create a computer aided manufacturing (CAM) model and generate the machining codes automatically using the CAM system |

## IX. COURSE OUTCOMES (COs):

| COs | Course Outcome | CLOs | Course Learning Outcome |
|---|---|---|---|
| CO 1 | Understand the features and specifications of CNC machines. | CLO 1 | Remember procedures for CNC machine start-up. |
| | | CLO 2 | Understand CNC machining and uses, and applications of CNC program. . |
| | | CLO 3 | Describe the capabilities and limitations of computer numerical control (CNC)/computer assisted manufacturing (CAM) equipment. |
| | | CLO 4 | Understand the Cartesian coordinate system as used in a CNC machine program. |
| CO 2 | Develop the process planning sheets and tool layouts. | CLO 5 | Understand the differences in absolute and incremental dimensioning as related to programming of a CNC machine. |
| | | CLO 6 | Understand the purpose or function of the preparatory commands for a CNC machine (G-codes) and miscellaneous commands used with a CNC machine (M-codes). |
| | | CLO 7 | Remember the purpose of other alphabetical commands used in programming operations of a CNC machine. |
| CO 3 | Understand the CAM software and its programming | CLO 8 | Knowledge about selecting tool for CNC operations and use CNC mill, CNC lathe, and CNC machine centers to project specifications. |
| | | CLO 9 | Remember different types of tooling required for CNC mills, CNC lathes, and CNC machine centers. |
| | | CLO 10 | Select tooling required for specific job on CNC mill, CNC machine centers, and CNC lathe. |
| CO 4 | Use the CAM software and prepare CNC part programs. | CLO 11 | Write a program for a given operation to be executed for the required machining operation. |
| | | CLO 12 | Execute programs for CNC mill, CNC lathe, and CNC machine center according to project specifications. |
| | | CLO 13 | Understand differences between CNC and VMC. |
| CO 5 | Execute the part program and machine the component as per the production drawing. | CLO 14 | Knowledge about selecting tool for VMC operations and use VMC machine. |
| | | CLO 15 | Understand different operations that are to be executed to get a final product which include drilling and reaming operations. |
| | | CLO 16 | Understand importance of feed and rate of cut and how to control each parameter in CNC based on the project specifications. |

## 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 |
|---|---|---|---|---|
| AAE110.01 | CLO 1 | Remember procedures for CNC machine start-up. | PO1 | 3 |
| AAE110.02 | CLO 2 | Understand CNC machining and uses, and applications of CNC program. | PO1 | 3 |
| AAE110.03 | CLO 3 | Describe the capabilities and limitationsof computer numerical control(CNC)/computer assisted manufacturing (CAM)equipment. | PO1 | 2 |
| AAE110.04 | CLO 4 | Understand the Cartesian coordinate system as used in a CNC machine program. | PO1 | 1 |

| CLO Code | CLO's | At the end of the course, the student will have the ability to: | PO's Mapped | Strength of Mapping |
|---|---|---|---|---|
| AAE110.05 | CLO 5 | Understand the differences in absolute and incremental dimensioning as related to programming of a CNC machine. | PO1 | 1 |
| AAE110.06 | CLO 6 | Understand the purpose or function of the preparatory commands for a CNC machine (G-codes) and miscellaneous commands used with a CNC machine (M-codes). | PO1 | 2 |
| AAE110.07 | CLO 7 | Remember the purpose of other alphabetical commands used in programming operations of a CNC machine. | PO2 | 2 |
| AAE110.08 | CLO 8 | Knowledge about selecting tool for CNC operations and use CNC mill, CNC lathe, and CNC machine centers to project specifications. | PO2 | 2 |
| AAE110.09 | CLO 9 | Remember different types of tooling required for CNC mills, CNC lathes, and CNC machine centers. | PO3 | 2 |
| AAE110.10 | CLO 10 | Select tooling required for specific job on CNC mill, CNC machine centers, and CNC lathe. | PO3 | 1 |
| AAE110.11 | CLO 11 | Write a program for a given operation to be executed for the required machining operation. | PO3 | 1 |
| AAE110.12 | CLO 12 | Execute programs for CNC mill, CNC lathe, and CNC machine center according to project specifications. | PO3 | 2 |
| AAE110.13 | CLO 13 | Understand differences between CNC and VMC. | PO3 | 1 |
| AAE110.14 | CLO 14 | Knowledge about selecting tool for VMC operations and use VMC machine | PO3 | 2 |
| AAE110.15 | CLO 15 | Understand different operations that are to be executed to get a final product which include drilling and reaming operations. | PO3 | 1 |
| AAE110.16 | CLO 16 | Understand importance of feed and rate of cut and how to control each parameter in CNC based on the project specifications. | PO3 | 1 |

