INSTITUTE OF AERONAUTICAL ENGINEERING

(Aproved by AICTE, New Delhi, Accreditated by NBA, New Delhi & Affliated to JNTU, Hyderabad)

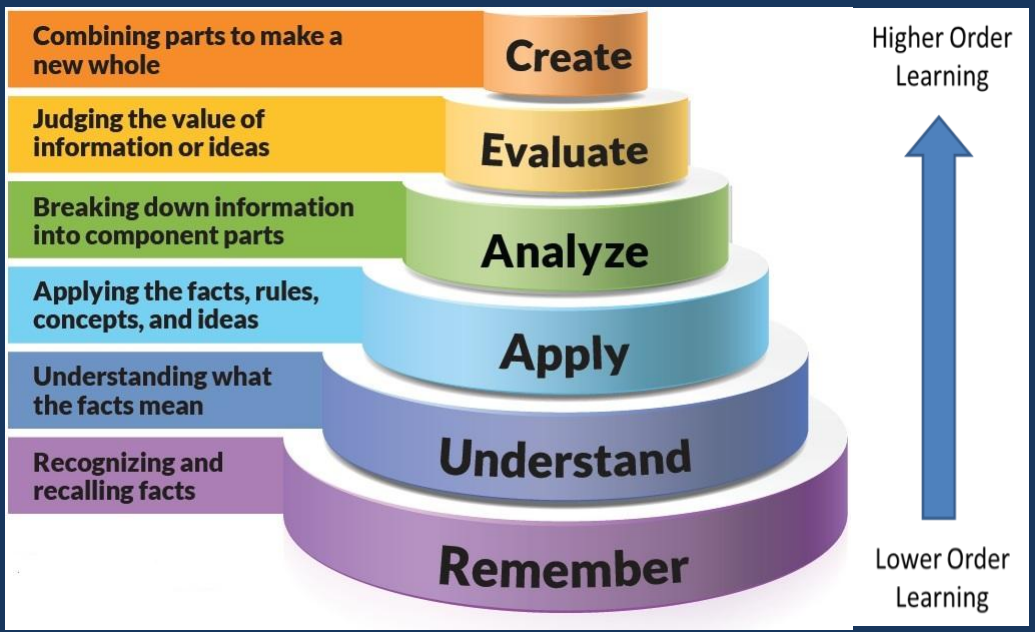
Dundigal, Hyderabad, Telangana – 500043

OUTCOME BASED EDUCATION SYSTEM

B Tech

AERONAUTICAL ENGINEERING

(For The Batches Admitted From 2014-15)



VISION

To build a strong community of dedicated graduates with expertise in the field of Aeronautical science and Engineering suitable for Industrial needs having a sense of responsibility, ethics and ready to participate in Aerospace activities of National and Global interest

MISSION

To actively participate in the Technological, Economic and Social development of the Nation through academic and professional contributions to Aerospace and Aviation areas, fostering academic excellence and scholarly learning among students of Aeronautical engineering

Contents

Program Education Objectives and Outcomes

As Per NBA Norms Post June, 2015
Semester: I, II-I, II-II, III-I, III-II, IV-I and IV-II

Part – I A

PROGRAM EDUCATIONAL OBJECTIVES AND OUTCOMES

First version 22 July, 2013

Educational Objectives Outcomes and Assessment Criteria(Approved by Aeronautical faculty 02/6/2013,Approved by DAC Aeronautical Engineering 9/6/2013):

Aeronautical Engineering Department Advisory Council: The Aeronautical Engineering Department Advisory Council (AEDAC) includes a diverse group of experts from academic and industry, as well as alumni representation. The Advisory Board meets annually, or as needed, for a comprehensive review of the Aeronautical Engineering Department strategic planning and programs. The Advisory Council meets with administration, faculty and students and prepares a report, which is presented to principal. In each visit, the Department of Aeronautical Engineering responds to the report indicating improvements and amendments to the program.

1. PROGRAM EDUCATIONAL OBJECTIVES, OUTCOMES AND ASSESSMENT CRITERIA

Learning Outcomes, Assessment Criteria

The educational aims of a module are statements of the broad intentions of the teaching team. They indicate what it is the teaching team intends to cover and the learning opportunities they intend to make available to the student. A learning outcome is a statement of what a learner (student) is expected to know, understand and/or be able to do at the end of a period of learning. It is advisable to express learning outcomes with the common prefix:

'On completion of (the period of learning e.g. module), the student is expected to be able to…'

Generally, learning outcomes do not specify curriculum, but more general areas of learning. It is not possible to prescribe precisely how specific a learning outcome statement should be. There is a balance to be struck between the degree of specificity in a learning outcome statement and that achieved by the assessment criteria (below). If there are too many learning outcomes for a module, then either they are becoming assessment criteria or they are specifying too much curricular detail. The curriculum should be described in the range statement. Too few learning outcomes are unlikely to provide sufficient information on the course. As a guide, there should be between 4 and 8 learning outcomes for a course.

2. B. TECH - AERONAUTICAL ENGINEERING PROGRAM OBJECTIVES

A graduate of Institute of Aeronautical Engineering in Aeronautical Engineering discipline should have a successful career in Aeronautical Engineering or a related field, and within three to five years, should attain the following:

PROGRAM EDUCATIONAL OBJECTIVES:

PEO1. Excellence in Career

To prepare and provide student with an academic environment for students to excel in postgraduate programs or to succeed in industry / technical profession and the life-long learning needed for a successful professional career in Aeronautical Engineering and related fields (**Preparation & Learning Environment**).

PEO2. Professional Effectiveness and Contribution to Society

To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies (**Core Competence**).

PEO3. Continuing Education

To train students with good scientific and engineering breadth so as to comprehend, analyze, design, and create novel products and solutions for the real life problems (**Breadth**).

PEO4. Exercising Leadership

To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context (**Professionalism)**.

These objectives are quite broad by intention, as Aeronautical Engineering graduates may seek further education or work in diverse areas. To make these objectives meaningful, they may be demonstrated by performance, actions, or achievements.

i. To prepare and provide student with an academic environment for students to excel in postgraduate programs or to succeed in industry / technical profession and the life-long learning needed for a successful professional career in Aeronautical Engineering and related fields

- To enhance the ability of students to work in teams and to establish the leadership role.

- Improving student's skills to adopt modern methods in mechanical engineering quest for improving technology.
- Provide students with opportunities in multi-disciplinary design teams to improve communication ability.
- To enhance the ability to work as practicing mechanical engineers in manufacturing industry and consulting firms.
- To participate effectively in technical association activities to enhance engineering professionalism with a view to ethics.

ii. To prepare the students who will be able to function professionally in an increasingly international and rapidly changing world due to the advances in technologies and concepts and Contribute to the needs of the society.

- To enhance the ability of students to apply mathematics and fundamentals of science for solving engineering problems.
- To enhance the skills of students in applying mathematical methods for optimizing resources.
- To enhance the ability of students to apply scientific methods for protection and preservation of environment.
- To promote awareness necessary to understand the impact of engineering on a global, economic, environmental and societal context.

iii. To train students with good scientific and engineering breadth so as to comprehend, analyze, design, and create novel products and solutions for the real life problems

- Effectively understanding the data related to mechanical engineering design systems and to analyze them using mathematical models.
- To motivate students to develop innovative methods of measuring product characteristics.
- To encourage students to develop analytical systems for controlling process parameters.
- To apply various statistical methods to analyze data pertaining to product quality.

iv. To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context

- Gives ample opportunity to work in diverse fields to acquire leadership roles in professional circles outside the workplace.
- Should keep in mind that the opportunities may change with the times.
- Should be prepared for creative solo and collaborative brainstorming sessions.
- Be able to inspire the team with selfless motivation and attitude to achieve success.
- Ability to think laterally or at-least have a flexibility of thought and make choices based on the requirement for situation.

3. B. TECH - AERONAUTICAL ENGINEERING PROGRAM OUTCOMES PROGRAM SPECIFIC OUTCOMES

A graduate of the Aeronautical Engineering Program Outcomes will demonstrate:

PROGRAM OUTCOMES:

PO1. Engineering knowledge

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. 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.

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.

PO4. 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.

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.

PO6. The engineer and society

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

PSO1. Professional skills
Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products

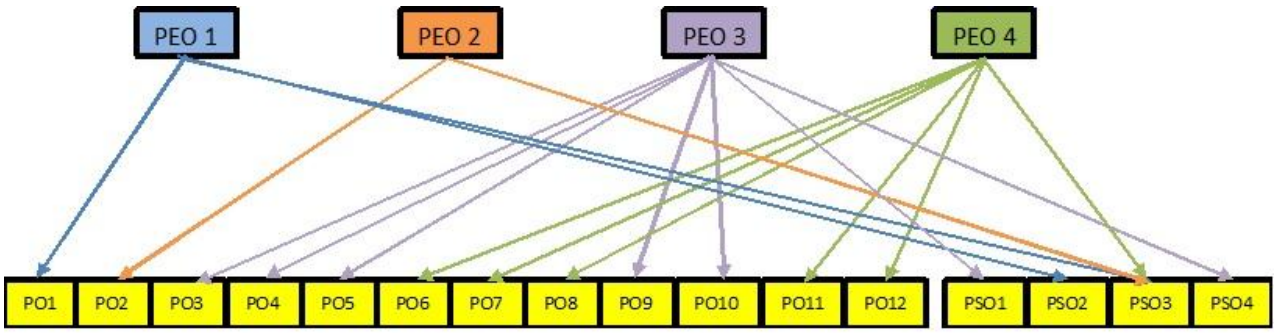
PSO2. Professional skills Imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problems of components to complete the challenge of airworthiness for flight vehicles

PSO3. 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

PSO4. 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

4.MAPPING OF PROGRAM EDUCATIONAL OBJECTIVES TO PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

The following Figure shows the correlation between the PEOs and the POs and PSOs



The following Table shows the correlation between the Program Educational Objectives and the Program Outcomes

