



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

## AERONAUTICAL ENGINEERING

### TUTORIAL QUESTION BANK

Course Title	UNMANNED AIR VEHICLES				
Course Code	AAE506				
Programme	B.Tech				
Semester	VII	AE			
Course Type	Professional Elective				
Regulation	IARE - R16				
Course Structure	Theory			Practical	
	Lectures	Tutorials	Credits	Laboratory	Credits
	3	-	3	-	-
Chief Coordinator	Dr. Praveen Kumar Balguri, Associate Professor				
Course Faculty	Dr. Praveen Kumar Balguri, Associate Professor				

#### COURSE OBJECTIVES:

The course should enable the students to:	
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, culmon 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	Understandthe 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

## TUTORIAL QUESTION BANK

<b>UNIT-I</b>				
<b>INTRODUCTION TO UNMANNED AIRCRAFT SYSTEMS</b>				
<b>Part - A (Short Answer Questions)</b>				
<b>S No</b>	<b>QUESTIONS</b>	<b>Blooms Taxonomy Level</b>	<b>Course Outcomes</b>	<b>Course Learning Outcomes (CLOs)</b>
1	What are UAS? Give two applications of UAS.	Remember	CO 1	AAE506.01
2	What is HALE? Give two applications with an example.	Understand	CO 1	AAE506.01
3	Define MALE? Give two applications with an example.	Remember	CO 1	AAE506.01
4	Differentiate RC Model aircraft and Drones.	Remember	CO 1	AAE506.01
5	Differentiate Drones and UAV	Understand	CO 1	AAE506.01
6	Define TUAV? Give two applications with an example.	Remember	CO 1	AAE506.02
7	What is MUAV? Give two applications with an example.	Remember	CO 1	AAE506.03
8	Define MAV? Give two applications with an example.	Remember	CO 1	AAE506.02
9	What is NAV? Give two applications with an example.	Understand	CO 1	AAE506.03
10	What is RPH?	Understand	CO 1	AAE506.02
11	Differentiate UCAV and UCAR?	Understand	CO 1	AAE506.03
12	What are DDD roles?	Remember	CO 1	AAE506.04
13	List the elements of UAS?	Understand	CO 1	AAE506.04
14	Define Radar tracking?	Understand	CO 1	AAE506.04
15	What is Radio tracking?	Remember	CO 1	AAE506.04
16	What are covert roles? Give examples of suitable UAVs for covert roles.	Understand	CO 1	AAE506.03
17	What is the purpose of 'Up-link'?	Remember	CO 1	AAE506.04
18	What is the purpose of 'Down-link'?	Understand	CO 1	AAE506.04
19	What are GCS, SCS and ACS?	Understand	CO 1	AAE506.04
20	What are factors involved in the selection of the airframe?	Remember	CO 1	AAE506.04
<b>Part - B (Long Answer Questions)</b>				
1	Write short notes on categories of systems based upon air vehicle types.	Remember	CO 1	AAE506.01
2	Why do we need UAS? Discuss in detail.	Understand	CO 1	AAE506.01
3	Draw the functional structure of AV system and discuss the control station and payload.	Remember	CO 1	AAE506.01
4	Discuss about the ' Air vehicle' in UAV system functional structure ( system composition)	Remember	CO 1	AAE506.01
5	Write short notes on launch, recovery and retrieval equipment for UAVs as a part of UAVs system functional structure.	Understand	CO 1	AAE506.01

6	Discuss the important parameters involved in 'Selection of Systems' for UAS.	Remember	CO 1	AAE506.02
7	Describe the conceptual phase of design of UAS.	Remember	CO 1	AAE506.03
8	Discuss the preliminary design and detailed design phases of UAVs.	Remember	CO 1	AAE506.02
9	Describe the applications of UAS for civilian and military uses.	Understand	CO 1	AAE506.03
10	Write short notes on the following design consideration of UAS i) Air vehicle selection based speed ii) Environmental conditions	Understand	CO 1	AAE506.02
11	Discuss 'Navigation Systems' and 'Communication Systems' of UAS	Remember	CO 1	AAE506.03
12	Discuss the UAV system selection as categories	Understand	CO 1	AAE506.04
13	Write short notes on the importance of 'Interface' between the sub-systems and with the other systems of UAS.	Remember	CO 1	AAE506.04
14	Write short notes on 'payload consideration' for design of UAS.	Remember	CO 1	AAE506.04
15	Discuss the importance of considering environmental conditions during the selection of UAS system	Understand	CO 1	AAE506.04

