School of Engineering and Technology
Aerospace Engineering

Year: BE B.Tech
Course: Aircraft Design

Semester: VII
Course Code: 17YAS701

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### Teaching Scheme

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<th>L</th>
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<th>Continuous Internal Assessment (CIA)</th>
<th>End Semester Examination</th>
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Max. Time, End Semester Exam (Theory) - NA
End Semester Exam (Lab) - 3Hrs.

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### Prerequisite

1. Aerodynamics  
2. Flight Dynamics  
3. Aerospace Structure  
4. Aerospace Propulsion

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### Course Objectives

1. Student will enhance his knowledge on implementation of computer based aircraft design methodologies.  
2. Student will learn design configuration of different aeroplane parts.  
3. Student will estimate the design process and sizing of aircraft.  
4. Student will calculate Lift and drag coefficient, design loads and component mass breakdown.  
5. Student will learn supersonic aircraft design concepts.  

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### Course Content

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Content</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to Aircraft Design: Three phases in aircraft design, computer based aircraft design methodologies, differences between LTA and HTA aircraft, type of civil and military aircraft.</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Configuration and Layout: Types and comparison of wing, tail, fuselage, landing gear, wing-tail combinations, power plant (types, numbers, locations), unconventional aircraft configurations.</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Sizing and Constraint Analysis: Initial sizing, estimation of design gross weight, rubber engine sizing and fixed engine sizing, refined sizing method and constraint analysis.</td>
<td>10</td>
</tr>
</tbody>
</table>
Estimation Methodologies: Lift and drag coefficient, design loads, component mass breakdown, acquisition cost, direct operating cost.

Operational and Environmental Issues: Range-payload diagram, V-n diagram, noise and emission levels, special considerations such as stealth, survivability, maintainability.

Advanced Concepts in Aircraft Design: Supersonic aircraft design, very large aircraft, morphing aircraft.

Course Outcome

Students should able to

CO1 Understand basic aircraft design methodologies

CO2 Evaluate the design parameters like and fixed engine sizing, refined sizing methods

CO3 Calculate Lift and drag coefficient, design loads, component mass breakdown

CO4 Understand the procedure of morphing aircraft

Recommended Resources

Text Books

Reference Books

E-Resources
Teaching Scheme

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</table>

Max. Time, End Semester Exam (Theory) - NA
End Semester Exam (Lab) - 3Hrs.

Prerequisite
1. Basic electronics

Course Objectives
1. To learn the concept of radio navigation systems
2. To study about the inertial sensors
3. To study satellite navigation & Hybrid navigation
4. To study longitudinal stability and to design the longitudinal autopilot
5. To learn about the approach and landing aids

Course Content

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Content</th>
<th>Hours</th>
</tr>
</thead>
</table>
| 1        | INERTIAL SENSORS
Gyroscopes-Mechanical-electromechanical-Ring Laser gyro- Fiber optic gyro, Accelerometers | 10    |
| 2        | INERTIAL NAVIGATION SYSTEMS - INS components: transfer function and errors-The earth in inertial space, the coriolis effect-Mechanisation. Platform and Strap down, INS system block diagram, Different co-ordinate systems, Schuler loop, compensation errors, Gimbal lock, Alignment. | 10    |
| 3        | RADIO NAVIGATION –
Different types of radio navigation- ADF, VOR/DME- Doppler –LORAN, DECCA and Omega - TACAN | 14    |
<p>| 4        | APPROACH AND LANDING AIDS - ILS, MLS, GLS - Ground controlled approach system - surveillance systems-radio altimeter, RNAV, Modern Navigation Aids. | 08    |</p>
<table>
<thead>
<tr>
<th>5</th>
<th>SATELLITE NAVIGATION &amp; HYBRID NAVIGATION - Introduction to GPS -system description -basic principles -position and velocity determination-signal structure-DGPS, Introduction to Kalman filtering-Estimation and mixed mode navigation-Integration of GPS and INS-utilization of navigation systems in aircraft.</th>
<th>08</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td><strong>50</strong></td>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

### Beyond the Syllabus

1. 
2. 