	Program Educational Objectives		Program Outcomes
I	To prepare and provide student with an academic environment for students to excel in postgraduate programs or to succeed in industry / technical profession and the life-long learning needed for a successful professional career in Aeronautical Engineering and related fields	**PO1**	**Engineering knowledge** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
		PSO2	**Professional 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
		PSO3	**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
II	To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required	**PO2**	**Problem Analysis** Identify, formulate, review research literature, and

	to solve engineering problems and also to pursue higher studies	PSO2	analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. **Professional 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
III	To train students with good scientific and engineering breadth so as to comprehend, analyze, design, and create novel products and solutions for the real life problems	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.
		PO4	**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.
		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.
		PO9	**Individual and team work** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
		PO10	**Communication** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
		PSO1	**Professional skills** Able to utilize the knowledge of Aeronautical/Aerospace engineering in innovative, dynamic and challenging environment for design and development of new products.
		PSO4	**Successful career and entrepreneurship:**

			To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of Aeronautical/Aerospace and allied systems and become technocrats
IV	To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context	**PO6**	**The engineer and society** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
		PO7	**Environment and sustainability** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
		PO8	**Ethics** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
		PO11	**Project management and finance** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
		PO12	**Life-long learning** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
		PSO3	**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

5. RELATION BETWEEN THE PROGRAM EDUCATIONAL OBJECTIVE AND THE OUTCOMES

A broad relation between the program objective and the outcomes is given in the following table:

PEOs → / POs ↓		(1) **Preparation & Learning Environment**	(2) **Core Competence.**	(3) **Breadth.**	(4) **Professionalism.**
PO1	Engineering knowledge	H			
PO2	Problem Analysis		H		
PO3	Design/development of solutions			H	
PO4	Conduct investigations of complex problems			H	
PO5	Modern tool usage			H	
PO6	The engineer and society				H
PO7	Environment and sustainability				H
PO8	Ethics				H
PO9	Individual and team work			H	
PO10	Communication			H	
PO11	Project management and finance				H
PO12	Life-long learning				H

Relationships between program Educational objectives and program outcomes
Key: H = Highly Related; S = Supportive

RELATION BETWEEN THE PROGRAM SPECIFIC OUTCOMES AND THE PROGRAM EDUCATIONAL OBJECTIVES

A broad relation between the program Educational Objectives and the Program Specific Outcomes are given in the following table:

PEOs → / **PSOs** ↓		(1) **Preparation & Learning Environment**	(2) **Core Competence.**	(3) **Breadth.**	(4) **Professionalism.**
PSO1	**Professional skills**			H	
PSO2	**Professional skills**	H	H		
PSO3	**Practical implementation and testing skills**	H		S	H

PSO4	**Successful career and entrepreneurship**	S		H	

Relationship between Program Specific Outcomes and Program Educational Objectives
Key: H = Highly Related; S = Supportive

Note:

- The assessment process can be direct or indirect.
- The direct assessment will be through interim assessment by the faculty or by industry / technology experts.
- The indirect assessment on the other hand could be by students through course outcomes, lab evaluation, department associations, exit interviews, engineering services, GATE etc.
- Frequency of assessment can be once in a semester and justified by the program coordinator.

6. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMESOF (B.Tech) AERONAUTICAL ENGINEERING GRADUATES

Graduates from accredited programs must achieve the following learning outcomes, defined by broad areas of learning.

The outcomes are distributed within and among the courses within our curriculum, and our students are assessed for the achievement of these outcomes, as well as specific course learning objectives, through testing, surveys, and other faculty assessment instruments. Information obtained in these assessments is used in a short-term feedback and improvement loop.

Each Aeronautical Engineering student will demonstrate the following attributes by the time they graduate:

PO1. Engineering Knowledge

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

Performance Criteria Definitions

- Identify the concepts and/or equations
- Execute the solution using a logic and structured approach
- Evaluate the solution of the problem

PO2. 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

Performance Criteria Definitions

- Identify an engineering problem
- Formulate appropriate theoretical basis for the analysis of a given problem
- Analyze an engineering problem
- Evaluate the appropriate solution to an engineering problem

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

Performance Criteria Definitions

- Awareness of global effects of the product / practice / event
- Understanding of economic factors
- Awareness of implications to society at large

PO4. 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

Performance Criteria Definitions

- Identify problem/purpose
- Prepare hypothesis
- Outline procedure
- List materials and equipment
- Conduct experiment
- Record observations, data and results
- Perform analysis
- Document 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

Performance Criteria Definitions

- Use modern engineering tools for the system design, simulation and analysis
- Use software applications effectively to write technical reports and oral presentations
- Use modern equipment and instrumentation in the design process, analysis and troubleshooting

PO6. The Engineer and Society

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

Performance Criteria Definitions

- Informal meetings on current issues
- Participation in public service extracurricular activities
- Required Humanities and Social Sciences (HSS) courses on contemporary issues

PO7. Environment and Sustainability

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

Performance Criteria Definitions

- Develop a methodology to accomplish the design
- Select a solution from the potential solutions
- Implement the solution

PO8. Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

Performance Criteria Definitions

- Demonstrate knowledge of professional code of ethics
- Understanding of ethical and professional issues
- Acknowledge the work of other in a consistent manner
- Exhibit honest behavior

PO9. Individual and Team Work

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings

Performance Criteria Definition

- Research and gather information
- Share responsibilities and duties
- Fulfill team role's duties
- listen to other teammates

PO10. Communication

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

Performance Criteria Definitions

- Use appropriate format and grammatical structure
- Create a well organized document
- Present the results appropriately
- Demonstrate effective oral communication

PO11. Project Management and Finance

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

Performance Criteria Definitions

- Awareness of global effects of the product / practice /event
- Understanding of economic factors
- Awareness of implications to society at large

PO12. Life-long Learning

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Performance Criteria Definitions

- Find relevant sources of information
- Participate in school or professional seminars

- Participate in students or professional associations

PROGRAM SPECIFIC OUTCOMES OF (B.Tech) AERONAUTICAL ENGINEERING GRADUATES

PSO1. Professional skills

Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products.

Performance Criteria Definitions.

- Identify the concepts and/or equations
- Execute the solution using a logic and structured approach
- Evaluatethesolutionofthe problem

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.

Performance Criteria Definitions

- Identify an engineering problem
- Formulate appropriate theoretical basis for the analysis of a given problem
- Analyze an engineering problem
- Evaluate theappropriatesolutiontoanengineeringproblem

PSO3. 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.

Performance Criteria Definitions

- Awareness about new technologies
- implications to appropriate methodologies
- Outline procedure
- List materials and equipment
- Conduct experiment
- Record observations, data and results
- Performanalysis

PSO4. 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.

- Ability to analyze existing system.
- Ability designing to a new innovative thermal (or) mechanical system.
- Visualize the requirements of mechanical system.
- Ability to utilize various utilities to design a system.
- Understand the specifications of various utilities, and appreciate their use under various conditions.
- Ability to explain and demonstrate the various mechanical systems.

Courses offered in Aeronautical Engineering Curriculum (JNTUH-R13) –Vs- Program Outcomes and Program Specific Outcomes Attained through course modules for II-II, III-I, III-II, IV-I, IV-II Semesters

I YEAR																
Code	Subject	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
A10001	English		√	√						√	√						√
A10002	Mathematics – I	√	√		√								√	√			
A10003	Engineering Mechanics	√	√		√								√	√			
A10004	Engineering Physics	√	√		√								√	√			
A10005	Engineering Chemistry	√	√		√								√	√			
A10501	Computer Programming	√			√	√							√	√			
A10301	Engineering Drawing	√	√										√	√			
A10581	Computer Programming Lab.	√			√								√	√			
A10081	Engineering Physics / Engineering Chemistry Lab	√	√		√								√	√			
A10083	English Language Communication Skills Lab.		√	√		√			√	√			√	√			
A10082	IT Workshop/ Engineering Workshop	√	√			√								√		√	
II YEAR I SEMESTER																	
Code	Subject	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
A30006	Mathematics – II	√	√		√								√	√			
A30306	Thermodynamics	√	√		√								√	√		√	
A30104	Mechanics of Solids	√	√		√								√	√	√	√	
A30103	Mechanics of Fluids	√	√		√								√	√	√	√	
A32101	Introduction of Aerospace Engg	√					√						√	√			
A30009	Environmental Studies	√	√	√			√										
A32181	Aircraft Engineering Drawing Lab	√	√			√							√	√		√	√
A30182	Mechanics of Solids and Mechanics of Fluids Lab	√	√		√									√		√	
II YEAR I SEMESTER																	
Code	Subject	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
A42102	Aerodynamics-I	√	√		√								√	√		√	
A42104	Aircraft Production Technology	√					√						√	√		√	

A40203	Electrical and Electronics Engineering	√	√		√								√				
A42103	Aerospace Vehicle Structures -I	√	√		√								√	√		√	
A42106	Introduction to Space Technology	√	√				√							√			
A42105	Flight Mechanics –I	√	√		√								√	√			
A42180	Aircraft Production Technology Lab	√					√							√		√	√
A40281	Electrical and Electronics Engineering Lab	√	√		√												
III YEAR I SEMESTER																	
Code	**Subject**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
A50014	Management Science	√	√	√			√										√
A52111	Flight Mechanics- II	√	√		√								√	√			
A52107	Aerodynamics– II	√	√		√								√	√		√	
A52109	Aerospace Vehicle Structures– II	√	√		√								√	√		√	
A52108	Aerospace Propulsion- I	√	√		√								√	√		√	
A52110	Air Transportation Systems						√							√			
A52184	Aerospace Structures Lab	√	√		√								√	√		√	
A52183	Aerodynamics and Propulsion Lab	√	√		√									√		√	
III YEAR II SEMESTER																	
Code	**Subject**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
A62114	Computational Aerodynamics	√	√		√	√							√	√	√		
A62115	Conceptual Design of Flight Vehicles	√	√										√	√	√		
A62112	Aerospace Propulsion- II	√	√		√								√	√		√	
A62113	Aircraft Systems	√	√		√		√						√	√		√	
A60330	Finite Element Methods	√	√		√								√	√	√		
OPEN ELECTIVE																	
A60117	Disaster Management			√			√		√					√			√
A60017	Intellectual Property Rights			√			√							√			√
A60018	Human Values and Professional Ethics			√			√		√					√			√