**Part – C ( Critical Thinking Questions)**

1	How UAVs can be categorized based on altitude, range, mass and wing span?	Analyze	CO 1	AAE506.01
2	What are different roles where UAVs can perform better than manned aircrafts, discuss them in detail?	Analyze	CO 1	AAE506.01
3	How UAVs can be better economically compared with manned aircrafts, discuss with respect to initial cost and operating costs?	Evaluate	CO 1	AAE506.01
4	What are different types of control stations and the roles of CS in UAS operation?	Remember	CO 1	AAE506.01
5	How the payload and the air vehicle affects the UAS?	Evaluate	CO 1	AAE506.01
6	What are different means of navigation (or fall-back options) when GPS system is blocked?	Remember	CO 1	AAE506.02
7	What are the functions of up-link and down-link?	Remember	CO 1	AAE506.03
8	How important the interfaces between UAS system components and other systems, discuss briefly?	Remember	CO 1	AAE506.02
9	How the design of most aircraft based systems begin, discuss the different phases?	Remember	CO 1	AAE506.03
10	Why should environmental conditions to be considered during the selection of UAS system?	Understand	CO 1	AAE506.02

**UNIT-II**

**AERODYNAMICS AND AIRFRAME CONFIGURATIONS**

**Part - A (Short Answer Questions)**

1	Define 'Lift induced drag'	Remember	CO 2	AAE506.05
2	How do you calculate the lift induced drag for fixed wing aircraft? Mention the variables involved.	Remember	CO 2	AAE506.05

3	What are the components of the lift induced drag? How do they affect lift induced drag?	Understand	CO 2	AAE506.05
4	Define 'Parasitic drag'?	Understand	CO 2	AAE506.05
5	How do you calculate the parasitic drag coefficient? Mention the variables involved.	Remember	CO 2	AAE506.05
6	How can be parasitic drag estimated for any level flight condition? Mention the variables involved.	Remember	CO 2	AAE506.05
7	What are the components of the parasitic drag? How do they affect lift induced drag?	Remember	CO 2	AAE506.05
8	What is the expression for parasitic drag when the aircraft is operated at high incidence? Mention the variables involved.	Remember	CO 2	AAE506.05
9	Define 'absolute minimum flight speed'	Understand	CO 2	AAE506.05
10	Give the expression to calculate $V_{min}$ for a fixed wing aircraft? Mention the variables involved.	Remember	CO 2	AAE506.06
11	How do you calculate $V_{min}$ for a UAV with flaps?	Remember	CO 2	AAE506.06
12	Define disc loading for a rotary wing?	Understand	CO 2	AAE506.07
13	List few HTOL aircraft configurations	Remember	CO 2	AAE506.07
14	Give the names of few VTOL configurations	Understand	CO 2	AAE506.07
15	What are the few hybrid aircraft configurations?	Understand	CO 2	AAE506.09
16	Comment on how minimum flight speed and wing loading are varying at sea level and at 15000 m altitude?	Understand	CO 2	AAE506.05
17	How $V_{min}$ and wing loading varies for MAVs?	Remember	CO 2	AAE506.06
18	How induced drag can be calculated by for the helicopter At a forward speed of about 70 km/hr? Mention the variables.	Remember	CO 2	AAE506.06
19	How profile power can be calculated In hover flight? Mention the variables.	Understand	CO 2	AAE506.07
20	How can be the vertical acceleration in response to a 1 m/s vertical gust calculated? Mention the variables.	Remember	CO 2	AAE506.07
<b>Part - B (Long Answer Questions)</b>				
1	Discuss the 'Lift Induced Drag' in detail with necessary diagrams.	Remember	CO 2	AAE506.05
2	Write notes on the calculation of lift induced drag?	Remember	CO 2	AAE506.05
3	What is 'Parasitic Drag', discuss in detail?	Understand	CO 2	AAE506.05
4	Explain 'Rotary-wing Aerodynamics'.	Understand	CO 2	AAE506.05
5	How does UAVs respond to air turbulence?	Remember	CO 2	AAE506.05
6	Discuss on wing loading of various UAVs.	Remember	CO 2	AAE506.05
7	Write notes on 'Different HTOL Airframe Configurations'.	Remember	CO 2	AAE506.05
8	Discuss 'Different VTOL Airframe Configurations'.	Remember	CO 2	AAE506.05
9	Discuss 'Coaxial Rotor' airframe with necessary diagram.	Understand	CO 2	AAE506.05
10	Write short notes on 'Convertible Rotor Aircraft' and 'Tilt-wing-body Aircraft'.	Remember	CO 2	AAE506.06
11	Explain 'Ducted Fan Aircraft' and 'Jet-life Aircraft' airframe configurations.	Remember	CO 2	AAE506.06