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

| Course Outcomes (COs) | Program Outcomes (POs) | | | | |
|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PSO1 | PSO3 |
| CO 1 | 3 | 2 | | 2 | |
| CO 2 | 1 | 2 | | 2 | |
| CO 3 | 2 | 2 | | | 2 |
| CO 4 | 2 | | 1 | | 2 |
| CO 5 | 2 | 2 | 2 | 1 | 2 |

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

| Course Learning Outcomes (CLOs) | Program Outcomes (POs) | | | | | | | | | | | | ProgramSpecific Outcomes(PSOs) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
| CLO 1 | 3 | | | | | | | | | | | | 2 | | | |
| CLO 2 | 3 | | | | | | | | | | | | 2 | | | |
| CLO 3 | 2 | | | | | | | | | | | | 3 | | | |
| CLO 4 | 1 | | | | | | | | | | | | 1 | | | |
| CLO 5 | 1 | | | | | | | | | | | | 1 | | | |
| CLO 6 | 2 | | | | | | | | | | | | 3 | | | |
| CLO 7 | | 2 | | | | | | | | | | | 2 | | | |
| CLO 8 | | 2 | | | | | | | | | | | 2 | | | |
| CLO 9 | | | 2 | | | | | | | | | | | | 2 | |
| CLO 10 | | | 3 | | | | | | | | | | | | 3 | |
| CLO 11 | | | 1 | | | | | | | | | | | | 2 | |
| CLO 12 | | | 2 | | | | | | | | | | | | 1 | |
| CLO 13 | | | 1 | | | | | | | | | | | | 1 | |
| CLO 14 | | | 2 | | | | | | | | | | | | 3 | |
| CLO 15 | | | 1 | | | | | | | | | | | | 2 | |
| CLO 16 | | | 1 | | | | | | | | | | | | 2 | |

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## XIII. ASSESSMENT METHODOLOGIES –DIRECT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| CIE Exams | PO 1, PO 2 PO 3 | SEE Exams | PO 1, PO 2 | Assignments | - | Seminars | - |
| Laboratory Practices | PO 1, PO 2 PO 3 | Student Viva | - | Mini Project | - | Certification | - |

## XIV. ASSESSMENT METHODOLOGIES -INDIRECT

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

## XV. SYLLABUS

| LIST OF EXPERIMENTS | |
|---|---|
| **Week-1** | **SIMULATION OF SIMPLE STEP TURNING AND FACING USING CNC MACHINE** |
| To write the manual part program as per given dimensions for step turning and facing operations and simulate | |
| **Week-2** | **MACHINING OF SIMPLE STEP TURNING AND FACING USING CNC MACHINE** |