A60086	Advanced Communication Skills Lab			√					√	√				√			√
A62185	Flight Vehicle Design & Instrumentation Lab	√	√		√		√							√	√	√	√
IV YEAR I SEMESTER																	
Code	**Subject**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
A72118	Airframe Structural Design	√	√		√								√	√	√	√	√
A72122	Mechanical Vibrations and Structural Dynamics	√	√		√								√	√		√	
A70328	CAD/CAM	√	√		√								√	√			
A72119	Control Theory – Application to Flight Control Systems	√	√		√								√	√			
Elective-I																	
A72116	Advanced Computational Aerodynamics	√	√		√	√							√	√	√	√	√
A72121	Flight Scheduling and Operations						√						√	√	√	√	√
A72123	Mechanisms and Mechanical Design	√	√		√								√	√	√	√	√
A72125	Theory of Elasticity	√	√		√								√	√	√	√	√
A70008	Probability and Statistics	√	√										√	√	√	√	√
Elective-II																	
A72124	Space Mechanics	√	√		√								√	√		√	√
A72120	Experimental Aerodynamics	√	√		√								√	√		√	√
A70352	Operations Research	√	√		√								√	√		√	√
A72117	Aircraft Maintenance Engineering	√	√				√						√	√		√	√
A72187	Computational Structures Lab	√	√		√	√							√	√	√		
A72186	Computational Aerodynamics Lab	√	√		√	√							√	√	√		
IV YEAR II SEMESTER																	
Code	**Subject**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
A82129	Avionics & Instrument Systems	√	√		√		√						√	√			
Elective-III																	
A82127	Airport Planning and Operations						√						√	√		√	√
A82128	Analysis of Composite Structures	√	√		√								√	√		√	√
A82130	Helicopter Engineering	√	√		√								√	√		√	√

A82131	Hypersonic Aerodynamics	√	√		√								√	√		√	√
Elective-IV																	
A80331	Heat Transfer	√	√		√								√	√		√	
A82132	Launch Vehicle and Missile Technology	√	√		√								√	√		√	
A82133	Wind Engineering and Industrial Aerodynamics	√	√		√								√	√		√	
A82126	Aero elasticity	√	√		√								√	√		√	
A80087	Industry Oriented Mini Project	√	√		√	√					√	√		√		√	√
A80089	Seminar	√	√		√	√					√	√		√			
A80088	Major Project	√	√		√	√					√	√		√	√	√	
A80090	Comprehensive Viva	√	√								√	√		√			

7. PROCEDURES FOR OUTCOME DELIVERY AND ASSESSMENT WITH RESPECT TO PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

The categorization of outcomes of the above Aeronautical Engineering courses is grouped as follows:

The Courses covered by Individual Program Outcomes and Program Specific Outcomes
Based on NBA-2013 Norms

PO1: Engineering knowledge **Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution complex engineering problems.**			
A10002	Mathematics – I	A62114	Computational aerodynamics
A10003	Engineering Mechanics	A62115	Conceptual Design of Flight Vehicles
A10004	Engineering Physics	A62112	Aerospace Propulsion- II
A10005	Engineering Chemistry	A62113	Aircraft Systems
A10501	Computer Programming	A60330	Finite Element Methods
A10301	Engineering Drawing	A62185	Flight Vehicle Design & Instrumentation Lab
A10581	Computer Programming Lab.	A72118	Airframe Structural Design
A10081	Engineering Physics / Engineering Chemistry Lab	A72122	Mechanical Vibrations and Structural Dynamics
A10083	English Language Communication Skills Lab.	A70328	CAD/CAM
A10082	Engineering Workshop / IT Workshop	A72119	Control Theory – Application to Flight Control Systems
A30006	Mathematics – II	A72116	Advanced Computational Aerodynamics
A30306	Thermodynamics	A72123	Mechanisms and Mechanical Design
A30104	Mechanics of Solids	A72121	Theory of Elasticity
A30103	Mechanics of Fluids	A70008	Probability and Statistics
A32101	Introduction of Aerospace Engg	A72124	Space Mechanics
A30009	Environmental Studies	A72120	Experimental Aerodynamics

A32181	Aircraft Engineering Drawing Lab	A70352	Operations Research
A30182	Mechanics of Solids and Mechanics of Fluids Lab	A72117	Aircraft Maintenance Engineering
A42102	Aerodynamics-I	A72187	Computational Structures Lab
A42104	Aircraft Production Technology	A72186	Computational Aerodynamics Lab
A40203	Electrical and Electronics Engineering	A82129	Avionics & Instrument Systems
A42103	Aerospace Vehicle Structures -I	A82128	Analysis of Composite Structures
A42106	Introduction to Space Technology	A82130	Helicopter Engineering
A42105	Flight Mechanics –I	A82131	Hypersonic Aerodynamics
A42180	Aircraft Production Technology Lab	A80331	Heat Transfer
A40281	Electrical and Electronics Engineering Lab	A82132	Launch Vehicle and Missile Technology
A50014	Management Science	A82133	Wind Engineering and Industrial Aerodynamics
A52111	Flight Mechanics- II	A82126	Aero elasticity
A52107	Aerodynamics– II	A80087	Industry Oriented Mini Project
A52109	Aerospace Vehicle Structures– II	A80089	Seminar
A52108	Aerospace Propulsion- I	A80088	Project Work
A52184	Aerospace Structures Lab	A80090	Comprehensive Viva
A52183	Aerodynamics and Propulsion Lab		

PO2: 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.

A10001	English	A62112	Aerospace Propulsion- II
A10003	Engineering Mechanics	A62113	Aircraft Systems
A10004	Engineering Physics	A60330	Finite Element Methods
A10005	Engineering Chemistry	A62185	Flight Vehicle Design & Instrumentation Lab
A10301	Engineering Drawing	A72118	Airframe Structural Design
A10081	Engineering Physics / Engineering Chemistry Lab	A72122	Mechanical Vibrations and Structural Dynamics
A10083	English Language Communication Skills Lab.	A70328	CAD/CAM
A10082	Engineering Workshop / IT Workshop	A72119	Control Theory – Application to Flight Control Systems
A30006	Mathematics – II	A72116	Advanced Computational Aerodynamics
A30306	Thermodynamics	A72123	Mechanisms and Mechanical Design
A30104	Mechanics of Solids	A72121	Theory of Elasticity
A30103	Mechanics of Fluids	A70008	Probability and Statistics
A30009	Environmental Studies	A72124	Space Mechanics
A32181	Aircraft Engineering Drawing Lab	A72120	Experimental Aerodynamics
A30182	Mechanics of Solids and Mechanics of Fluids Lab	A70352	Operations Research
A42102	Aerodynamics-I	A72117	Aircraft Maintenance Engineering

A40203	Electrical and Electronics Engineering	A72187	Computational Structures Lab
A42103	Aerospace Vehicle Structures -I	A72186	Computational Aerodynamics Lab
A42106	Introduction to Space Technology	A82129	Avionics & Instrument Systems
A42105	Flight Mechanics –I	A82128	Analysis of Composite Structures
A40281	Electrical and Electronics Engineering Lab	A82130	Helicopter Engineering
A50014	Management Science	A82131	Hypersonic Aerodynamics
A52111	Flight Mechanics- II	A80331	Heat Transfer
A52107	Aerodynamics– II	A82132	Launch Vehicle and Missile Technology
A52109	Aerospace Vehicle Structures– II	A82133	Wind Engineering and Industrial Aerodynamics
A52108	Aerospace Propulsion- I	A80087	Industry Oriented Mini Project
A52184	Aerospace Structures Lab	A80089	Seminar
A52183	Aerodynamics and Propulsion Lab	A80088	Project Work
A62114	Computational aerodynamics	A80090	Comprehensive Viva
A62115	Conceptual Design of Flight Vehicles		
A10001	English	A60117	Disaster Management
A10083	English Language Communication Skills Lab.	A60017	Intellectual Property Rights
A30009	Environmental Studies	A60018	Human Values and Professional Ethics
A50014	Management Science	A60086	Advanced Communication Skills Lab

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.

A10001	English	A30009	Environmental Studies
A10083	English Language Communication Skills Lab.	A60017	Intellectual Property Rights
A50014	Management Science	A60018	Human Values and Professional Ethics
A60117	Disaster Management	A60086	Advanced Communication Skills Lab

PO4: 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.

A10002	Mathematics – I	A60330	Finite Element Methods
A10003	Engineering Mechanics	A62185	Flight Vehicle Design & Instrumentation Lab
A10004	Engineering Physics	A72118	Airframe Structural Design
A10005	Engineering Chemistry	A72122	Mechanical Vibrations and Structural Dynamics
A10501	Computer Programming	A70328	CAD/CAM
A10581	Computer Programming Lab.	A72119	Control Theory – Application to Flight

			Control Systems
A10081	Engineering Physics / Engineering Chemistry Lab	A72116	Advanced Computational Aerodynamics
A30006	Mathematics – II	A72123	Mechanisms and Mechanical Design
A30306	Thermodynamics	A72121	Theory of Elasticity
A30104	Mechanics of Solids	A72124	Space Mechanics
A30103	Mechanics of Fluids	A72120	Experimental Aerodynamics
A30182	Mechanics of Solids and Mechanics of Fluids Lab	A70352	Operations Research
A42102	Aerodynamics-I	A72187	Computational Structures Lab
A40203	Electrical and Electronics Engineering	A72186	Computational Aerodynamics Lab
A42103	Aerospace Vehicle Structures -I	A82129	Avionics & Instrument Systems
A42105	Flight Mechanics –I	A82128	Analysis of Composite Structures
A40281	Electrical and Electronics Engineering Lab	A82130	Helicopter Engineering
A52111	Flight Mechanics- II	A82131	Hypersonic Aerodynamics
A52107	Aerodynamics– II	A80331	Heat Transfer
A52109	Aerospace Vehicle Structures– II	A82132	Launch Vehicle and Missile Technology
A52108	Aerospace Propulsion- I	A82133	Wind Engineering and Industrial Aerodynamics
A52184	Aerospace Structures Lab	A82126	Aero elasticity
A52183	Aerodynamics and Propulsion Lab	A80087	Industry Oriented Mini Project
A62114	Computational aerodynamics	A80089	Seminar
A62112	Aerospace Propulsion- II	A80088	Project Work
A62113	Aircraft Systems		

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.