12	Write notes on 'Scale Effects' with necessary diagrams.	Understand	CO 2	AAE506.07
13	What is 'Packaging Density', discuss in detail with respect to UAVs?	Remember	CO 2	AAE506.07
14	Explain in detail the 'Undercarriage Design'.	Understand	CO 2	AAE506.07
15	Write short notes on 'Structure Design' of UAVs with necessary diagrams.	Understand	CO 2	AAE506.09
16	Discuss 'Mechanical Design' and 'Wear and Fatigue' of UAVs.	Remember	CO 2	AAE506.05
17	Write short notes on 'Piston engines' for UAVs.	Remember	CO 2	AAE506.05
18	Discuss the importance points in selection of power-plants for UAVs with the help of power-generation systems.	Understand	CO 2	AAE506.05
19	Discuss the gas turbine engines for UAVs.	Understand	CO 2	AAE506.05
20	Explain the role of electric motors for UAVs.	Remember	CO 2	AAE506.05

**Part – C (Critical Thinking Questions)**

1	How does airspeed, wing loading and drag are related? Discuss with necessary diagrams	Remember	CO 2	AAE506.05
2	How does drag of rotary wing aerodynamics are different from fixed wing aerodynamics?	Remember	CO 2	AAE506.05
3	What are two main causes for an aircraft to have a high response to atmospheric turbulence, discuss by considering wing loading?	Understand	CO 2	AAE506.05
4	Explain the importance of 'Airframe configuration' in design of UAVs?	Understand	CO 2	AAE506.05
5	How does 'Hybrid Airframe Configurations' perform?	Remember	CO 2	AAE506.05
6	Discuss airframe design of UAVs with respect to packaging density and scaling effects	Remember	CO 2	AAE506.05
7	Explain the importance of structures and mechanisms by taking AUM of aircraft in to consideration	Remember	CO 2	AAE506.05
8	Explain the importance of undercarriage for UAVs and discuss the design parameters.	Remember	CO 2	AAE506.05
9	Discuss the importance points in selection of power-plants for UAVs with the help of power-generation systems.	Understand	CO 2	AAE506.05
10	How modular construction concept does helps in the design of UAVs.	Remember	CO 2	AAE506.06

**UNIT-III**

**CHARACTERISTICS OF AIRCRAFT TYPES**

**Part - A (Short Answer Questions)**

1	What are the airframe options available for MAV?	Remember	CO 3	AAE506.14
2	Give two names and applications of MAVs.	Remember	CO 3	AAE506.14
3	Discuss NAVs.	Understand	CO 3	AAE506.14
4	Mention two examples and applications of UCAV?	Remember	CO 3	AAE506.14
5	What are the important parameters of UCAV airframe?	Remember	CO 3	AAE506.14

6	Give two examples and applications of novel hybrid aircraft configurations.	Remember	CO 3	AAE506.14
7	How UAVs can be used for research purpose?	Understand	CO 3	AAE506.15
8	Discuss 'disposable load fraction'.	Remember	CO 3	AAE506.11
9	What are the three important design parameters for HALE and MALE UAVs?	Remember	CO 3	AAE506.11
10	Why longer wing span is preferred for long range UAVs, discuss with an example?	Remember	CO 3	AAE506.11
11	Discuss the 'Span loading'.	Understand	CO 3	AAE506.11
12	Define 'aspect ratio of wing' and its importance for HALE and MALE.	Remember	CO 3	AAE506.11
13	Comment on 'sfc' of HALE at height altitudes and medium altitudes.	Remember	CO 3	AAE506.15
14	Give any two possible forms of airframes for MAVs with necessary examples.	Understand	CO 3	AAE506.11
15	What are limiting factors of large wing area for HALE UAV?	Understand	CO 3	AAE506.11
16	Discuss the importance of 'rotor diameter' with necessary examples.	Remember	CO 3	AAE506.14
17	Discuss the blade loading.	Remember	CO 3	AAE506.14
18	Give few applications of Close-range/Battlefield aircrafts with necessary examples.	Understand	CO 3	AAE506.14
19	Compare the issues related to long ramp and short ramp.	Remember	CO 3	AAE506.14
20	Write short notes on Scan Eagle.	Remember	CO 3	AAE506.14
<b>Part - B (Long Answer Questions)</b>				
1	Discuss (i) Low aerodynamic drag, (ii) High disposable load fraction, and for Long-endurance, Long-range Role UAV designer.	Remember	CO 3	AAE506.14
2	Explain various aspects of power- plant selection for HALE UAVs.	Remember	CO 3	AAE506.14
3	Explain the performance of a HALE UAV considering variation of aircraft drag with airspeed, altitude, aspect ratio and aircraft mass.	Understand	CO 3	AAE506.14
4	Explain the performance of a HALE UAV considering power required to maintain height with airspeed, altitude and AUM.	Remember	CO 3	AAE506.14
5	Compare MALE and HALE UAVs.	Remember	CO 3	AAE506.14
6	Discuss about the Medium-range, Tactical fixed wing UAVs	Remember	CO 3	AAE506.14
7	Discuss about the Medium-range, Tactical VTOL (Rotary wing) UAV	Understand	CO 3	AAE506.15
8	Explain Close-range/ Battlefield Non- VTOL aircraft systems with necessary diagrams.	Remember	CO 3	AAE506.11
9	Explain Close-range/ Battlefield VTOL aircraft systems with necessary details.	Remember	CO 3	AAE506.11
10	Compare Close-range UAV systems	Remember	CO 3	AAE506.11
11	Write about MUAV's technologies.	Understand	CO 3	AAE506.11
12	What are the different types of MAVs, discuss in detail?	Remember	CO 3	AAE506.11



