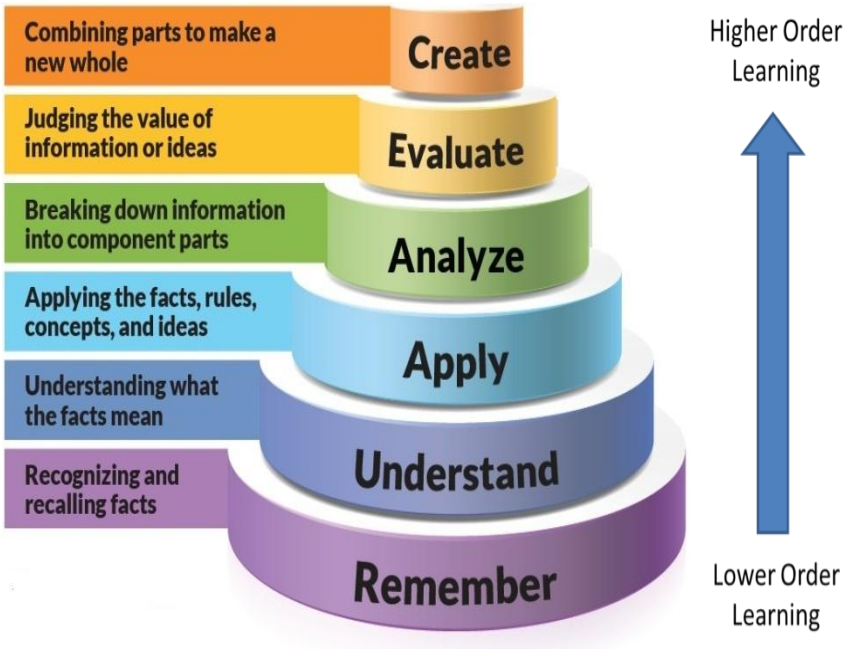
OUTCOME BASED EDUCATION BOOKLET

AERONAUTICAL ENGINEERING

B.Tech

For the Batch of Students admitted during

Academic Year 2018-19



INSTITUTE OF AERONAUTICAL ENGINEERING
(AUTONOMOUS)
Approved by AICTE: Affiliated to JNTUH and Accredited by NAAC with 'A' Grade
Dundigal, Hyderabad-500043

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-I, I-II, II-I, II-II, III-I, III-II, IV-I, 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

Outcome based education (OBE)

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience, each student should have achieved the goal. There is no single specified style of teaching or assessment in OBE; instead, classes, opportunities, and assessments should all help students achieve the specified outcomes. The role of the faculty adapts into instructor, trainer, facilitator, and/or mentor based on the outcomes targeted.

2. B. TECH - AERONAUTICAL ENGINEERING PROGRAM EDUCATIONAL 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

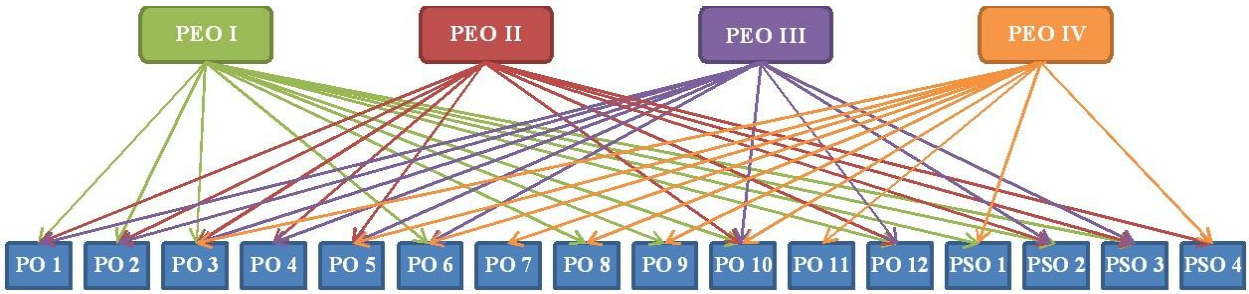
PSO2. Problem solving skills
Imparted through simulation language skills and general purpose CAE packages to solve practical, design and analysis problems of components to complete the challenge of airworthiness for flight vehicles