A10501	Computer Programming	A72187	Computational Structures Lab
A10083	English Language Communication Skills Lab.	A72186	Computational Aerodynamics Lab
A10082	Engineering Workshop / IT Workshop	A80087	Industry Oriented Mini Project
A32181	Aircraft Engineering Drawing Lab	A80089	Seminar
A62114	Computational aerodynamics	A80088	Project Work
A72116	Advanced Computational Aerodynamics		

PO6: The engineer and society

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

A32101	Introduction of Aerospace Engg	A60017	Intellectual Property Rights
A30009	Environmental Studies	A60018	Human Values and Professional Ethics

A42104	Aircraft Production Technology	A62185	Flight Vehicle Design & Instrumentation Lab
A42106	Introduction to Space Technology	A72121	Flight Scheduling and Operations
A42180	Aircraft Production Technology Lab	A72117	Aircraft Maintenance Engineering
A50014	Management Science	A82129	Avionics & Instrument Systems
A52110	Air Transportation Systems	A82127	Airport Planning and Operations
A60117	Disaster Management		

PO7:Environment and Sustainability

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

A52110	Air Transportation Systems	A60018	Human Values and Professional Ethics
A60117	Disaster Management	A72121	Flight Scheduling and Operations
A60017	Intellectual Property Rights		

PO8: Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

A60017	Intellectual Property Rights	A60018	Human Values and Professional Ethics

PO9: Individual and team work

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

A10001	English	A60086	Advanced Communication Skills Lab
A10083	English Language Communication Skills Lab.		

PO10: Communication

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

A10001	English	A80089	Seminar
A10083	English Language Communication Skills Lab.	A80088	Project Work
A60086	Advanced Communication Skills Lab	A80090	Comprehensive Viva
A80087	Industry Oriented Mini Project		

PO11: Project management and finance

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

A50014	Management Science	A80088	Project Work
A80087	Industry Oriented Mini Project	A80090	Comprehensive Viva
A80089	Seminar		

PO12: Life-long learning

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

A10002	Mathematics – I	A62114	Computational aerodynamics
A10003	Engineering Mechanics	A62115	Conceptual Design of Flight Vehicles
A10004	Engineering Physics	A62112	Aerospace Propulsion- II
A10005	Engineering Chemistry	A62113	Aircraft Systems
A10501	Computer Programming	A60330	Finite Element Methods
A10301	Engineering Drawing	A62185	Flight Vehicle Design & Instrumentation Lab
A10581	Computer Programming Lab.	A72118	Airframe Structural Design
A10081	Engineering Physics / Engineering Chemistry Lab	A72122	Mechanical Vibrations and Structural Dynamics
A10083	English Language Communication Skills Lab.	A70328	CAD/CAM
A10082	Engineering Workshop / IT Workshop	A72119	Control Theory – Application to Flight Control Systems
A30006	Mathematics – II	A72116	Advanced Computational Aerodynamics
A30306	Thermodynamics	A72123	Mechanisms and Mechanical Design
A30104	Mechanics of Solids	A72121	Theory of Elasticity
A30103	Mechanics of Fluids	A70008	Probability and Statistics
A32101	Introduction of Aerospace Engg	A72124	Space Mechanics
A30009	Environmental Studies	A72120	Experimental Aerodynamics
A32181	Aircraft Engineering Drawing Lab	A70352	Operations Research
A30182	Mechanics of Solids and Mechanics of Fluids Lab	A72117	Aircraft Maintenance Engineering
A42102	Aerodynamics-I	A72187	Computational Structures Lab
A42104	Aircraft Production Technology	A72186	Computational Aerodynamics Lab
A40203	Electrical and Electronics Engineering	A82129	Avionics & Instrument Systems
A42103	Aerospace Vehicle Structures -I	A82128	Analysis of Composite Structures
A42106	Introduction to Space Technology	A82130	Helicopter Engineering
A42105	Flight Mechanics –I	A82131	Hypersonic Aerodynamics
A42180	Aircraft Production Technology Lab	A80331	Heat Transfer
A40281	Electrical and Electronics Engineering Lab	A82132	Launch Vehicle and Missile Technology
A50014	Management Science	A82133	Wind Engineering and Industrial Aerodynamics
A52111	Flight Mechanics- II	A82126	Aero elasticity
A52107	Aerodynamics– II	A80087	Industry Oriented Mini Project
A52109	Aerospace Vehicle Structures– II	A80089	Seminar
A52108	Aerospace Propulsion- I	A80088	Project Work
A52184	Aerospace Structures Lab	A80090	Comprehensive Viva

A52183	Aerodynamics and Propulsion Lab		

The categorization of specific outcomes of the above Aeronautical engineering courses is grouped as follows:

PSO1: Professional skills: **Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products**			
A10002	Mathematics – I	A62115	Conceptual Design of Flight Vehicles
A10003	Engineering Mechanics	A62112	Aerospace Propulsion- II
A10004	Engineering Physics	A62113	Aircraft Systems
A10005	Engineering Chemistry	A60330	Finite Element Methods
A10501	Computer Programming	A62185	Flight Vehicle Design & Instrumentation Lab
A10301	Engineering Drawing	A72118	Airframe Structural Design
A10581	Computer Programming Lab.	A72122	Mechanical Vibrations and Structural Dynamics
A10081	Engineering Physics / Engineering Chemistry Lab	A70328	CAD/CAM
A10083	English Language Communication Skills Lab.	A72119	Control Theory – Application to Flight Control Systems
A10082	Engineering Workshop / IT Workshop	A72116	Advanced Computational Aerodynamics
A30006	Mathematics – II	A72123	Mechanisms and Mechanical Design
A30306	Thermodynamics	A72121	Theory of Elasticity
A30104	Mechanics of Solids	A70008	Probability and Statistics
A30103	Mechanics of Fluids	A72124	Space Mechanics
A32101	Introduction of Aerospace Engg	A72120	Experimental Aerodynamics
A32181	Aircraft Engineering Drawing Lab	A70352	Operations Research
A30182	Mechanics of Solids and Mechanics of Fluids Lab	A72117	Aircraft Maintenance Engineering
A42102	Aerodynamics-I	A72187	Computational Structures Lab
A42104	Aircraft Production Technology	A72186	Computational Aerodynamics Lab
A42103	Aerospace Vehicle Structures -I	A82129	Avionics & Instrument Systems
A42106	Introduction to Space Technology	A82128	Analysis of Composite Structures
A42105	Flight Mechanics –I	A82130	Helicopter Engineering
A42180	Aircraft Production Technology Lab	A82131	Hypersonic Aerodynamics
A52111	Flight Mechanics- II	A80331	Heat Transfer
A52107	Aerodynamics– II	A82132	Launch Vehicle and Missile Technology
A52109	Aerospace Vehicle Structures– II	A82133	Wind Engineering and Industrial Aerodynamics

A52108	Aerospace Propulsion- I	A82126	Aero elasticity
A52184	Aerospace Structures Lab	A80087	Industry Oriented Mini Project
A52183	Aerodynamics and Propulsion Lab	A80089	Seminar
A62114	Computational aerodynamics	A80088	Project Work
		A80090	Comprehensive Viva

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

A30104	Mechanics of Solids	A62185	Flight Vehicle Design & Instrumentation Lab
A30103	Mechanics of Fluids	A72118	Airframe Structural Design
A62114	Computational aerodynamics	A72116	Advanced Computational Aerodynamics
A62115	Conceptual Design of Flight Vehicles	A72187	Computational Structures Lab
A60330	Finite Element Methods	A72186	Computational Aerodynamics Lab
		A80088	Project Work

PSO3: 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

A10082	IT Workshop/ Engineering Workshop	A52184	Aerospace Structures Lab
A30306	Thermodynamics	A52183	Aerodynamics and Propulsion Lab
A30104	Mechanics of Solids	A62112	Aerospace Propulsion- II
A30103	Mechanics of Fluids	A62113	Aircraft Systems
A32181	Aircraft Engineering Drawing Lab	A72118	Airframe Structural Design
A30182	Mechanics of Solids and Mechanics of Fluids Lab	A72122	Mechanical Vibrations and Structural Dynamics
A42102	Aerodynamics-I	A72121	Theory of Elasticity
A42104	Aircraft Production Technology	A72120	Experimental Aerodynamics
A42103	Aerospace Vehicle Structures -I	A82130	Helicopter Engineering
A42180	Aircraft Production Technology Lab	A82131	Hypersonic Aerodynamics
A52107	Aerodynamics– II	A80087	Industry Oriented Mini Project
A52109	Aerospace Vehicle Structures– II	A80088	Project Work
A52108	Aerospace Propulsion- I		

PSO4: 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**			
A10301	Engineering Drawing	A62185	Flight Vehicle Design & Instrumentation Lab
A32181	Aircraft Engineering Drawing Lab	A72118	Airframe Structural Design
A42104	Aircraft Production Technology	A72116	Advanced Computational Aerodynamics
A42180	Aircraft Production Technology Lab	A72117	Aircraft Maintenance Engineering
A50014	Management Science	A82133	Wind Engineering and Industrial Aerodynamics
A60117	Disaster Management	A80087	Industry Oriented Mini Project
A60086	Advanced Communication Skills Lab	A80088	Project Work

