

Hall Ticket No

Question Paper Code: AAE506



**INSTITUTE OF AERONAUTICAL ENGINEERING**  
**(Autonomous)**  
**Dundigal, Hyderabad - 500 043**

**MODEL QUESTION PAPER-II**

B.Tech VII Semester End Examinations, November/December – 2019

**Regulations: IARE - R16**

**UNMANNED AIR VEHICLES**  
**(AERONAUTICAL ENGINEERING)**

**Time: 3 hours**

**Max. Marks: 70**

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

**UNIT – I**

1. a) Write short notes on categories of systems based upon air vehicle types. [7M]  
b) Write short notes on the following design consideration of UAS [7M]
  - i) Air vehicle selection based speed
  - ii) Environmental conditions
2. a) Write short notes on the importance of 'Interface' between the sub-systems and with the other systems of UAS. [7M]  
b) Write short notes on 'payload consideration' for design of UAS. [7M]

**UNIT – II**

3. a) What is 'Parasitic Drag', discuss in detail? [7M]  
b) Explain 'Rotary-wing Aerodynamics'. [7M]
4. a) What are two main causes for an aircraft to have a high response to atmospheric turbulence, discuss by considering wing loading? [7M]  
b) Discuss aerodynamics of UAVs with respect to packaging density and scaling effects. [7M]

**UNIT – III**

5. a) Discuss (i) Low aerodynamic drag, (ii) High disposable load fraction, and (iii) Power-plant Selection for Long-endurance, Long-range Role UAV designer. [7M]  
b) Compare MALE and HALE UAVs. [7M]
6. a) Explain Close-range/ Battlefield Non- VTOL aircraft systems with necessary diagrams. [7M]  
b) Write about MUAV's technologies. [7M]

#### **UNIT – IV**

7. a) Discuss the different communication media between UAV and control station. [7M]  
b) Explain radio frequency band designations and radio/microwave frequency allocation. [7M]
8. a) Discuss 'Vulnerability' of UAV system and possible measures to reduce it. [7M]  
b) Explain NAVSTAR GPS mentioning different types and detailed services. [7M]

#### **UNIT – V**

9. a) Explain HTOL spatially stabilized configuration using AFCS. [7M]  
b) Discuss the control and stability aspects of Coaxial-rotor Helicopter with necessary AFCS. [7M]
10. a) How the control and stability can be achieved for SMR helicopter, explain with necessary diagrams and examples. [7M]  
b) Discuss briefly the payload control in UAS [7M]



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**COURSE OBJECTIVES:**

<b>The course should enable the students to:</b>	
I	Introduce to the student about the basic ideas of Unmanned Air Vehicles
II	Familiarize the students about the aerodynamics and airframe configurations
III	Accustom the student to the wide variety of unmanned air vehicles
IV	Acquaint the student about the various communication and navigation systems of unmanned air vehicles

**COURSE OUTCOMES (COs):**

CO 1	Describe the concept of UAS-system composition and design concepts with some applications of UAS
CO 2	Understand the concept of aerodynamics, airframe configurations, structures, mechanisms, selection of power-plants, modular construction and ancillary equipment
CO 3	Explore the concept of Long-endurance, long range, Medium-range, tactical aircraft and aircraft configurations
CO 4	Describe the concept of communications, Mid-air collision avoidance, communications data rate and bandwidth usage Inertial Navigation - Radio Tracking - Way-point Navigation
CO 5	Understand the concept of convertible rotor aircraft payload control, culmion filter and autonomy

**COURSE LEARNING OUTCOMES (CLOs):**

AAE506.01	Understand the unmanned aerial vehicle types based on the design and application
AAE506.02	Understand different elements of UAS (composition) and their importance.
AAE506.03	Describe the design concepts of UAS
AAE506.04	Apply the knowledge of selection of the system
AAE506.05	Understand the different types of drags for UAVs.
AAE506.06	Describe the range of airframe configurations available for UAVs
AAE506.07	Remember the aerodynamic efficiency factors
AAE506.08	Analyze the structures and mechanical design factors in the design of UAVs
AAE506.09	Understand the design of a UAS-based flight mission.
AAE506.10	Apply the knowledge of different types of power-plants in selection.
AAE506.11	Recognize and recommend potential airframe for long-endurance long-range UAVs

AAE506.12	Apply acquired knowledge and critical thinking skills to select airframe for medium-range, tactical aircraft
AAE506.13	Understand the MUAV types
AAE506.14	Analyze the different types of MAV, NAV and UCAV
AAE506.15	Understand the novel hybrid aircraft configurations and UAVs for Research purpose
AAE506.16	Understand the communication media and radio communication between GCS and aircraft
AAE506.17	Apply the knowledge of regulations to avoid mid-air collision
AAE506.18	Understand the technology of communication data rate and bandwidth usage
AAE506.19	Apply knowledge of GPS
AAE506.20	Identify the different navigation systems and tracking
AAE506.21	Understand the issues and challenges of control and stability of different types of UAVs
AAE506.22	Apply the knowledge of payload control
AAE506.23	Ability to understand the role of different sensors and autonomy in control and stability of UAV systems

### MAPPING OF SEMESTER END EXAMINATION TO COURSE OUTCOMES

SEE Question No.		Course Learning Outcomes	Course Outcomes	Blooms' Taxonomy Level	
1	a	AAE506.02	Understand different elements of UAS (composition) and their importance.	CO 1	Remember
	b	AAE506.01	Understand the unmanned aerial vehicle types based on the design and application	CO 1	Understand
2	a	AAE506.03	Describe the design concepts of UAS	CO 1	Remember
	b	AAE506.02	Understand different elements of UAS (composition) and their importance.	CO 1	Understand
3	a	AAE506.05	Understand the different types of drags for UAVs.	CO 2	Understand
	b	AAE506.05	Understand the different types of drags for UAVs.	CO 2	Understand
4	a	AAE506.06	Describe the range of airframe configurations available for UAVs	CO 2	Remember
	b	AAE506.06	Describe the range of airframe configurations available for UAVs	CO 2	Understand
5	a	AAE506.11	Recognize and recommend potential airframe for long-endurance long-range UAVs	CO 3	Understand
	b	AAE506.12	Apply acquired knowledge and critical thinking skills to select airframe for medium-range, tactical aircraft	CO 3	Understand
6	a	AAE506.12	Apply acquired knowledge and critical thinking skills to select airframe for medium-range, tactical aircraft	CO 3	Understand
	b	AAE506.15	Understand the novel hybrid aircraft configurations and UAVs for Research purpose	CO 3	Understand

7	a	AAE506.16	Understand the communication media and radio communication between GCS and aircraft	CO 4	Remember
	b	AAE506.16	Understand the communication media and radio communication between GCS and aircraft	CO 4	Understand
8	a	AAE506.18	Understand the technology of communication data rate and bandwidth usage	CO 4	Remember
	b	AAE506.18	Understand the technology of communication data rate and bandwidth usage	CO 4	Understand
9	a	AAE506.21	Understand the issues and challenges of control and stability of different types of UAVs	CO 5	Remember
	b	AAE506.21	Understand the issues and challenges of control and stability of different types of UAVs	CO 5	Understand
10	a	AAE506.21	Understand the issues and challenges of control and stability of different types of UAVs	CO 5	Remember
	b	AAE506.21	Understand the issues and challenges of control and stability of different types of UAVs	CO 5	Understand

**Signature of Course Coordinator**

**HOD, AE**