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. **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. **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. **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 **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. **PSO.1 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

		PSO.3 Practical implementation and testing skills Providing different types of in house and training and industry practice to fabricate and test and develop the products with more innovative technologies **PSO.4 Successful career and entrepreneurship** To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of aerospace and allied systems and become technocrats
II	To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies	**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. **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 **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. **PSO.2 Professional skills** Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products **PSO.3 Practical implementation and testing skills** Providing different types of in house and training and industry practice to fabricate and test and develop the products with more innovative technologies **PSO.4 Successful career and entrepreneurship** To prepare the students with broad aerospace knowledge to design and develop systems and subsystems of aerospace and allied systems and become technocrats
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	**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. **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 **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 **PSO.2 Professional skills** Able to utilize the knowledge of aeronautical/aerospace engineering in innovative, dynamic and challenging environment for design and development of new products **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
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	**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. **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. **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 **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. **PSO.1 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 **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

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:

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

Relationships between program Educational objectives and program outcomes
Key: 3 = Highly Related; 2 = Medium; 1=Low

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:

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

PSO4	**Successful career and entrepreneurship**	3	3	2	3

Relationship between Program Specific Outcomes and Program Educational Objectives
Key: 3 = Highly Related; 2 = Medium; 1=Low

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
- Evaluate the solution of the 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 the appropriate solution to an engineering problem

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
- Perform analysis

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 (IARE- R18) –Vs- Program Outcomes and Program Specific Outcomes Attained through course modules for I-I, I-II Semesters

I YEAR I SEMESTER																
Code	**Subject**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
AHSB02	Linear Algebra and	✓	✓											✓			

	Calculus																
AHSB04	Waves and Optics	✓	✓		✓										✓		
ACSB01	Programming for Problem Solving	✓	✓	✓		✓							✓	✓	✓	✓	
AHSB10	Engineering Physics Laboratory	✓	✓		✓					✓		✓	✓			✓	
ACSB02	Programming for Problem Solving Laboratory	✓											✓	✓			✓
AMEB01	Workshop/Manufacturing Practices Laboratory	✓		✓												✓	
I YEAR II SEMESTER																	
Code	**Subject**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
AHSB01	English									✓	✓	✓				✓	
AHSB11	Mathematical Transform Techniques	✓	✓		✓									✓			
AHSB03	Engineering Chemistry	✓	✓		✓			✓						✓			
AAEB01	Engineering Mechanics	✓	✓	✓										✓			
AHSB08	English Language and Communication Skills Laboratory						✓		✓	✓	✓		✓				✓
AHSB09	Engineering Chemistry Laboratory	✓												✓	✓	✓	
AMEB02	Engineering graphics and Design Laboratory	✓				✓								✓			
AAEB02	Basic Simulation with MAT Laboratory	✓	✓	✓	✓	✓							✓	✓	✓		

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 Norms

PO1: Engineering knowledge **Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution complex engineering problems.**			
Code	**Subject**	**Code**	**Subject**
I Semester			

AHSB02	Linear Algebra and Calculus	ACSB01	Programming for Problem Solving
AHSB04	Waves and Optics	AHSB10	Engineering Physics Laboratory
AMEB01	Workshop/Manufacturing Practices Laboratory	ACSB02	Programming for Problem Solving Laboratory
II Semester			
AHSB11	Mathematical Transform Techniques	AAEB01	Engineering Mechanics
AHSB03	Engineering Chemistry	AMEB02	Engineering graphics and Design Laboratory
AAEB02	Basic Simulation with MAT Laboratory	AHSB09	Engineering Chemistry Laboratory

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.