### Course Outcome

**Students should able to**

<table>
<thead>
<tr>
<th>CO1</th>
<th>Understand the working of integral sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Learn about the different types of radio navigation systems</td>
</tr>
<tr>
<td>CO3</td>
<td>Analyse satellite navigation &amp; hybrid navigation systems.</td>
</tr>
<tr>
<td>CO4</td>
<td>Designing ground controlled approach systems</td>
</tr>
</tbody>
</table>

### Recommended Resources

**Text Books**

**Reference Books**

**E-Resources**
School of Engineering and Technology  
Aerospace Engineering  

Year: BE B.Tech  
Semester: VII  
Course : Aerospace Computational Analysis  
Course Code: 17YAS703  

<table>
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Max. Time, End Semester Exam (Theory) - NA  
End Semester Exam (Lab) - 3Hrs.  

Prerequisite  
1. Numerical Methods  
2. Engineering Mathematics  

Course Objectives  
1. Understand the concept of CFD and its importance.  
2. Classify and understand the different PDE’s.  
3. Outline the types of discretization and various mesh types.  
4. Understand basic concept of FVM.  
5. Outline commonly used techniques in CFD.  

Course Content  

<table>
<thead>
<tr>
<th>Unit No.</th>
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<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Basic Aspects, Governing Equations and Physical Boundary Conditions of Computational Aerodynamics:</strong> Why Computational Fluid Dynamics? What is CFD? CFD as a research tool- as a design tool. Applications in various branches of engineering. - Models of fluid flow- Finite Control Volume, Infinitesimal Fluid Element. Substantial derivative- physical meaning of Divergence of velocity. Derivation of continuity, momentum and energy equations- physical boundary conditions- significance of conservation and non-conservation forms and their implication on CFD applications- strong and weak conservation forms- shock capturing and shock fitting approaches.</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td><strong>Mathematical Behavior of Partial Differential Equations and Their Impact on Computational Aerodynamics:</strong> Classification of quasi-linear partial differential equations by Cramer’s rule and eigen value method. General behaviour of different classes of partial differential</td>
<td>10</td>
</tr>
</tbody>
</table>
equations and their importance in understanding physical and CFD aspects of aerodynamic problems at different Mach numbers involving hyperbolic, parabolic and elliptic equations - domain of dependence and range of influence for hyperbolic equations. Well-posed problems.

### Basic Aspects of Discretization, Grid Types and Characteristics:

- Introduction to finite differences - finite difference approximation for first order, second order and mixed derivatives. Pros and cons of higher order difference schemes.

### Finite Volume Methods:


### CFD Techniques:

- Pressure correction technique - application to incompressible viscous flow - need for staggered grid. Philosophy of pressure correction method - pressure correction formula. Numerical procedures - SIMPLE, SIMPLER, SIMPLEC and PISO algorithms. Boundary conditions for the pressure correction method.

### Course Outcome

**Students should able to**

**CO1** Classify the quasilinear PDE’s as hyperbolic, elliptic or parabolic.

**CO2** Describe the different approaches used in Discretization and the usage of different mesh types.

**CO3** Outline the general concept of FVM.

**CO4** Explain the commonly used methods in CFD analysis.
### Recommended Resources

| **E-Resources** | 1.  
2.  
3. |
## Teaching Scheme (Hrs/Week)

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Max. Time, End Semester Exam (Theory) - NA

End Semester Exam (Lab) - 3Hrs.

## Prerequisite

1. Rocket Propulsion  
2. Aerospace Structure  
3. Flight Dynamics

## Course Objectives

1. Know the various systems of rocket, its functions and operations.  
2. Know the working principle and System in rockets.  
3. Understand the Aerodynamics of Rockets, Missiles and Airframe Components.  
4. Study the Rocket Motion in Free Space and Gravitational Field.  
5. Determination of range and Altitude Simple Approximations to Burnout Velocity.