8. METHODS OF MEASURING LEARNING OUTCOMES AND VALUE ADDITION

There are many different ways to assess student learning. In this section, we present the different types of assessment approaches available and the different frameworks to interpret the results.

i. Mid Semester Course Evaluation
ii. End-of Semester Course Evaluation
iii. Continuous Evaluation of Classroom Performance
iv. Course Objective Surveys
v. Course Instructor's Evaluations
vi. Graduating Senior's survey
vii. Alumni Survey
viii. Employer Survey
ix. Laboratory and Project Works
x. Balanced Composition in Curriculum
xi. DAC and Faculty Meetings
xii. Professional Societies

The above assessment indicators are detailed below:

i. Mid Semester Course Evaluation

Aeronautical Engineering department conducts mid-semester reviews for all courses. All departmental students are encouraged to fill out a brief survey on the state of the courses they are currently taking, and space is provided for a written comment. Faculty are strongly encouraged to review these evaluations, and draft a brief response on how they will react to correct any deficiencies noted by the students. The results are reviewed by departmental faculty (all faculty have permission to read results for all courses).

ii. End-of Semester Course Evaluation

J N T University conducts end-of-semester examination for all courses. Summary results for each course are distributed to the appropriate instructor and the HOD, summarizing the course-specific results and comparing them to the average percentage across the university. Students are encouraged to write specific comments about the positive and negative aspects of

the course. The statistical summary and student comments are presented and are also submitted to the principal and department academic council for review.

iii. Departmental course objective surveys:

Aeronautical Engineering department conducts end-of-semester course objective surveys for all courses. All departmental students are encouraged to fill out a brief survey on the state of the courses they are currently taking, and space is provided for a written comment. Faculty are strongly encouraged to review these evaluations, and draft a brief response on how they will react to correct any deficiencies noted by the students. The results are reviewed by departmental faculty (all faculty have permission to read results for all courses). The results of how courses satisfy their objectives are discussed at a faculty meeting. Based on this feedback for certain courses, alterations or changes to respective course objectives can be done.

iv. Course portfolio evaluations:

We collect course portfolios from the instructor of each course offered in the given semester. They remain on file for the entire teaching fraternity to study. These portfolios help the course coordinator monitor how the course is being taught, and help new faculty understand how more experienced colleagues teach the given course. With respect to assessment, each portfolio contains two surveys to be filled out by the instructor of the course. The beginning-of-semester survey encourages faculty members to think about what they can do to improve the teaching and administration of their course, compared with the last time they taught it. The end-of-semester survey encourages faculty to record what did/did not work well during this course offering and what changes should be made for the future.

v. Exit Interviews:

Inputs from final year students are solicited annually through Computer Science and Engineering Exit Survey. The results are disseminated to the faculty and department advisory council for analysis and discussion. The questioner is designed to survey program outcomes, solicit about program experiences, career choices as well as suggestions and comments. This instrument seeks to assess how students view the department's program in retrospect.

vi. Alumni feedback:

The alumni survey is a written questionnaire which alumni are asked to complete. We use this survey seeking input on Program Objectives and Learning Outcomes based on their experience after graduation and after they have spent time in the working world. Alumni are an excellent resource with perspective on the value and advantages of their education. They are also resource for current students for potential networking and employment. The data will be analyzed and used in continuous improvement.

vii. Employer surveys:

The employer survey is a written questionnaire which employers of the program's graduates are asked to complete. We review the effectiveness of our curriculum and how well the student is prepared in the department of Aeronautical/Aerospace Engineering, IARE. To do this, we survey Employers and Advisors of alumni who graduated four years ago. We ask about several categories of preparation, and for each category, how well an individual think that he/she was prepared, and how important individual think preparation in that area is to him/her in the current position. This survey will greatly assist us in determining the college overall level of achievement of our Program Educational Objectives.

viii. Department academic council meetings:

Aeronautical/Aerospace Engineering Department Advisory Council (ANEDAC) constitutes a diversified group of experts from academia, industry, and alumni representations. The Advisory Board meets annually or frequently as required, for a comprehensive review of the ongoing Aeronautical/Aerospace Engineering Department strategic planning and program. The Advisory Council meets with administration, faculty as well as students and a thorough report is documented, and further submitted to principal for review. In each visit, the Department of Aeronautical/Aerospace Engineering responds to the submitted report indicating improvements and amendments to the existing program.

ix. Faculty meetings:

The state of undergraduate program is always on the agenda during monthly faculty meeting. Individual faculty devotes a substantial amount of time to formal and informal discussions assessing the state of program and searching for necessary improvements.

x. Seminars:

The students are tested to assess their ability to assimilate, comprehend, and communicate the knowledge acquired for a specific topic of their current interest.

xi. Industry Oriented Mini Projects:

The students are sent to various industries for four weeks after B.Tech III year, II semester to understand industrial practices/techniques/skills for product manufacturing with a critical reasoning.

xii. Comprehensive Viva-voce:

The students are assessed about their technical competence in the domain knowledge and beyond for real time applications.

xiii. Project work:

The final project reports, must demonstrate that students produced qualitative solutions to research/industry problems involving contemporary issues. There is no scale for this tool as the reports provide qualitative and quantitative data.

xiv. Laboratories:

The students are imparted deductive inputs from fundamentals to basic humanities and advanced engineering disciplines.

xv. Job Placements:

Data from Placement and Training Centre on graduates' job placement reflects how successful are the graduates in securing a job in their related field of study.

xvi. Professional societies:

The role of professional societies in introducing our students to technical, entrepreneurial and societal aspects of the field and in providing outstanding opportunities for lifelong learning makes them important constituents.

Part - II

METHODOLOGY FOR PREPARATION AND ASSESSMENT OF COURSE LEVEL STUDENT LEARNING OUTCOMES

Although the term "Expected Learning Outcome" may be new, the process of identifying the key concepts or skills that students are expected to learn during specific courses is not. Many people are more familiar with the terms "course objective" or "course competency". Expected learning outcomes are really very similar to both of these concepts, so if already equipped with course objectives or competencies, it reflects proximity to have reached the expected learning outcomes for class.

This will provide information on exactly what expected learning outcomes are and what methods can be used to assess them. This is designed to assist faculty with the process of developing expected learning outcomes and methods for assessing those outcomes in their courses. This provides basic information related to (1) course purpose; (2) expected learning outcomes; (3) methods for assessing expected learning outcomes; (4) criteria for grade determination; and (5) course outline.

Expected Learning Outcomes:
After reading and completing this, individuals will be able to:

- Prepare a description of the course as well as a written statement regarding the course's purpose;
- Construct/develop expected learning outcomes for the course;
- Create an assessment plan that outlines the specific methods that will be used to assess the expected student learning outcomes for a course;
- Describe how grades will be determined in a process that is separate and distinct from assessing the expected learning outcomes;
- Identify the common components of a course outline
- Revise their course syllabi to incorporate a course purpose, expected learning outcomes, methods to assess those outcomes, the criteria for grade determination, and a course outline.
- This process uses some terminology related to expected learning outcomes and assessment. A brief glossary of terms has been provided below for reference purposes.

Assessment of expected learning outcomes: The process of investigating (1) what students are learning and (2) how well they are learning it in relation to the stated expected learning outcomes for the course.

Assessment plan: The proposed methods and timeline for assessment-related activities in a given course (e.g., when are you going to check what/how well the students are learning and how are you going to do that?).

Classroom Assessment Technique (CAT): Angelo and Cross (1993) developed a variety of techniques/activities than can be used to assess students' learning. These CATs are often done anonymously and are not graded. These activities check on the class' learning while students are still engaged in the learning process. An example of a CAT is a non-graded quiz given a few weeks before the first exam.

Course description:
Formal description of material expected for coverage in the course.

Course purpose:
Course purpose describes objective of the course and how best it contributes to the program. The course purpose goes beyond the course description.

Expected learning outcome:
A formal statement of what students are expected to learn in a course (synonyms for "expected learning outcome" include learning outcome, learning outcome statement, and student learning outcome).

Evaluation:
Making judgment about quality of student learning/work and assigning marks based on that judgment. Evaluation activities (such as exams, papers, etc.) are often seen as formal ways to assess the expected learning outcomes for a course.

Methods for assessing student learning outcomes: This term refers to any technique or activity that is used to identify what students are learning or how well they are learning. Formal methods for evaluating student learning outcomes include Continuous Assessment Tests, Mid Semester Test, Tutorials, and End Semester Examination etc. The assessment methods are used to identify how the well students have acquired the learning outcomes for the course.

1. COURSE PURPOSE

Primitive step in identifying expected learning outcomes for a course is identifying the basic objective of teaching the course. By clarifying the purpose of course, faculty can help discover main topics or themes related to students' learning. These themes help to outline the expected learning outcomes for a specified course.

The course purpose involves the following:

1. What role does this course play within the program?
2. How is the course unique/different from other courses?
3. Why should/do students take this course? What essential knowledge or skills should they gain from this experience?
4. What knowledge or skills from this course will students need to have mastered to perform well in future classes or jobs?
5. Why is this course important for students to take?

The “Course Description” provides general information regarding the topics and content addressed in the course, and “Course Purpose” goes beyond to describe how this course fits into the student’s educational experience of the program.

2. EXPECTED LEARNING OUTCOMES

Expected Learning Outcome (definition)
An expected learning outcome is a formal statement of what students are expected to learn in a course. Expected learning outcome statements refer to specific knowledge, practical skills, areas of professional development, attitudes, higher-order thinking skills etcetera that faculty members expect students to develop, learn, or master during a course (Suskie, 2004). Expected learning outcomes are also often referred to as "learning outcomes", "student learning outcomes", or "learning outcome statements".

Simply stated, expected learning outcome statements describe:
1. What faculty members want students to *know* at the end of the course and
2. What faculty members want students *to be able to do* at the end of the course.