Code	Subject	Code	Subject
I Semester			
AHSB02	Linear Algebra and Calculus	ACSB01	Programming for Problem Solving
AHSB04	Waves and Optics	AHSB10	Engineering Physics Laboratory
II Semester			
AHSB11	Mathematical Transform Techniques	AAEB01	Engineering Mechanics
AHSB03	Engineering Chemistry	AAEB02	Basic Simulation with MAT Laboratory

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.

Code	Subject	Code	Subject
I Semester			
ACSB01	Programming for Problem Solving	AMEB01	Workshop/Manufacturing Practices Laboratory
II Semester			
AAEB01	Engineering Mechanics	AAEB02	Basic Simulation with MAT Laboratory

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.

Code	Subject	Code	Subject
I Semester			
AHSB04	Waves and Optics	AHSB10	Engineering Physics Laboratory
II Semester			

AHSB11	Mathematical Transform Techniques	AHSB03	Engineering Chemistry
AAEB02	Basic Simulation with MAT Laboratory		

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.

Code	Subject	Code	Subject
I Semester			
ACSB01	Programming for Problem Solving		
II Semester			
AAEB02	Basic Simulation with MAT Laboratory	AMEB02	Engineering graphics and Design Laboratory

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.

Code	Subject	Code	Subject
II Semester			
AHSB08	English Language and Communication Skills Laboratory		

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.

Code	Subject	Code	Subject
II Semester			
AHSB03	Engineering Chemistry		

PO8: Ethics

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

Code	Subject	Code	Subject
II Semester			
AHSB08	English Language and Communication Skills Laboratory		

PO9: Individual and team work

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

Code	Subject	Code	Subject

I Semester			
AHSB10	Engineering Physics Laboratory		
II Semester			
AHSB01	English	AHSB08	English Language and Communication Skills Laboratory

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.

Code	Subject	Code	Subject
II Semester			
AHSB01	English	AHSB08	English Language and Communication Skills Laboratory

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.

Code	Subject	Code	Subject
I Semester			
AHSB10	Engineering Physics Laboratory		
II Semester			
AHSB01	English		

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.

Code	Subject	Code	Subject
I Semester			
ACSB01	Programming for Problem Solving	AHSB10	Engineering Physics Laboratory
ACSB02	Programming for Problem Solving Laboratory		
II Semester			
AHSB08	English Language and Communication Skills Laboratory	AAEB02	Basic Simulation with MAT Laboratory

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			
Code	**Subject**	**Code**	**Subject**
I Semester			
AHSB02	Linear Algebra and Calculus	ACSB01	Programming for Problem Solving
ACSB02	Programming for Problem Solving Laboratory		
II Semester			
AHSB11	Mathematical Transform Techniques	AAEB01	Engineering Mechanics
AHSB03	Engineering Chemistry	AAEB02	Basic Simulation with MAT Laboratory
AHSB09	Engineering Chemistry Laboratory	AMEB02	Engineering graphics and Design Laboratory

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**			
I Semester			
AHSB04	Waves and Optics	ACSB01	Programming for Problem Solving
II Semester			
AHSB09	Engineering Chemistry Laboratory	AAEB02	Basic Simulation with MAT Laboratory

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**			
Code	**Subject**	**Code**	**Subject**
I Semester			
ACSB01	Programming for Problem Solving	AHSB10	Engineering Physics Laboratory
AMEB01	Workshop/Manufacturing Practices Laboratory		
II Semester			
AHSB01	English	AHSB09	Engineering Chemistry Laboratory

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**			
Code	**Subject**	**Code**	**Subject**
I Semester			
ACSB02	Programming for Problem Solving Laboratory		

