INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

AERONAUTICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**AIRCRAFT PRODUCTION TECHNOLOGY**				
Course Code	**AAEB16**				
Programme	B.Tech				
Semester	V	AE			
Course Type	Core				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	3	2
Chief Coordinator	Mr. R Suresh Kumar,Assistant Professor.				
Course Faculty	Mr. R Suresh Kumar,Assistant Professor.				

I. COURSE OVERVIEW:

Production Technology is a combination of manufacturing technology with management science. The goal is to accomplish the production process in the smoothest, most-judicious and most-economic way. Production engineering encompasses the application of castings, machining processing, joining processes, metal cutting & tool design, metrology, machine tools, machining systems, automation, jigs and fixtures, and dies and mould design and material science and design of automobile parts and machine designing and manufacturing. Production engineering also overlaps substantially with manufacturing engineering and industrial engineering. In industry, once the design is realized, production engineering concepts regarding work-study, ergonomics, operation research, manufacturing management, materials management, production planning, etc., play important roles in efficient production processes. These deal with integrated design and efficient planning of the entire manufacturing system, which is becoming increasingly complex with the emergence of sophisticated production methods and control systems.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS005	1	Engineering Chemistry	4
UG	AHS007	I	Applied Physics	4

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIAExamination	Total Marks
Aircraft Production Technology	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:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

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

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

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	Theory			Total Marks
Type of Assessment	CIE Exam	Quiz	AAT	
CIA Marks	20	05	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 20 marks of 2 hours duration consisting of five descriptive type questions out of which four questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz - Online Examination

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are to be answered by choosing the correct answer from a given set of choices (commonly four). Such a question paper shall be useful in testing of knowledge, skills, application, analysis, evaluation and understanding of the students. Marks shall be awarded considering the average of two quiz examinations for every course.

Alternative Assessment Tool (AAT)

This AAT enables faculty to design own assessment patterns during the CIA. The AAT converts the classroom into an effective learning centre. The AAT may include tutorial hours/classes, seminars, assignments, term paper, open ended experiments, METE (Modeling and Experimental Tools in Engineering), five minutes video, MOOCs etc.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignments, term paper, Laboratory practices.
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Term paper, Seminars
PO3	**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, and environmental considerations.	2	Micro Projects
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and researchmethods including design of experiments, analysis and interpretation of data,	2	Projects

Program Outcomes (POs)		Strength	Proficiency assessed by
	and synthesis of the information to provide valid conclusions.		
PO5	**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	Assignments, Practical's

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:** Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products	2	Lecture, Assignments.
PSO 2	**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	-	-
PSO 4	**Successful career and entrepreneurship:** To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of aerospace and allied systems and become technocrats	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Study the composition of microstructures of metals and alloys with their applications in aerospace industry.
II	Discuss the various manufacturing processes and selection of process for suitable applications
III	Understand the working principles and applications of conventional and unconventional machining alongwith their advantages and disadvantages.
IV	Demonstrate the importance of composites with their applications in different areas of aerospace industry

IX. COURSE OUTCOMES(COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Demonstrate different type of materials used in aircraft industry and study its properties	CLO 1	Choose a concept or idea of technical real time problems to form solutions for the same.
		CLO 2	Understand, Identify, Study and comprehend processes that lead to solutions to a particular production.
		CLO 3	Develop one- self to extend

CO 2	Understand the process of casting and inspection techniques used for production.	CLO 4	Outline performance of the output of research, development or design.
		CLO 5	Identify, solve new problems and gain new knowledge.
		CLO 6	Understand about the turning, milling, grinding and drilling of a specimen.
CO 3	Explain sheet metal operations and its tooling operations used for aircraft industry.	CLO 7	Getting knowledge about the techniques to produce a safe, effective, economic final product.
		CLO 8	Understand the theoretical knowledge behind the design and development of aircraft components.
		CLO 9	Gain knowledge about the basic convectional, unconventional riveting and welding for knowledge based exams.
CO 4	Gain knowledge about the basic convectional and unconventional Machining	CLO 10	Discuss the principle of advanced materials and what factors drive to develop the composite materials.
		CLO 11	Extend the outputs of earlier research and discover good ideas for new products or improving current products.
		CLO 12	Memorize procedure and steps to keep the products working effectively.
CO 5	Understand the importance of composites and its manufacturing process.	CLO 13	Gain knowledge about what materials used to manufacture for each component in an aircraft.
		CLO 14	Ability to summarize the efficiency of the product development in achieving the mission goal.
		CLO 15	Ability to summarize the efficiency of the safety of flight