Learning outcomes have three major characteristics
1. They specify an action by the students/learners that is ***observable***
2. They specify an action by the students/learners that is ***measurable***
3. They specify an action that is done by the ***students/learners*** (rather than the faculty members)

Effectively developed expected learning outcome statements should possess all three of these characteristics. When this is done, the expected learning outcomes for a course are designed so that they can be assessed (Suskie, 2004).

3. TO DEFINE EFFECTIVE LEARNING OUTCOME STATEMENTS

When stating expected learning outcomes, it is important to use verbs that describe exactly what the learner(s) will be able to *do* upon completion of the course.

Examples of good action words to include in expected learning outcome statements:
Compile, identify, create, plan, revise, analyze, design, select, utilize, apply, demonstrate, prepare, use, compute, discuss, explain, predict, assess, compare, rate, critique, outline, or evaluate

There are some verbs that are unclear in the context of an expected learning outcome statement (e.g., know, be aware of, appreciate, learn, understand, comprehend, and become familiar with). These words are often vague, have multiple interpretations, or are simply difficult to observe or measure (American Association of Law Libraries, 2005). As such, it is best to avoid using these terms when creating expected learning outcome statements.

For example, please look at the following learning outcomes statements:

- The students will understand basic Computational Fluid Dynamicstechniques.
- The students will appreciate knowledge discovery from Computational Fluid Dynamics techniques.

Both of these learning outcomes are stated in a manner that will make them difficult to assess. Consider the following:

- How do you observe someone "understanding" a theory or "appreciating" Computational Fluid Dynamicstechniques?
- How easy will it be to measure "understanding" or "appreciation"?

These expected learning outcomes are more effectively stated the following way:

- The students will be able to identify and describe what techniques are used to extract knowledge from Conceptual Design of Flight Vehicles.
- The students will be able to identify the characteristics of Classification techniques from other Computational Fluid Dynamics techniques.

Incorporating Critical Thinking Skills into Expected Learning Outcomes Statements

Many faculty members choose to incorporate words that reflect critical or higher-order thinking into their learning outcome statements. Bloom (1956) developed a taxonomy outlining the different types of thinking skills people use in the learning process. Bloom argued that people use different levels of thinking skills to process different types of information and situations. Some of these are basic cognitive skills (such as memorization) while others are complex skills (such as creating new ways to apply information). These skills are often referred to as critical thinking skills or higher-order thinking skills.

Bloom proposed the following taxonomy of thinking skills. All levels of Bloom's taxonomy of thinking skills can be incorporated into expected learning outcome statements. RANEntly, Anderson and Krathwohl (2001) adapted Bloom's model to include language that is oriented towards the language used in expected learning outcome statements. A summary of Anderson and Krathwohl's revised version of Bloom's taxonomy of critical thinking is provided below.

Definitions of the different levels of thinking skills in Bloom's taxonomy

1. **Remember** – recalling relevant terminology, specific facts, or different procedures related to information and/or course topics. At this level, a student can remember something, but may not really understand it.

2. **Understand** – the ability to grasp the meaning of information (facts, definitions, concepts, etc.) that has been presented.

3. **Apply** – being able to use previously learned information in different situations or in problem solving.

4. **Analyze** – the ability to break information down into its component parts. Analysis also refers to the process of examining information in order to make conclusions regarding cause and effect, interpreting motives, making inferences, or finding evidence to support statements/arguments.

5. **Evaluate** – being able to judge the value of information and/or sources of information based on personal values or opinions.

6. **Create** – the ability to creatively or uniquely apply prior knowledge and/or skills to produce new and original thoughts, ideas, processes, etc. At this level, students are involved in creating their own thoughts and ideas.

List of Action Words Related to Critical Thinking Skills

Here is a list of action words that can be used when creating the expected student learning outcomes related to critical thinking skills in a course. These terms are organized according to the different levels of higher-order thinking skills contained in Anderson and Krathwohl's (2001) revised version of Bloom's taxonomy.

REMEMBER	UNDERSTAND	APPLY	ANALYZE	EVALUATE	CREATE
Choose	Classify	Apply	Analyze	Agree	Adapt

Define	Compare	Build	Assume	Appraise	Build
Find	Contrast	Choose	Categorize	Assess	Change
How	Demonstrate	Construct	Classify	Award	Choose
Label	Explain	Develop	Compare	Choose	Combine
List	Extend	Experiment with	Conclusion	Compare	Compile
Match	Illustrate	Identify	Contrast	Conclude	Compose
Name	Infer	Interview	Discover	Criteria	Construct
Omit	Interpret	Make use of	Dissect	Criticize	Create
Recall	Outline	Model	Distinguish	Decide	Delete
Relate	Relate	Organize	Divide	Deduct	Design
Select	Rephrase	Plan	Examine	Defend	Develop
Show	Show	Select	Function	Determine	Discuss
Spell	Summarize	Solve	Inference	Disprove	Elaborate
Tell	Translate	Utilize	Inspect	Estimate	Estimate
What			List	Evaluate	Formulate
When			Motive	Explain	Happen
Where			Relationships	Importance	Imagine
Which			Simplify	Influence	Improve
Who			Survey	Interpret	Invent
Why			Take part in	Judge	Make up
			Test for	Justify	Maximize
			Theme	Mark	Minimize
				Measure	Modify
				Opinion	Original
				Perceive	Originate
				Prioritize	Plan
				Prove	Predict
				Rate	Propose
				Recommend	Solution
				Rule on	Solve
				Select	Suppose
				Support	Test
				Value	Theory

4. TIPS FOR DEVELOPING COURSE LEVEL EXPECTED LEARNING OUTCOMES STATEMENTS

- Limit the course-level expected learning outcomes to 5 - 10 statements for the entire course (more detailed outcomes can be developed for individual units, assignments, chapters, etc.).
- Focus on overarching or general knowledge and/or skills (rather than small or trivial details).
- Focus on knowledge and skills that are central to the course topic and/or discipline.
- Create statements that are student-centered rather than faculty-centered (e.g., "upon completion of this course students will be able to list the names of all Data Mining techniques " versus "one objective of this course is to teach the names of all Data Mining techniques").
- Focus on the learning that results from the course rather than describing activities or lessons in the course.
- Incorporate or reflect the institutional and departmental missions.

Incorporate various ways for students to show success (outlining, describing, modeling, depicting, etc.) rather than using a single statement such as "at the end of the course, students will know _____ " as the stem for each expected outcome statement.

5. SAMPLE EXPECTED LEARNING OUTCOMES STATEMENTS

The following depict some sample expected learning outcome statements from selected courses.

Computer Programming:
Students who complete this course should be able to:

- Demonstrate an understanding of computer programming language concepts.
- Demonstrate an understanding of the major programming domains and the knowledge of the most appropriate computer programming language for each domain.
- To be able to develop C programs on at least two platforms.
- Demonstrate an understanding of ethical and legal issues for computing professionals and the impact of computing technology in society.
- Able to implement the algorithms and draw flowcharts for solving Mathematical and small Engineering problems.
- Ability to design and develop Computer programs, analyze, and interpret the concept of pointers, declarations, initialization, operations on pointers and their usage.
- Able to define structure data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures. Student must be able to define union and enumeration user defined data types.
- Able to demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks like Graphics and real time applications.
- Able to learn opening of data files and learn input/ output of file data. Also he must learn to write programs for reading, writing and appending data to sequential data Files.
- Develop confidence for self education and ability for life-long learning needed for Computer language.

Aerospace Vehicle Structures:
After completing this course, the student will be able to:

- Get clear understanding of Different structural members.
- Understand the different kind of loads acting on different types of structures.
- Analyze various structural members subjected to different loads.
- Perform different analysis like stress analysis, buckling analysis etc.
- Determine the loads acting on different structural components.
- Choose the Structural Member for a component for various applications.
- Estimate loads and stresses acting on different aircraft structural components.
- Use this course as prerequisite to understand the more advanced courses like ASD, AE, ACS, etc.

6. AN OVERVIEW OF ASSESSMENT

What is assessment?
According to Palomba and Banta (1999) assessment involves the systematic collection, review, and use of evidence or information related to student learning. Assessment helps faculty understand how well their students understand course topics/lessons. Assessment exercises are often anonymous. This anonymity allows students to respond freely, rather than trying to get the "right" answer or look good. Assessment exercises attempt to gauge students' understanding in order to see what areas need to be re-addressed in order to increase the students' learning.

In other words, assessment is the process of investigating (1) what students are learning and (2) how well they are learning it in relation to the stated expected learning outcomes for the course. This process also involves providing feedback to the students about their learning and providing new learning opportunities/strategies to increase student learning.

For example, Dr. JVR initiates a class discussion on material from Chapter One and determines that most students are confused about Topic X. This class discussion served as a method for assessing student learning and helped determine the fact that student learning related to Topic X is somewhat lacking. Dr. JVR now has the opportunity to (1) inform the students that there is some confusion and (2) make adjustments to address this confusion (e.g., ask student to re-read Chapter One, re-lecture over Topic X, etc.). This assessment process helps increase students' learning.

What is the difference between "evaluation" and "assessment"?
Evaluation focuses on making a judgment about student work to be used in assigning marks that express the level of student performance. Evaluation is usually used in the process of determining marks. Evaluation typically occurs after student learning is assumed to have taken place (e.g., a final exam). Evaluation is part of the assessment process. Course assignments that are evaluated/graded (e.g., exams, papers, tutorials, etc.) are often seen as formal assessment techniques.

While evaluation is an important component of most classrooms, it does have some limitations. For example, if the class average on an exam is a 45%, is seems pretty clear that something went wrong along the way. When one has only evaluated the final learning product, it can be challenging to go back and discover what happened. It can also be difficult to address the situation or provide opportunities for students to learn from their mistakes. Yes, a curve on an exam can help address a low class average, but does it help the students learn? Engaging in informal assessment activities throughout the course can help avoid this situation.

What is involved in the assessment process?