II Semester			
AHSB08	English Language and Communication Skills Laboratory		

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

The end-of semester course reviews are conducted, feedback taken from students and remedial measures will be taken up such that the student gets benefited before going for the university end exams. The positive and negative comments made by the students about the course are recorded and submitted to the departmental academic council (DAC) and to the Principal for taking necessary actions to better the course for subsequent semesters.

iii. Continuous Evaluation of Classroom Performance

Students are encouraged and motivated to participate actively in the classroom proceedings by way of interactive teaching by the instructor. Surprise class tests comprising of short answer questions, quiz based discussions, multiple-choice, true-false, and matching tests are conducted to strengthen the teaching-learning process. Apart from teacher control and covering content, the teacher also act a safe licitator and students discover things for

themselves, enabling them to be more independent and becoming life – long learners exploring student-centric educational philosophy..

iv. Course Objective Surveys

Students are encouraged to fill-out a brief survey on the fulfillment of course objectives. The data is reviewed by the concerned course faculty and the results are kept open for the entire faculty. Based on this, alterations or changes to the course objectives are undertaken by thorough discussions in faculty and DAC meetings.

v. Course Instructor's Evaluations

The course coordinator will collect the course portfolios from the respective instructors of each course offered in a given semester at the beginning of the semester as well as at the end of the semester. They remain on file for verification and study by the entire faculty. This helps the course coordinator and faculty to understand how effectively we can teach the given course. Betterment can be achieved from time to time and continuous improvement can be shown in handling courses in the subsequent semesters.

vi. Graduating Senior's Suvery

The graduating seniors survey form is to be filled by all the students leaving the institution. The questionnaire is designed in such away to gather information from the students regarding the program educational objectives, solicit about program experiences, carrier choices, as well as any suggestions and comments for the improvement of the program. The opinions expressed in exit interview forms are reviewed by the DAC for implementation purposes.

vii. Alumni Survey

The survey asks former students of the department about the status of their employment and further education, perceptions of institutional emphasis, estimated gains in knowledge and skills, involvement a sunder graduate students, and continuing involvement with Institute of Aeronautical Engineering. This survey is administered every three years. The data obtained will be analyzed and used in continuous improvement.

viii. Employer Survey

The main purpose of this employer questionnaire is to know employer's views about the skills they require of employees compared to the skills actually possessed by them. The purpose e is also to identify gaps in technical and vocational skills, need for required training practices to fill these gaps and criteria for hiring new employees. These employer surveys are reviewed by the College Academic Council (CAC) to affect the present curriculum to suit the requirement so the employer.

ix. Laboratory and Project Works

The laboratory work is continuously monitored and assessed to suit the present demands of the industry. Students are advised and guided to do project works giving solutions to research / industrial problems to the extent possible by the capabilities and limitations of the student. The results of the assessment of the individual projects and laboratory work can easily be conflated

in order to provide the students with periodic reviews of their overall progress and to produce terminal marks and grading.

x. Balanced Composition in Curriculum

The undergraduate program in aeronautical engineering is designed to prepare students for successful careers in engineering and related fields by providing a balanced education, that prepares students to apply analytical, computational, experimental, and methodological tools to solve engineering problems; a strong foundation in mathematics and physical sciences; abroad and balanced general education in the humanities, arts, social sciences, and interdisciplinary studies; sufficient training and development of skills for effective communication and teamwork; a proper understanding of an engineer's professional and ethical responsibilities in relation to engineering fields and society; and recognition of the need for lifelong learning. The student's intellectual and ethical development is assessed continuously in relation to the balanced composition in curriculum.

xi. Department Academic committee and Faculty meetings

The DAC meets bi-annually for every academic year to review the strategic planning and modification of PEOs. Faculty meetings are conducted at least once in fortnight for ensuring the implementation of DAC's suggestions and guidelines. All these proceeding are recorded and kept for the availability of all faculties.

xii. Professional Societies

The importance of professional societies like IEEE, IETE, ISTE etc., are explained to the students and they are encouraged to become members of the above to carry out their continuous search for knowledge. Student and faculty chapters of the above societies are constituted for a better technical and entrepreneurial environment. These professional societies promote excellence in instruction, research, public service and practice.