| | |
|---|---|
| To execute step turning and facing operations using the codes on CNC lathe | |
| **Week-3** | **SIMULATION OF TAPPER TURNING AND CHAMFERING USING CNC MACHINE** |
| To write the manual part program as per given dimensions for taper turning and chamfering operations and simulate | |
| **Week-4** | **MACHINING OF TAPPER TURNING AND CHAMFERING USING CNC MACHINE** |
| To execute taper turning and chamfering operations using the codes on CNC lathe. | |
| **Week-5** | **SIMULATION OF SIMPLE TURNING, CHAMFERING AND FILLET USING CNC MACHINE** |
| To write the manual part program to the given dimensions for simple turning, chamfering and fillet operations and simulate | |
| **Week-6** | **MACHINING OF SIMPLE TURNING, CHAMFERING AND FILLET USING CNC MACHINE** |
| To execute simple turning, chamfering and fillet operations using the codes on CNC lathe. | |
| **Week-7** | **SIMULATION OF SIMPLE TURNING AND THREADING CYCLE USING CNC MACHINE** |
| To write the manual part program to the given dimensions for simple turning and threading operations and simulate | |
| **Week-8** | **MACHINING OF SIMPLE TURNING AND THREADING CYCLE USING CNC MACHINE** |
| To execute simple turning and threading operations using the codes on CNC lathe | |
| **Week-9** | **SIMULATION OF CONTOUR MILLING USING VMC MACHINE** |
| To write the manual part program to the given dimensions for contour milling operations and simulate | |
| **Week-10** | **MACHINING OF CONTOUR MILLING USING VMC MACHINE** |
| To execute contour milling operations using the codes on CNC lathe, | |
| **WeeK-11** | **SIMULATION OF DRILLING AND REAMING USING CNC MACHINE** |
| To write the manual part program to the given dimensions and execute contour milling operations in CNC | |
| **Week-12** | **MACHINING OF DRILLING AND REAMING USING CNC MACHINE** |
| To execute drilling and reaming operations using the codes on CNC. | |
| **Text Books:** | |
| 1 Computer Aided Manufacturing by T.K.Kundra, Tata McGraw-Hill Education, 13th Soft cover Reprint2008.<br>2 Lalit Narayan, "Computer Aided Design and Manufacturing", Prentice-Hall IndiaLearning Private Limited (2008). | |
| **Web Reference:** | |
| 1. https://wings.buffalo.edu/eng/mae/courses/460-564/Course-Notes/cnc-classnotes.pdf<br>2. https://www.engr.uvic.ca/~mech410/CAM_references/CNC_Computer_Numerical_Control_Programming_Basics.pdf<br>3. https://www.cnccookbook.com/CCCNCGCodeCourse.htm | |

## XVI. COURSEPLAN:

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

| Week No. | Topics to be covered | Course Learning Outcomes (CLOs) | Reference |
|---|---|---|---|
| 1 | To write the manual part program as per given dimensions for step turning and facing operations and simulate | CLO 1, CLO 2, CLO 4, CLO 5 | T1:1.3 R1:1.4 |
| 2 | To execute step turning and facing operations using the codes on CNC lathe | CLO 1, CLO 2, CLO 5, CLO 6 | T1:1.6 R1:2.1 |
| 3 | To write the manual part program as per given dimensions for taper turning and chamfering operations and simulate | CLO 3, CLO 5, CLO 7 | T1:2.5 R1:2.5 |
| 4 | To execute taper turning and chamfering operations using the codes on CNC lathe. | CLO 5, CLO 6, CLO 7, CLO 9 | T1:2.5 R1:2.6 |
| 5 | To write the manual part program to the given dimensions for simple turning, chamfering and fillet operations and simulate | CLO 5, CLO 6, CLO 7 | T1:3.2 |
| 6 | To execute simple turning, chamfering and fillet operations using the codes on CNC lathe. | CLO 8, CLO 9 | T1:6.3 R1:5.3 |
| 7 | To write the manual part program to the given dimensions for simple turning and threading operations and simulate | CLO 8, CLO 9 | T1:7.5 R1:6.3 |
| 8 | To execute simple turning andthreading operations using the codes on CNClathe | CLO 10, CLO 13, CLO 14 | T1:8.5 R1:6.8 |
| 9 | To write the manual part program to the given dimensions for contour milling operations and simulate | CLO 10, CLO 13, CLO 14 | T1:12.2 R1:13.1 |
| 10 | To execute contour milling operations using the codes on CNC lathe, | CLO 13, CLO 14 | T1:12.3 R1:13.2 |
| 11 | To write the manual part program to the given dimensions and execute contour milling operations in CNC | CLO 15, CLO 16 | T1:12.10 R1:13.7 |
| 12 | To execute drilling and reaming operations using the codes on CNC. | CLO 15, CLO 16 | T1:11.2 R1:10.2 |

## XVII.GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSIONREQUIREMENTS:

| S No | Description | Proposed actions | Relevance with POs | Relevance with PSOs |
|---|---|---|---|---|
| 1 | To improve standards and analyze the concepts. | Guest lectures | PO 1, PO 2 | PSO 1 |
| 3 | Encourage students to solve real time applications and prepare towards competitive examinations. | NPTEL | PO 2 | PSO 1 |

**Prepared by:**

Mr. M. Vijay Kumar,AssistantProfessor **HOD, AE**