## Course Content

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Content</th>
<th>Hours</th>
</tr>
</thead>
</table>
| 1        | ROCKETS SYSTEM  
Ignition System in rockets - types of Igniters - Igniter Design Considerations - Design Consideration of liquid Rocket Combustion Chamber, Injector Propellant Feed Lines, Valves, Propellant Tanks Outlet and Helium Pressurized and Turbine feed Systems - Propellant Slosh and Propellant Hammer, Elimination of Geysering Effect in Missiles - Combustion System of Solid Rockets. | 10 |
| 2        | AERODYNAMICS OF ROCKETS AND MISSILES  
Airframe Components of Rockets and Missiles - Forces Acting on a Missile While Passing Through Atmosphere - Classification of Missiles - methods of Describing Aerodynamic Forces and Moments Lateral Aerodynamic Moment - Lateral Damping Moment and Longitudinal Moment of a Rocket - lift and Drag Forces - Drag Estimation - Body Up wash and Downwash in Missiles - Rocket Dispersion Numerical Problems. | 15 |
### Course Outcome

**Students should able to**

| CO1 | Design Consideration of liquid Rocket Combustion Chamber |
| CO2 | Igniter Design Considerations and types of igniters. Describe the drag and lift forces acting on rocket and missile. |
| CO3 | The various methods of Describing Aerodynamic Forces and Moments. Lateral Damping Moment and Longitudinal Moment of a Rocket. |
| CO4 | The One Dimensional and Two Dimensional rocket Motions in Free Space and Homogeneous Gravitational Fields. |
| CO5 | The description of Vertical and Inclined and Gravity Turn Trajectories. It will give the various methods of thrust determinations and thrust vector control. It will also describe the rocket's Separation Techniques. |

### Recommended Resources

<table>
<thead>
<tr>
<th>Text Books</th>
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<table>
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<tr>
<th>Reference Books</th>
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### Beyond the Syllabus

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4.
School of Engineering and Technology
Aerospace Engineering

Year: TE B.Tech
Course: Composite Material
Semester: VII
Course Code: 17YASE02

Teaching Scheme (Hrs/Week) | Continuous Internal Assessment (CIA) | End Semester Examination | Total
--- | --- | --- | ---
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Max. Time, End Semester Exam (Theory) - NA | End Semester Exam (Lab) - 3Hrs.

Prerequisite
1. Mechanics of Solids
2. Aerospace Structure
3. Engineering Mathematics

Course Objectives
1. Know the types of composites.
2. Understand the need for stress strain relation.
3. Understand the fabrication methods.
4. Understand the laminated plate.
5. Study and understand the different methods & analysis of composite materials.

Course Content

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Content</th>
<th>Hours</th>
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</table>
| 1 | STRESS STRAIN RELATION
Introduction- Advantages and application of composite materials, reinforcements and matrices - Generalised Hooke's Law - Elastic constants for anisotropic, orthotropic and isotropic materials. | 10 |
| 2 | METHODS OF ANALYSIS
Micro mechanics - Mechanics of materials approach, elasticity approach to determine material properties - Macro Mechanics - Stress-strain relations with respect to natural axis, arbitrary axis - Determination of material properties. Experimental characterization of lamina. | 15 |
| 3 | LAMINATED PLATES
Governing differential equation for a general laminate, angle ply and cross ply laminates. Failure criteria for composites. | 10 |
4. SANDWICH CONSTRUCTIONS
Basic design concepts of sandwich construction - Materials used for sandwich construction - Failure modes of sandwich panels.

5. FABRICATION PROCESS
Various Open and closed mould processes. Manufacture of fibers - Types of resins and properties and applications - Netting analysis

Total 50

Beyond the Syllabus
1.
2.

Course Outcome
Students should able to

CO1 Analysis of composite structures
CO2 Do microscopic and macroscopic analysis
CO3 Analyze sandwich and laminated plates
CO4 Understand fabrication techniques
CO5 Construct and analysis different composite technique

Recommended Resources

Text Books

Reference Books

E-Resources
School of Engineering and Technology
Aerospace Engineering

Year: TE B.Tech
Course : Unmanned Aerial Vehicle
Semester: VII
Course Code: 17YASE03

<table>
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**Max. Time, End Semester Exam (Theory) - NA**
End Semester Exam (Lab) - 3Hrs.