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 Dynamics techniques.
- 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 Dynamics techniques?
- 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 Who Why			Simplify Survey Take part in Test for Theme	Influence Interpret Judge Justify Mark Measure Opinion Perceive Prioritize Prove Rate Recommend Rule on Select Support Value	Improve Invent Make up Maximize Minimize Modify Original Originate Plan Predict Propose Solution Solve Suppose Test 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

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INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

AERONAUTICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**ENGINEERING MECHANICS**				
Course Code	AAEB01				
Programme	B.Tech				
Semester	II	AE			
Course Type	Foundation				
Regulation	IARE - R18				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	4	-	-
Chief Coordinator	Mr. S. Devaraj, Assistant Professor				
Course Faculty	Mr. T. Mahesh Kumar, Assistant Professor				

I. COURSE OVERVIEW:

The aim of Engineering Mechanics is to introduce students to the fundamental concepts and principles applied by engineers -whether civil, mechanical, aeronautical, etc. This course introduces the concepts of engineering based on forces in equilibrium. Topics include concentrated forces, distributed forces, forces due to friction, inertia, work –energy principle and vibrations as they apply to machines, structures, and systems. It is the branch of science for analyzing force systems that acts upon the bodies at either at rest or in motion.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites
-	-	-	Basic concepts of physics and mathematics

III. MARKS DISTRIBUTION

Subject	SEE Examination	CIA Examination	Total Marks
Engineering Mechanics	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

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

V. EVALUATION METHODOLOGY

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

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

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

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

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

Table 1: Assessment pattern for CIA

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

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

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

Alternative Assessment Tool (AAT)

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

The AAT chosen for this course is given in section XI.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminar
PO 3	**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.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

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

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Students should develop the ability to work comfortably with basic engineering mechanics concepts required for analyzing static structures.

II	Identify an appropriate structural system to studying a given problem and isolate it from its environment, model the problem using good free-body diagrams and accurate equilibrium equations
III	Understand the meaning of centre of gravity (mass)/centroid and moment of Inertia using integration methods and method of moments
IV	To solve the problem of equilibrium by using the principle of work and energy, impulse momentum and vibrations for preparing the students for higher level courses such as Mechanics of Solids, Mechanics of Fluids, Mechanical Design and Structural Analysis etc...

IX. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AAEB01.01	CLO 1	A basic understanding of the laws and principle of mechanics	PO 1	3
AAEB01.02	CLO 2	The ability to solve simple force system problems in mechanics	PO 2	2
AAEB01.03	CLO 3	Determine the resultant and apply conditions of static equilibrium to a plane force system	PO 1	3
AAEB01.04	CLO 4	Solve the problems of simple systems with the friction, calculate the linear moving bodies in general plane motion and applications of friction	PO 1	3
AAEB01.05	CLO 5	Analyze planer and spatial systems to determine the force in the members of truss and frames	PO 2	3
AAEB01.06	CLO 6	Solve the problems on different types of beams	PO 2	2
AAEB01.07	CLO 7	Obtain the centroid, center of gravity, first moment and second moment of area	PO 2	3
AAEB01.08	CLO 8	Understand the concept of virtual work and an ability to solve practical problems	PO 2	2
AAEB01.09	CLO 9	Understand the concepts of kinematics of the particles and rectilinear motion	PO 3	1
AAEB01.10	CLO 10	Explore knowledge & ability to solve various particle motion problems.	PO 3	1
AAEB01. 11	CLO 11	Derive the D' Alembert's principle and apply it to various field problems of kinetic motion.	PO 2	2
AAEB01. 12	CLO 12	Determine the impact, impulse and impulsive forces occurring in the system and able to solve the problems	PO 2	2
AAEB01. 13	CLO 13	Develop the work energy relations and apply to connected systems.	PO 1	2
AAEB01. 14	CLO 14	Understand the fixed axis rotation theory and solving the field problems by application of work energy method.	PO 3	2
AAEB01. 15	CLO 15	Introduction to concepts of vibration and explain the relation between simple harmonic motion and the equilibrium systems.	PO 1	3
AAEB01. 16	CLO 16	Derive the expressions for the concepts of simple, compound and torsional pendulums.	PO 1, PO 2	3
AAEB01. 17	CLO 17	Explore the use of modern engineering tools, software and equipment to prepare for competitive exams, higher studies etc.	PO 1,PO 2	3