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
AAEB16.01	CLO 1	Choose a concept or idea of technical real time problems to form solutions for the same.	PO1	3
AAEB16.02	CLO 2	Understand, Identify, Study and comprehend processes that lead to solutions to a particular production.	PO1	2
AAEB16.03	CLO 3	Develop one- self to extend the outputs of research.	PO2	2
AAEB16.04	CLO 4	Outline performance of the output of research, development or design.	PO3	1
AAEB16.05	CLO 5	Identify, solve new problems and gain new knowledge.	PO4	2
AAEB16.06	CLO 6	Understand about the turning, milling, grinding and drilling of a specimen.	PO2	2
AAEB16.07	CLO 7	Getting knowledge about the techniques to produce a safe, effective, economic final product.	PO3	3
AAEB16.08	CLO 8	Understand the theoretical knowledge behind the design and development of aircraft components.	PO1	2
AAEB16.09	CLO 9	Gain knowledge about the basic convectional, unconventional riveting and welding for knowledge based exams.	PO2	2
AAEB16.10	CLO 10	Discuss the principle of advanced materials and what factors drive to develop the composite materials.	PO4	1
AAEB16.11	CLO 11	Extend the outputs of earlier research and discover good ideas for new products or improving current products.	PO5	2

AAEB16.12	CLO 12	Memorize procedure and steps to keep the products working effectively.	PO2	2
AAEB16.13	CLO 13	Gain knowledge about what materials used to manufacture e of each component in an aircraft.	PO1	3
AAEB16.14	CLO 14	Ability to summarize the efficiency of the product development in achieving the mission goal and safety of flight.	PO5	3
AAEB16.15	CLO 15	Ability to summarize the efficiency of the safety of flight	PO5	2

3 = High; 2 = Medium; 1 = Low

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

Course Outcomes (COs)	Program Outcomes (POs)					Program Specific Outcomes (PSOs)
	PO 1	PO 2	PO 3	PO 4	PO 5	PSO 1
CO 1	3	2				1
CO 2		2	1	2		2
CO 3	2	2	3			2
CO 4		2		1	2	
CO 5					3	1

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	PSO4
CLO 1	3															
CLO 2	2												1			
CLO 3		2														
CLO 4			1										2			
CLO 5				2												
CLO 6		2														
CLO 7			3													
CLO 8	2															
CLO 9		2											2			
CLO 10				1												
CLO 11					2											
CLO 12		2														

CLO 13	3															
CLO 14					3								1			
CLO 15					2											

3 = High; 2 = Medium; 1 = Low

XIII. ASSESSMENT METHODOLOGIES–DIRECT

CIE Exams	PO1,PO2, PO3,PO4,PO5	SEE Exams	PO1, PO2, PO3,PO4,PO5	Assignments	PO1, PO2, PO4	Seminars	PO2
Laboratory Practices	PO1	Student Viva	PO4	Mini Project	PO3	Certification	-
Term Paper	-						

XIV. ASSESSMENT METHODOLOGIES–INDIRECT

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

XV. SYLLABUS

MODULE-I	AIRCRAFT ENGINEERING MATERIALS
Engineering materials Steels, study of iron, iron carbon phase diagram, heat treatment-annealing, normalizing, hardening and tempering of Aluminum and steel, Non-Ferrous metals and Alloys: Structure and properties of copper and its alloys, Aluminum and its alloys, Titanium and its alloys, Corrosion - Types of Corrosions - Prevention – Protective Treatments.	
MODULE-II	**CASTING, WELDING AND INSPECTION TECHNIQUES**
General principles of various casting processes Sand casting, die-casting, centrifugal casting, investment casting, Shell molding types; Principles and equipment used in arc welding, gas welding, resistance welding, solid, laser welding, and electron beam welding, soldering and brazing techniques. Need for NDT, ultrasonic testing, Radiographic testing, Flight testing.	
MODULE-III	**SHEET METAL PROCESSES IN AIRCRAFT INDUSTRY**
Sheet metal operations: shearing, punching, super plastic forming; operations in bending like stretch forming spinning drawing. Riveting, types and techniques, equipment, fasteners, integral tanks, final assembly of aircraft, Jigs and Fixtures, stages of assembly, aircraft tooling concepts.	
MODULE-IV	**CONVENTIONAL AND UNCONVENTIONAL MACHINING PROCESSES**
General working principles, applications and operations of lathe, shaper, milling machines, grinding, drilling machine, computer numeric control machining. Working principles and applications of abrasive jet machining, ultrasonic machining, Electric discharge machining and electro chemical machining, laser beam, electron beam, plasma arc machining.	
MODULE-V	**AIRCRAFT COMPOSITES**
Production of semi-fabricated forms, Aerospace applications, Plastics and rubber, Introduction to fiber reinforced plastics, glass and carbon composites; Fibers and resins; Characteristics and applications, Classification of aircraft materials; Materials used for aircraft components, Application of composite materials, Super alloys, indigenized alloys, emerging trends in aerospace materials..	