**Prerequisite**
1. Basic electronics and avionics

**Course Objectives**

1. To introduce the concept of UAV and its applications.
2. Explain the various aspects of UAV.
3. Understand modelling and control of helicopter models.
4. Explain the concept of UAV design, modelling and control.
5. Understand application based deployment of UAV systems.

**Course Content**

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Content</th>
<th>Hours</th>
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</thead>
</table>
| 1        | INTRODUCTION TO UAS
History of unmanned aerial vehicles- types- Introduction to Unmanned aircraft systems-Unmanned aerial vehicles –Micro aerial vehicles definitions, history, classification- applications-recent research and development in civil and defence applications – autonomous vehicles -future research in autonomous vehicles – design standards and regulatory aspects introduction to design and selection of systems | 10    |
| 2        | ASPECTS OF UAS SYSTEMS
Involvement of different aspects in the development of UAV-aerodynamic configurations -Aspects of airframe design- Stealth design, payload types, communication, navigations & guidance systems, control & stability, launch, recovery and support systems, reliability design | 10    |
| 3        | MODELING AND CONTROL HELICOPTER MODEL
Modelling and control of small and miniature unmanned helicopters –single rotor helicopter design – coaxial rotor helicopter design - autonomous control of a mini quad rotor vehicle using LQG controllers – linearization | 10    |
and identification of helicopter model.

| 4 | **UAV DESIGN MODELING & CONTROL**  
Development of autonomous quad tilt wing – advanced flight control systems for rotorcraft UAV and MAV – mathematical modelling and nonlinear control of VTOL aerial vehicles | 10 |
|---|---|---|
| 5 | **DEPLOYMENT OF UAS/UAV SYSTEMS**  
Only application point of view of various UAS roles played in civil, defense applications -vision based navigation company trails- certification of UAS/UAV/MAV systems | 10 |

**Total**  50

**Beyond the Syllabus**
1. 
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**Course Outcome**

**Students should able to**

| **CO1** | Elucidate the various aspects related to UAV’s. |
| **CO2** | Explain the modelling and control parameters associated with helicopter models. |
| **CO3** | Outline the modelling and design aspects related to UAV’s. |
| **CO4** | Describe the deployment of UAV systems in various functional areas. |

**Recommended Resources**

**Text Books**

**Reference Books**

**E-Resources**
School of Engineering and Technology
Aerospace Engineering

Year: TE B.Tech  
Course: Operation Research  
Semester: VII  
Course Code: 17YASE04

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Max. Time, End Semester Exam (Theory) - NA  
End Semester Exam (Lab) - 3Hrs.

Prerequisite  
1.

Course Objectives
1. Students will calculate optimal solution variants of assignment problem.
2. Students will apply sequencing and replacement procedures
3. Students will apply the game theory
4. Students will learn the applications of finite and infinite population
5. Students will learn different type of simulation models

Course Content

<table>
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<tr>
<th>Unit No.</th>
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</table>
| 1        | **Allocation:** Linear Programming Problem Formulation – Graphical solution  
Simple method – Artificial variables techniques: Two–phase method, Big-M method. | 08 |
| 2        | **Transportation Problem** – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.  
**Assignment problem** – Formulation – Optimal solution - Variants of Assignment Problem- Traveling Salesman problem. | 10 |
| 3        | **Sequencing** – Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through ‘m’ machines  
**Replacement:** Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement. | 10 |
### Theory of Games
Introduction – Terminology – Solution of games with saddle points and without saddle points - 2 x 2 games – dominance principle – m x 2 & 2 x n games - graphical method.

### Inventory
Introduction – Single item, Deterministic models – Purchase inventory models with one price break and multiple price breaks – Stochastic models – demand may be discrete variable or continuous variable – Single Period model and no setup cost.