3 = High; 2 = Medium; 1 = Low

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

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO 1	3												1			
CLO 2		2														
CLO 3	3												2			
CLO 4	3												1			
CLO 5		3														
CLO 6		2														
CLO 7		3														
CLO 8		2														
CLO 9			1													
CLO 10			1													
CLO 11		2											2			
CLO 12		2											2			
CLO 13	2															
CLO 14			2													
CLO 15	3															
CLO 16	3	2											1			
CLO 17	3	2											2			

3 = High; 2 = Medium; 1 = Low

XI. ASSESSMENT METHODOLOGIES – DIRECT

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

XII. ASSESSMENT METHODOLOGIES - INDIRECT

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

XIII. SYLLABUS

Module-I	INTRODUCTION TO ENGINEERING MECHANICS	Classes: 10
Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy		
Module-II	**FRICTION AND BASICS STRUCTURAL ANALYSIS**	**Classes: 09**
Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack; Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members;		

Beams &types of beams; Frames &Machines;		
Module-III	**CENTROID AND CENTRE OF GRAVITY AND VIRTUAL WORK AND ENERGY METHOD**	**Classes: 10**
Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere,Hook. Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.		
Module-IV	**PARTICLE DYNAMICS AND INTRODUCTION TO KINETICS**	**Classes: 08**
Particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton‟s 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique). Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems;		
Module-V	**MECHANICAL VIBRATIONS**	**Classes: 08**
Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;		
Text Books:		
1. Irving H. Shames (2006), “Engineering Mechanics”, Prentice Hall, 4th Edition,2013 2. F. P. Beer and E. R. Johnston (2011), “Vector Mechanics for Engineers”, Vol I - Statics, Vol II, – Dynamics, Tata McGraw Hill , 9th Edition,2013. 3. R. C. Hibbler (2006), “Engineering Mechanics: Principles of Statics and Dynamics”, Pearson Press.		
Reference Books:		
1. S.Bhavikatti,“ATextBookofEngineeringMechanics”,NewAgeInternational,1st Edition,2012 2. A.K.Tayal, “Engineering Mechanics”, Uma Publications, 14th Edition, 2013. 3. R. K. Bansal “Engineering Mechanics”, Laxmi Publication, 8thEdition, 2013.		

XIV. COURSE PLAN:

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

Lecture No	Topic/s to be covered	Course Learning Outcomes (CLOs)	Reference
1	Introduction to Engineering Mechanics	CLO 1	T2:5.5 R1:1.12.1
2	Basic Concepts- Force and types of forces	CLO 1	T2:5.6 R1:1.12.3
3	Laws of mechanics,Parallelogram laws of forces	CLO 1	T2:5.10 R1:1.15
4	Composition and resolution of forces	CLO 1	T2:5.15 R1:1.16
5	Problems on composition and resolution	CLO 3	T2:5.17 R1:1.13.1
6	Problems on concurrent forces	CLO 3	T2:5.18 R1:1.13.2
7	Composition of non-concurrent forces	CLO 3	T2:5.19 R1:1.13.3