1. Establishing expected learning outcomes for the course;
2. Systematically gathering, analyzing, and interpreting evidence (through formal assessment activities such as exams or papers and informal assessment activities such as in-class discussions exercises) to determine how well the students' learning matches:
    - Faculty expectations for what students will learn and
    - The stated expected learning outcomes for the course
3. Faculty members should use this evidence/assessment of student learning to:
    - Provide questioner to students about their learning (or lack thereof) and
    - Adjust their teaching methods and/or students' learning behaviors to ensure greater student learning (Maki, 2004).

The Best Practice in a Classroom Assessment and is an example of a method that can be used to assess learning outcomes. At the end of a class period or major topic, faculty ask students to anonymously write down what point(s) were the most unclear to them. After class, faculty members review these responses and then re-teach or re-address any confusing topics, thus increasing student learning (Angelo & Cross, 1993).

7. DESCRIPTION OF A COURSE PURPOSE

Determining the PURPOSE of teaching the course

When planning a course and determining the Learning Outcomes for that course, it is important to examine the course's purpose within the context of the college, and/or the department/program. This process will assist faculty in determining the intent of the course as well as how the course fits into the curriculum. This will help identify the essential knowledge, skills, etc. that should be incorporated into the course and the stated expected learning outcomes for the course. The course purpose section should clarify the course's standing within the program (e.g., is the course required or an elective?, does this class have a pre-requisite?, etc.). It should also describe the course's role in the departmental/programmatic curriculum by addressing the intent (importance, main contribution, intrinsic value, etc.) of the class.

STEP ONE: Determine if the course is part of the IEEE / ACM / AICTE Model Curriculum

The earliest curriculum was published in 1968 for computer science (CS) by the Association for Computing Machinery (ACM), and in 1977 the Computer Society of the Institute for Electrical and Electronic Engineers (IEEE-CS) provided its first curriculum recommendations. In the late 1980's the ACM and the IEEE-CS together formed a task force to create curricula for computer science and computer engineering. The core curriculum covers classes in computer science curriculum, and subsequently separate curricula reports were issued for information systems, software engineering and computer engineering

STEP TWO: Determine how the course fits into the departmental curriculum

Here are some questions to ask to help determine how a course fits in the departmental curriculum:
What role does the course play in the departmental/programmatic curriculum?

- Is this course required?
- Is this course an elective?
- Is this course required for some students and an elective for others?
- Does this class have a pre-requisite?
- Is this class a pre-requisite for another class in the department?
- Is this course part of IEEE / ACM / AICTE Model Curriculum?

How advanced is this course?

- Is this course an undergraduate or graduate course?
- Where does this course fall in students' degree plan - as an introductory course or an advanced course?
- Can I expect the students taking this course to know anything about the course topic?
- Are other faculty members counting on students who have taken this course to have mastered certain knowledge or skills?

When students leave this course, what do they need to know or be able to do?

- Is there specific knowledge that the students will need to know in the future?
- Are there certain practical or professional skills that students will need to apply in the future?
- Five years from now, what do you hope students will remember from this course?

What is it about this course that makes it unique or special?

- Why does the program or department offer this course?
- Why can't this course be "covered" as a sub-section of another course?
- What unique contributions to students' learning experience does this course make?
- What is the value of taking this course? How exactly does it enrich the program or department?

8. PROCEDURE FOR DEVELOPMENT OF EXPECTED LEARNING OUTCOMES FOR A COURSE

The following pages should be of assistance in developing several broad, effectively stated expected learning outcomes for a course. When beginning to construct expected learning outcome statements, it is always good to think about the learners.

Please take a moment to think about the student learners in the course. Please consider the following questions:

- What are the most essential things the students need to know or be able to do at the end of this course?
- What knowledge and skills will they bring with them?
- What knowledge and skills should they learn from the course?

When you begin thinking about the expected learning outcomes for a course, it is a good idea to think broadly. Course-level expected learning outcomes do not need to focus on small details; rather, they address entire classes of theories, skill sets, topics, etc.

The "Course Description" contains the following contents:

- Course Overview
- Prerequisite(s)
- Marks Distribution
- Evaluation Scheme
- Course Objectives
- Course Outcomes
- How Course Outcomes are assessed
- Syllabus
- List of Text Books / References / Websites / Journals / Others
- Course Plan
- Mapping course objectives leading to the achievement of the program outcomes
- Mapping course outcomes leading to the achievement of the program outcomes

9. REFERENCES

1. American Association of Law Libraries (2005). Writing learning outcomes.
2. Retrieved May 31, 2005 from http://www.aallnet.org/prodev/outcomes.asp .
3. Anderson, L.W., and Krathwohl, D.R. (Eds.) (2001). A taxonomy of learning, teaching, and assessment: A revision of Bloom's taxonomy of educational objectives. New York: Longman.
4. Angelo, T.A. & Cross, K.P. (1993). Classroom assessment techniques: A handbook for college teachers (2nd Ed.). San Francisco, CA: Jossey-Bass. Ball State University, (1999).
5. Bloom's Classification of Cognitive Skills. Retrieved
6. June 10, 2005 from http://web.bsu.edu/IRAA/AA/WB/chapter2.htm .
7. Bloom, B.S., (1956) Taxonomy of educational objectives: The classification of educational goals: Handbook I, cognitive domain. Longmans, Green: New York, NY.
8. Hales, L.W. & Marshall, J.C. (2004). Developing effective assessments to improve teaching and learning. Norwood, MA: Christopher-Gordon Publishers, Inc.

9. Huba, M.E., (2005). Formulating intended learning outcomes. Retrieved June 16, 2005
10. Fromhttp://www.viterbo.edu/academic/titleiii/events/files/Jun04/Intended%20Learning%20Outcomes.ppt#256,1,Formulating Intended Learning Outcomes .
11. Kansas State University, (2004). Assessment of student learning plan. Retrieved
12. May 15, 2005 from http://www.k-state.edu/assessment/Library/templatew.doc.
13. Kansas State University, (2004). Form for identifying strategies and processes for
14. the assessment of student learning outcome(s). Retrieved May 15, 2005 from http://www.k-state.edu/assessment/Library/strategies.pdf .
15. Kansas State University, (2005). How to write student learning outcomes: Action
16. verb List – suggested verbs to use in each level of thinking skills. Retrieved May 15, 2005 from http://www.k-state.edu/assessment/Learning/action.htm.
17. Krumme, G (2001). Major categories in the taxonomy of educational objectives
18. (Bloom 1956). Retrieved June 6, 2005 from http://faculty.washington.edu/krumme/guides/bloom1.html .
19. Maki, P.L. (2004). Assessing for learning: Building a sustainable commitment across the institution. Stylus: Sterling, VA.
20. Palomba, C.A. & Banta, T.W. Eds. (2001). Assessing student competence in accredited disciplines: Pioneering approaches to assessment in higher education. Stylus: Sterling, VA.
21. Siebold, R. & Beal, M. (May 2005). Online course development guide: The workbook. Presented at The Teaching Professor Conference in Shaumburg, IL.
22. Suskie, L. (ed) (2001). Assessment to promote deep learning: Insight from AAHE's 2000 and 1999 Assessment Conferences.
23. Suskie, L. (2004). Assessing student learning: A common sense guide. Anker Publishing Company: Bolton, MA.
24. St. Edward's University Center for Teaching Excellence (2004). Task Oriented Question
25. Construction Wheel Based on Bloom's Taxonomy. Retrieved on May 17, 2005 from http://www.stedwards.edu/cte/resources/bwheel.htm.
26. Texas Tech University (2005). Texas Tech University 2005-06 Undergraduate and Graduate Catalog Volume LXXXII. Published by the Office of Official Publications: Lubbock.
27. TX. Texas Tech University Office of the Ombudsman, (2005). Syllabus Guide for Faculty: Tips for creating a conflict free syllabus. Retrieved June 9, 2005 from
28. http:// www.depts.ttu.edu/ombudsman/publications/SyllabusGuideforFaculty.doc.

Annexure-A: Sample Course Description (As Per NBA Norms post June, 2015)

INSTITUTE OF AERONAUTICAL ENGINEERING

Dundigal, Hyderabad - 500 043

AERONAUTICAL ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**AIR TRANSPORTATION SYSTEMS**			
Course Code	**(A52110)**			
Regulation	**R13 - JNTUH**			
Course Structure	Lectures	Tutorials	Practicals	Credits
	4		-	4
Course Coordinator	M.snigdha			
Team of Instructors	Ms. M.snigdha, G.R.K swamy, R.suresh			

I. COURSE OVERVIEW:

Study key issues, concepts and developments in the aviation industry, and improve your understanding of a range of specialized subjects and global best practices. Learn how aviation business planning interrelates with current regulatory and evolving state policy issues. Evaluate current air transport economic issues and the industry value chain, and learn how to apply your air transport economic knowledge in the workplace. Some prior industry experience is useful to fully understand course content, although sessions are accessible to new industry professionals

II. PREREQUISITE(S):

Level	Credits	Periods/ Week	Prerequisites
UG	4	4	Basic concepts of aviation management, air traffic control and air transportation systems.

III MARKS DISTRIBUTION

Sessional Marks	University End Exam marks	Total marks
Mid Semester Test There shall be two midterm examinations. Each midterm examination consists of subjective type and objective type tests.	75	100

The subjective test is for 10 marks of 60 minutes duration. Subjective test of shall contain 4 questions; the student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks of 20 minutes duration. It consists of 10 Multiple choice and 10 objective type questions, the student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first two and half units of syllabus and second midterm examination shall be conducted for the remaining portion		

Sessional Marks	University End Exam marks	Total Marks
Assignment Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course.		