### Waiting Lines
Introduction – Terminology - Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models – Multichannel – Poisson arrivals and exponential service times with infinite population.


### Simulation
Introduction, Definition, types of simulation models, Steps involved in the simulation process - Advantages and disadvantages - applications of simulation to queuing and inventory.

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### Beyond the Syllabus
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### Course Outcome

Students should able to

<table>
<thead>
<tr>
<th>CO1</th>
<th>Summerize the importance of operational research</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Estimate transportation and assignment problem</td>
</tr>
<tr>
<td>CO3</td>
<td>Calculate replacement of items that deteriorate with time</td>
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<tr>
<td>CO4</td>
<td>Distinguish different aspects of game theory and inventory control</td>
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<tr>
<td>CO5</td>
<td>Categorise different types of simulation models</td>
</tr>
</tbody>
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### Recommended Resources

#### Text Books
1. Operations Research /J.K.Sharma 4e. /MacMilan
2. Introduction to O.R/Hillier & Libermann/TMH
3. Introduction to O.R /Taha/PHI

#### Reference Books
<table>
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<th>Resources</th>
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<tr>
<td><strong>E-Resources</strong></td>
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</tbody>
</table>
Year: TE B.Tech                                      Semester: VII
Course : Automatic Control System                  Course Code: 17YASA07

Teaching Scheme                                      Continuous Internal Assessment (CIA)                                      End Semester Examination                                      Total
(Hrs/Week)                                          CIA-1     CIA-2     CIA-3     CIA-4     Lab     Theory     Lab
L         T         P     C   CIA-1     CIA-2     CIA-3     CIA-4     Lab     Theory     Lab
0         0         0     0   0         0         0         0         0     0         0

Max. Time, End Semester Exam (Theory) - NA
End Semester Exam (Lab) - 3Hrs.

Prerequisite
1.

Course Objectives
1. At the conclusion of this course, the students will be able to: Describe the transfer functions for automatic control systems; open-loop and closed-loop systems.
2. Describe the various time domain and frequency domain tools for analysis and design of linear control systems.
3. Describe the methods to analyze the stability of systems from transfer function forms.
4. Describe the methods to analyze the stability of systems from transfer function forms.
5. Describe the methods to analyze the sampled-data control systems.

Course Content

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<th>Content</th>
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<tbody>
<tr>
<td>1</td>
<td>INTRODUCTION TO AUTOMATIC CONTROL SYSTEMS: Historical review, Examples of control systems: simple pneumatic, hydraulic and thermal systems, series and parallel systems, analogies, mechanical and electrical components.</td>
<td>10</td>
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<tr>
<td>2</td>
<td>OPEN AND CLOSED LOOP SYSTEMS: Closed loop control versus open loop control, Feedback control systems, Block diagram representation of control systems, reduction of block diagrams, Output to input ratios.</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>TRANSIENT AND STEADY-STATE RESPONSE ANALYSIS: Laplace transformation, Response of systems to different inputs viz. Step, impulse, pulse, parabolic and sinusoidal inputs, Time response of first and second order systems, steady state errors and error constants of unity feedback circuit.</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>STABILITY ANALYSIS: Stability definitions, characteristic equation, location of roots in the s-plane for stability, Routh-Hurwitz criteria of stability, Root locus and Bode techniques, concept and construction, frequency response.</td>
<td>10</td>
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<td>5</td>
<td>SAMPLED DATA CONTROL SYSTEMS: Sampled data control systems - functional elements - sampling process - z transforms - properties - inverse z-transforms - response between samples modified z-transforms - ZOH and First order Hold process - mapping between s and z planes - pulse transfer functions - step response - stability analysis Jury’s stability test.</td>
<td>10</td>
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**Beyond the Syllabus**

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**Course Outcome**

 Students should able to

CO1

CO2

CO3

CO4

CO5

**Recommended Resources**

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<td>E-Resources</td>
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School of Engineering and Technology
Aerospace Engineering

Year: TE B.Tech  Semester: VII
Course: Introduction to NDT  Course Code: 17YASA08

<table>
<thead>
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<th>Teaching Scheme (Hrs/Week)</th>
<th>Continuous Internal Assessment (CIA)</th>
<th>End Semester Examination</th>
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Max. Time, End Semester Exam (Theory) - NA  End Semester Exam (Lab) - 3Hrs.