8	Problems on non-concurrent forces	CLO 3	T2:5.20 R1:1.17.1
9	Composition of concurrent forces in space	CLO 2	T2:5.24 R1:1.17.3
10	Problems on concurrent forces in space	CLO 2	T2:6.1 R1:2.3
11	Moment concept, types of moments, Varginons principle	CLO 1	T2:6.3 R1:2.6.1
12	Moment couple, characteristics of couple, parallel like and unlike forces	CLO 1	T2:6.5 R1:2.6.2
13	Problems on moments	CLO 2	T2:7.3 R1:2.8
14	Problems on parallel like and unlike forces	CLO 2	T2:7.5,7.6 R1:2.9.2
15	Equilibrium and principles of equilibrium,Types of forces - Applied and non-Applied	CLO 2	T2:7.7 R1:2.10
16	Free body diagram, Lamis theorem statement and proof	CLO 1	T2:7.7 R1:2.10
17	Problems on Lamis theorem with strings	CLO 2	T2:7.11 R1:2.10.2
18	Problems on Lamis theorem with cylinders	CLO 2	T2:7.11 R1:2.32
19	Problems on equilibrium by using equilibrium equations	CLO 2	T2:15.2 R1:8.2
20	Problems on Rope by using equilibrium equations	CLO 2	T2:15.7 R1:8.3.3
21	Problems on concurrent force system in space	CLO 2	T2:15.13 R1:8.7.2
22	Introduction to friction,Theory of Friction, Angle of friction	CLO 4	T2:15.13 R1:8.7.2
23	Laws of Friction, Static and Dynamic Frictions	CLO 4	T2:15.16 R1:8.7.3
24	Derivation for Min and max force required to make the block equilibrium on inclined plane subjected to force parallel to plane	CLO 4	T1:11.9 R2:12.24
25	Derivation for Min and max force required to make the block equilibrium on inclined plane subjected to horizontal force	CLO 4	T1:11.9 R3:12.25
26	Derivation for Min and max force required to make the block equilibrium on inclined plane subjected to force inclined to plane	CLO 4	T1:3.2 R3:3.2
27	Problems on max and min force required to overcome the friction force	CLO 4	T1:3.3.1 R3:3.2
28	Problems on max and min force required to overcome the friction force	CLO 4	T2:16.5 R1:8.10
29	Problems on ladder	CLO 4	T2:16.9 R1:8.11.1
30	Problems on ladder	CLO 4	T2:16.9 R1:8.11.2
31	Problems on wedge	CLO 4	T2:16.8 R1:8.12.1
32	Problems on wedge	CLO 4	T2:16.8 R1:8.12.2
33	Problems on screw jack	CLO 4	T2:16.11 R1:8.14