IV. EVALUATION SCHEME

S. No	Component	Duration	Marks
1.	I Mid Examination	80 minutes	20
2.	I Assignment	-	5
3.	II Mid Examination	80 minutes	20
4.	II Assignment	-	5
5.	External Examination	3 hours	75

V. COURSE OBJECTIVES:

1. Explain how aviation players usually act and compete in different market structures (monopolies and oligopolies)
2. To learn tools and methods to design, plan, and analyze air transportation systems,
3. To understand the technology and basic performance of aircraft as they operate in the air transport system,
4. To understand the operating principles of Air Traffic Control (ATC) and the future of the National Airspace System (NAS),
5. Provide a foundation of airline operations research,
6. To understand the principle of operation of large-scale airspace and airfield simulation models and their application in NAS studies.

VI. COURSE OUTCOMES:

The theory should be taught and practical should be carried out in such a manner that

students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

29. Plan airport layout incorporating its different features
30. Execute construction of runway and taxiway and aprons as per geometric design for all parameters.
31. Assure desire quality in construction of runway
32. Check the requirements of terminal area as per drawing and design
33. Check the visual aids for air traffic control system.
34. Explain various elements of Heliports and its planning aspects
35. AirTrafficServices
36. describe the history and development of Air Traffic Services (ATS);
37. explain the airway structure and aids to navigation;
38. summarize air traffic rules and procedures;

k. explain radio and radio navigation, including radar and radar facilities, and Instrument Landing systems

l. This program is designed to help you enhance your knowledge of your key duties, responsibilities and potential liabilities in the area of Air Law and Air Transport Management

VIIHOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency assessed by
PO1	**Engineering knowledge** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	H	Assignments, Tutorials
PO2	**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.	S	Assignments
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	H	Mini Projects
PO4	**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.	H	Projects

Program Outcomes		Level	Proficiency assessed by
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.	S	Projects
PO6	**The engineer and society** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	N	--
PO7	**Environment and sustainability** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	N	--
PO8	**Ethics** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	S	Oral Discussions
PO9	**Individual and team work** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	N	--
PO10	**Communication** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	S	Presentations
PO11	**Project management and finance** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	S	Seminars, Discussions
PO12	**Life-long learning** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	H	Development of Prototype, Projects

N - None **S - Supportive** **H - Highly Related**

VIII HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Level	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	H	Lectures, Assignments

Program Specific Outcomes		Level	Proficiency assessed by
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	S	Tutorials
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	S	Seminars and Projects
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	S	Career Programmes

N - None **S - Supportive** **H - Highly Related**

IX. SYLLABUS:

UNIT- I :
AVIATION INDUSTRY AND ITS REGULATORYENVIRONMENT
Introduction, history of aviation- evolution, development, growth, challenges. Aerospace industry, air transportation industry- economic impact- types and causes. Airline Industry- structure and economic characteristics. The breadth of regulation- ICAO, IATA, national authorities (DGCA, FAA). Safety regulations- risk assessment- human factors and safety, security regulations, environmental regulations.

UNIT- II :
AIRSPACE
Categories of airspace- separation minima, airspace sectors- capacity, demand and delay. Evolution of air traffic control system- procedural ATC system, procedural ATC with radar assistance, first generation 'automated' ATC system, current generation radar and computer-based ATC systems. Aerodrome air traffic control equipment and operation - ICAO future air-navigation systems (FANS). Air-navigation service providers as businesses. Communication, navigation and surveillance systems(CNSS). Radio communications-VHF,HF,ACARS,SSR,ADS, NAVIGATION –NDB,VOR,DME,area-navigation systems(R-nav),ILS,MLS,GPS,INS.

UNIT- III:
AIRCRAFT
Costs- project cash-flow, aircraft price. Compatibility with the operational infrastructure. Direct and indirect operating costs. Balancing efficiency and effectiveness- payload-range, fuel efficiency, technical contribution to performance, operating speed and altitude,

aircraft field length performance. typical operating costs. Effectiveness- wake-vortices, cabin dimensions, flight deck.

UNIT- IV:
AIRPORTS
Setting up an airport- airport demand, airport siting, runway characteristics- length, declared distances, aerodrome areas, obstacle safeguarding. Runway capacity- evaluating runway capacity- sustainable runway capacity. Runway pavement length, Manoeuvring area- airfield lighting, aprons, Passenger terminals-terminal sizing and configuration. Airport demand, capacity and delay. .

UNIT- V:
AIRLINES
Setting up an airline- modern airline objectives. Route selection and development, airline fleet planning, annual utilization and aircraft size, seating arrangements. Indirect operating costs. Aircraft- buy or lease. Revenue generation, Computerized reservation systems, yield management. Integrating service quality into the revenue-generation process. Marketing the seats. Airline scheduling. Evaluating success- financial viability, regulatory compliance, efficient use of resources, effective service.

TEXT BOOK

1. Hirst, M., *The Air Transport System*, Woodhead Publishing Ltd, Cambridge, England, 2008.

REFERENCES

1. Wensven, J.G., *Air Transportation: A Management Perspective*, Ashgate, 2007.
2. Belobaba, P., Odoni, A. and Barnhart, C., *Global Airline Industry*, Wiley, 2009.
3. M. Bazargan, M., *Airline Operations and Scheduling*, Ashgate, 2004.
4. Nolan, M.S., *Fundamentals of Air Traffic Control*, 4thedn., Thomson Learning, 2004.
5. Wells, A. and Young, S., *Airport Planning and Management*, 5thedn., McGraw-Hill, 1986.

X Course plan:

At the end of the course, the students are able to achieve the following course learning outcomes

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1-4	**DESCRIBE** the history of aviation	**UNIT- I: AVIATION INDUSTRY And Its REGULATORY ENVIRONMENT** Introduction, history of aviation- evolution, development, growth, challenges	

	EXPLAIN the types and causes of ATS	Aerospace industry, air transportation industry- economic impact- types and causes	
	DEFINE THE TERMS ICAO,IATA,DGCA,FAA	Airline Industry- structure and economic characteristics. The breadth of regulation- ICAO, IATA, national authorities (DGCA, FAA).	
	DETERMINE SAFETY REGULATION	Safety regulations- risk assessment- human factors and safety, security regulations, environmental regulations.	
5-9	**EXPLAIN** THE CATEGORIES OF AIRSPACE	**UNIT 2: AIRSPACE** Categories of airspace- separation minima, airspace sectors- capacity, demand and delay. Evolution of air traffic control system- procedural ATC system, procedural ATC with radar assistance, first generation 'automated' ATC system, current generation radar and computer-based ATC systems. Aerodrome air traffic control equipment and operation - ICAO future air-navigation systems (FANS).	
	DISCUSSING DIFFERENT TYPES OF AIR- NAVIGATION SYSTEMS	Air-navigation service providers as businesses. Communication, navigation and surveillance systems(CNSS). Radio communications- VHF,HF,ACARS,SSR,ADS, NAVIGATION – NDB,VOR,DME,area-navigation systems(R-nav),ILS,MLS,GPS,INS.	
10-14	**DISCUSS** DIRECT AND INDIRECT OPERATING COSTS	**UNIT3: AIRCRAFT** Costs- project cash-flow, aircraft price. Compatibility with the operational infrastructure. Direct and indirect operating costs	

	EXPLAIN THE EFFICIENCY AND AFFECTIVENESS OF PAYLOAD-RANGE FUEL, SPEED , ALTITUTE, AIRCRAFT LENGTH PERFORMANCE.	Balancing efficiency and effectiveness-payload-range, fuel efficiency, technical contribution to performance, operating speed and altitude, aircraft field length performance.typical operating costs. Effectiveness- wake-vortices, cabin dimensions, flight deck.	
15-19	**DISCUSS THE CHARACTERISTICS OF AIRPORTS**	**UNIT-IV: AIRPORTS** Setting up an airport- airport demand, airport siting, runway characteristics- length, declared distances, aerodrome areas, obstacle safeguarding **.** Runway capacity- evaluating runway capacity- sustainable runway capacity	
	DETERMINE THE TERM OF RUNWAY PAVEMENT,MANOEUVRING AREA	Runway pavement length, Manoeuvring area- airfield lighting, aprons, Passenger terminals-terminal sizing and configuration. Airport demand, capacity and delay..	
34-38	**EXAMINE THE SETTING UP AN AIRLINE N MODERN AIRLINE OBJECTIVES**	**UNIT-V:AIRLINES:**Setting up an airline- modern airline objectives. Route selection and development, airline fleet planning, annual utilization and aircraft size, seating arrangements. Indirect operating costs. Aircraft-buy or lease. Revenue generation, Computerized reservation systems, yield management	
39-44	**DISCUSS ABOUT THE QUALITY SERVICE N REVENUE-GENERATION PROCESS**	. Integrating service quality into the revenue-generation process. Marketing the seats. Airline scheduling. Evaluating success-financial viability, regulatory compliance, efficient use of resources, effective service.	

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

Course objectives	Program Outcomes												Program specific outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO:12	PSO:1	PSO:2	PSO:3	PSO:4
I	S	H	H	S	S	S			H	H		S	S	H	H	S
II	S	S	H		S			H		S			H	S	S	H
III	H		H	S	H		S		S	H			S	H	S	H
IV	H	H			S		H			S			H	S	S	S
V	S	S				H	H		S	S			H	H	S	H
VI		H	H			S	S	S		H		H	S	S	H	H

S = Supportive H = Highly Related

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

Course Outcomes	Program Outcomes												Program specific outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	pso1	pso2	pso3	pso4
1	S	S	H	S	H					S		H	H	H	H	S
2	H	H	S	H	S					H		S	S	H	S	H
3	S	S	S	S	H					S		H	H	S	S	H
4	H	S	H	S	H					H		S	H	H	H	S
5	S	S	S	H	S					S		H	H	S	S	S
6	H	S	H	S	H					H		S	S	H	H	H
7	S	H	S	H	S					S		H	H	H	H	S
8	H	S	H	S	H					H		S	S	H	H	S
9	S	S	H	H	S					S		H	H	H	S	S
10	H	S	S	S	H					H		S	H	S	H	H
11	S	H	S	H	S					S		H	H	H	S	S
12	H	S	H	H	H					S		S	S	H	S	H

S = Supportive H = Highly Related

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