Prerequisite
1. 

Course Objectives
1. Study the basics of NDT, its history and applications.
2. Study the process of various visual testing techniques used in NDT.
3. Study the process of radiographic testing and its applications.
4. Study the process of ultrasonic testing and its applications.
5. Study the other methods used in NDT technique.

Course Content

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Content</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to NDT, concern in NDT, History, NDT vs. Destructive, Conditions for NDT, Personal Considerations, Certification, Primary production of metal, castings, cracks, welding discontinuities, corrosion induced discontinuities, fatigue cracking, creep, brittle fracture, geometric discontinuities.</td>
<td>10</td>
</tr>
</tbody>
</table>
### Course Outcome

**Students should able to**

| CO1 | Understand the background of NDT and its applications. |
| CO2 | Understand the different methods of visual testing and their advantages. |
| CO3 | Understand the technique of radiographic testing and its equipments. |
| CO4 | Understand the technique of ultrasonic testing and its equipments |
| CO5 | Understand other different method used in NDT. |

### Beyond the Syllabus

1. 
2. 

### Recommended Resources

**Text Books**

P. E. Mix, "Introduction to non-destructive testing", Wiley Interscience,, John Wiley & Sons, Inc, Publ., 2005

**Reference Books**


**E-Resources**
School of Engineering and Technology
Aerospace Engineering

Year: TE B.Tech  
Course: Combustion Engineering  
Semester: VII  
Course Code: 17YASA09

<table>
<thead>
<tr>
<th>Teaching Scheme (Hrs/Week)</th>
<th>Continuous Internal Assessment (CIA)</th>
<th>End Semester Examination</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
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<td>T</td>
<td>P</td>
<td>C</td>
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</tbody>
</table>

Max. Time, End Semester Exam (Theory) - NA  
End Semester Exam (Lab) - 3Hrs.

Prerequisite  
1. 

Course Objectives

1. Concepts in combustion  
2. To make combustion calculations  
3. To know supersonic combustion  
4. To understand the Combustion in rockets  
5. To learn the Supersonic combustion

Course Content

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Content</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FUNDAMENTAL CONCEPTS IN COMBUSTION : Thermo - chemical equations - Heat of reaction first order, second order and third order reactions — premixed flames - Diffusion flames</td>
<td>10</td>
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<tr>
<td>2</td>
<td>CHEMICAL KINETICS AND FLAMES : Measurement of burning velocity - Various methods - Effect of various parameters on burning velocity - Flame stability - Detonation - Deflagration Rankine – Hugoniot curve - Radiation by flames.</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>-COMBUSTION IN GAS TURBINE ENGINES : Combustion in gas turbine combustion chambers - Re-circulation – Combustion efficiency - Factors affecting combustion efficiency - Fuels used for gas turbine combustion chambers - Combustion stability - Flame holder types – Numerical problems.</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>COMBUSTION IN ROCKETS : Solid propellant combustion - Double base and composite propellant combustion - Various combustion models - Combustion in liquid rocket engines - Single fuel droplet combustion model - Combustion in hybrid rockets.</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>SUPersonic combustion controlled by mixing, diffusion and heat convection - Analysis of reaction and mixing processes - Supersonic burning with detonation shocks.</td>
<td>10</td>
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<tr>
<td>---</td>
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<tr>
<td><strong>Total</strong></td>
<td>50</td>
<td></td>
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</tbody>
</table>

**Beyond the Syllabus**
1. 
2. 

**Course Outcome**

**Students should be able to**

- **CO1**
- **CO2**
- **CO3**
- **CO4**
- **CO5**

**Recommended Resources**

**Text Books**

**Reference Books**

**E-Resources**