34	Problems on screw jack	CLO 4	T2:16.11 R1:8.20
35	Problems on differential screw jack	CLO 4	T2:16.12 R1:8.19
36	Concept of method of joints and method of sections	CLO 5	T2:16.12 R1:8.77
37	Problems on method of joints	CLO 5	T2:1.2 R1:7.2
38	Problems on method of sections	CLO 5	T2:1.16 R1:7.7
39	Beams- types of beams, types of supports and types of loads	CLO 6	T2:1.20 R1:7.8
40	Analysis of beams finding the reactions	CLO 6	T2:1.20 R1:7.8
41	Introduction to Centroids and Centre of gravity	CLO 7	T2:2.1 R1:7.9.2
42	Problems on finding the centroid for simple figures	CLO 7	T2:2.2 R1:7.9.1
43	Problems on finding the centroid for simple figures	CLO 7	T2:2.3 R1:7.10
44	Problems on Centroids of Composite Figures	CLO 7	T2:2.4 R1:7.11
45	Problems on Centroids of Composite Figures	CLO 7	T2:2.5 R1:7.11.1
46	Derivation for parallel axis theorem and perpendicular axis theorem	CLO 7	T2:16.8 R1:8.12.1
47	Problems on parallel and perpendicular axis theorem	CLO 7	T2:16.8 R1:8.12.2
48	Problems on parallel and perpendicular axis theorem	CLO 7	T2:16.11 R1:8.14
49	Problems on parallel and perpendicular axis theorem	CLO 7	T2:16.8 R1:8.12.1
50	Derivethe equation for parallel and perpendicular axis theorems, finding surface areas and volumes of cone, sphere, etc	CLO 7	T2:5.17 R1:1.13.1
51	Moment of inertia, polar moment of inertia and radius of gyration	CLO 7	T2:5.18 R1:1.13.2
52	Problems on moment of inertia	CLO 7	T2:5.19 R1:1.13.3
53	Problems on moment of inertia	CLO 7	T2:5.20 R1:1.17.1
54	Problems on moment of inertia	CLO 7	T2:5.24 R1:1.17.3
55	Problems on polar moment of inertia and radius of gyration	CLO 7	T2:6.1 R1:2.3
56	Introduction to dynamics types of motions, equations of motion for uniform velocity, uniform acceleration, and variable acceleration.	CLO 9	T2:6.3 R1:2.6.1
57	Problems on rectilinear motion	CLO 9	T2:6.5 R1:2.6.2
58	Problems on rectilinear motion under gravity	CLO 9	T2:5.24 R1:1.17.3
59	Problems on rectilinear motion for variable acceleration	CLO 9	T2:6.1 R1:2.3
60	Curvilinear motion, 1 horizontal projection 2 inclined projection on level ground 3 inclined projection on	CLO 9	T2:6.3 R1:2.6.1

	different levels of ground		
61	Problems on inclined projection	CLO 9	T2:15.13 R1:8.7.2
62	Problems on inclined plane and point of projection and point of strike at different levels	CLO 8	T2:15.13 R1:8.7.2
63	Kinematics of rigid bodies	CLO 14	T2:15.16 R1:8.7.3
64	General plane motion concept ICR, problems on ICR	CLO 14	T1:11.9 R2:12.24
65	Problems on rigid body plane motion	CLO 10	T1:11.9 R3:12.25
66	Introduction to kinetics	CLO 10	T1:3.2 R3:3.2
67	Problems on rectilinear kinetics	CLO 11	T1:3.3.1 R3:3.2
68	Problems on rigid body kinetics	CLO 11	T2:16.5 R1:8.10
69	Problems on kinetics of centroidal rotation	CLO 11	T2:16.9 R1:8.11.1
70	Problems on general plane motion	CLO 12	T2:16.9 R1:8.11.2
71	Concept of work energy method	CLO 13	T2:15.13 R1:8.7.2
72	Problems on work energy method translation	CLO 13	T2:15.13 R1:8.7.2
73	Problems on work energy method rotation	CLO 13	T2:15.16 R1:8.7.3
74	Problems on work energy method plane motion	CLO 15	T1:11.9 R2:12.24
75	Introduction to vibration, simple harmonic motion	CLO 15	T1:11.9 R3:12.25
76	Problems on vibrations	CLO 16	T1:3.2 R3:3.2
77	Concept of simple pendulum, compound pendulum and torsional pendulum	CLO 17	T1:3.3.1 R3:3.2
78	Problems on simple, compound and torsional pendulum	CLO 16	T2:16.5 R1:8.10
79	Problems on simple, compound and torsional pendulum	CLO 16	T2:16.9 R1:8.11.1
80	Problems on simple, compound and torsional pendulum	CLO 16	T2:16.9 R1:8.11.2

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

S NO	DESCRIPTION	PROPOSED ACTIONS	RELEVANCE WITH POs	RELEVANCE WITH PSOs
1	To improve standards and analyze the concepts of Engineering mechanics.	Seminars	PO 1	PSO 1
2	To improve the aility of understanding the concept of centroids and center of gravity with some complex problems	Seminars / MOOC	PO 3	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2	PSO 1

Prepared by: Mr. S.Devaraj, Assistant Professor **HOD, AE**