Text Books:
1. S. Kalpakjian, Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley 5th Edition, 1991. 2. S. C. Keshu, K. K Ganapathy, "Aircraft production technology and management", Interline Publishing House, Bangalore, 3rd Edition, 1993. 3. Douglas F. Horne, "Aircraft production technology", Cambridge University Press, 1st Edition, 1986.
REFERENCES:
1. S. C. Keshu, K. K Ganapathy, "Air craft production techniques", Interline Publishing House, Bangalore, 3rd Edition, 1993. 2. R. K. Jain, "Production Technology", McGraw-Hill, 1st Edition, 2002. 3. O. P. Khanna, M. Lal, "Production Technology", Dhanpat Rai Publications, 5th Edition, 1997.

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
1-2	Engineering materials Steels, study of iron	CLO1	T2:5.5 R1:1.12.1
3-5	Iron carbon phase diagram	CLO1	T2:5.6 R1:1.12.3
6-7	Heat treatment-annealing, normalizing, hardening and tempering of Aluminum and steel, Non-Ferrous metals and Alloys	CLO1	T2:5.10 R1:1.15
8-10	Structure and properties of copper and its alloys, Aluminum and its alloys, Titanium and its alloys,	CLO2	T2:5.15 R1:1.16
11-12	Corrosion - Types of Corrosions - Prevention – Protective Treatments	CLO3	T2:5.17 R1:1.13.1
13-14	General principles of various Casting Processes - Sand casting, die-casting, centrifugal casting, investment casting.	CLO4	T2:5.18 R2:1.13.2
15-16	shell molding types	CLO4	T2:5.19 R1:1.13.3
17-21	Principles and equipment used in arc welding, gas welding	CLO4	T2:5.20 R1:1.17.1
22-23	Laser welding , Electron beam welding	CLO5	T2:5.24 R1:1.17.3
24-25	Soldering and brazing techniques	CLO5	T2:6.1 R1:2.3
26-27	Need for NDT, ultrasonic testing, Radiographic testing	CLO6	T2:6.3 R1:2.6.1
28-30	Sheet metal operations-shearing	CLO7	T2:6.5 R1:2.6.2
31-32	punching, super plastic forming and diffusion bonding	CLO7	T2:7.3 R1:2.8
33-34	Different operations in bending like stretch forming spinning drawing etc.	CLO8	T2:7.5,7.6 R1:2.9.2
35-36	types of equipment for riveted joints	CLO9	T2:7.7 R1:2.10
37-39	Aircraft tooling concepts and Jigs and Fixtures	CLO9	T2:7.7 R1:2.10
40-41	General principles of working and types of lathe	CLO10	T2:7.11 R2:2.10.2
42-44	Shaper, milling machines, grinding, drills m/c, CNC machining and general principles.	CLO10	T2:7.11 R1:2.32
45-48	Plane turning, threading, tapering, grooving, knurling and chamfering	CLO11	T2:15.2 R1:8.2

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
49-50	Importance of CNC and Advantages	CLO11	T2:15.7 R2:8.3.3
51-52	Principles (with schematic diagram only) of working and applications of abrasive jet machining,	CLO11	T2:15.13 R1:8.7.2
53-54	USM, EDM, ECM and LBM operations	CLO12	T2:5.20 R1:1.17.1
55-57	Introduction, Physical metallurgy, Wrought aluminum alloys, Cast aluminum alloys, Production of semi-fabricated forms	CLO13	T3:6.1 R1:2.3
58-60	Introduction to fiber reinforced plastics, glass and carbon composites; Fibers and resins.	CLO13	T2:6.3 R3:2.6.1
61	Characteristics and applications, Classification of aircraft materials;	CLO13	T2:6.5 R1:2.6.2
62-63	Materials used for aircraft components, Application of composite material	CLO13	T2:7.3 R1:2.8
64-65	Super alloys, indigenized alloys	CLO14	T3:7.5,7.6 R3:2.9.2
67-66	emerging trends in aerospace materials	CLO14	T3:7.7 R3:2.10

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

S NO	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Gain information about lift augmentation devices and control surfaces	Seminars / Guest Lectures/ NPTEL	PO 1,PO2	PSO 4
2	Encourage students to make case studies on different air vehicles to get knowledge of practical applications of the control devices	Assignments	PO 1, PO 2, PO 3	PSO 4

Prepared by:
Mr. Suresh Kumar R, Assistant Professor.

HOD, AE