13	Explain the Nano air vehicle systems	Remember	CO 3	AAE506.15
14	What are the different novel hybrid aircraft configurations, discuss with necessary examples?	Understand	CO 3	AAE506.11
15	Discuss how the ramp size affects the UAVs.	Understand	CO 3	AAE506.11
<b>Part – C (Critical Thinking Questions)</b>				
1	What are the three main concerns of the Long-endurance, Long-range Role UAV designer, discuss in detail with the necessary diagram?	Remember	CO 3	AAE506.14
2	Explain the performance of a HALE UAV considering i) Variation of aircraft drag with airspeed and altitude (ii) Effect of wing aspect ratio on aircraft drag at high altitudes	Remember	CO 3	AAE506.14
3	Compare Ramp-launched and VTOL Close-range UAV systems	Understand	CO 3	AAE506.14
4	Why do we need Close-range UAV systems, discuss few design aspects.	Remember	CO 3	AAE506.14
5	Discuss the design aspects of high-altitude long endurance UAS.	Remember	CO 3	AAE506.14
6	Discuss the design aspects of medium-altitude long endurance UAS.	Remember	CO 3	AAE506.14
7	What are the applications of TUAVs and discuss different types of TUAVs.	Understand	CO 3	AAE506.15
8	Why do we need Nano air vehicle systems? Explain the developments of NAVs.	Remember	CO 3	AAE506.11
9	Differentiate MUAV, MAV, NAV and UCAVs.	Remember	CO 3	AAE506.11
10	Explain the different performance parameters of a HALE UAV.	Remember	CO 3	AAE506.11
<b>UNIT-IV</b>				
<b>COMMUNICATIONS NAVIGATION</b>				
<b>Part - A (Short Answer Questions)</b>				
1	How the data does is transmitted between UAV and CS and what type of data could be transmitted?	Understand	CO 4	AAE506.16
2	Why the maintenance of the communications does is of paramount importance in UAS operations?	Understand	CO 4	AAE506.16
3	Discuss few reasons for the loss of communication during UAS operations.	Understand	CO 4	AAE506.16
4	What is 'data rate', how is it measured?	Understand	CO 4	AAE506.16
5	Define 'bandwidth' and how is it measured?	Understand	CO 4	AAE506.17
6	Why the laser method of communication is abandoned?	Remember	CO 4	AAE506.17
7	For what kind of roles data transmission by fibre-optics is suitable option?	Understand	CO 4	AAE506.18
8	What is NAVSTAR GPS?	Remember	CO 4	AAE506.18
9	How LOS Range can be calculated? Mention the variables involved.	Understand	CO 4	AAE506.19
10	What is 'System of Systems (SoS)'?	Understand	CO 4	AAE506.19

11	What are the three systems in use to designate frequency bands?	Understand	CO 4	AAE506.19
12	Define 'Line Losses' in radio communications.	Understand	CO 4	AAE506.19
13	What is the path loss in radio communications?	Remember	CO 4	AAE506.20
14	Define 'multi-path propagation'.	Remember	CO 4	AAE506.20
15	What are the two ways in which a UAV system may be vulnerable?	Remember	CO 4	AAE506.20
16	What are three types of anti-jam (AJ) measures?	Understand	CO 4	AAE506.16
17	What are the different navigation systems developed by different countries?	Understand	CO 4	AAE506.16
18	Discuss PPS and SPS.	Understand	CO 4	AAE506.16
19	What are patch antennae?	Understand	CO 4	AAE506.16
20	Write short notes on Yagi-Uda antennae?	Understand	CO 4	AAE506.17
<b>Part - B (Long Answer Questions)</b>				
1	Discuss the different communication media between UAV and control station.	Understand	CO 4	AAE506.16
2	Discuss various radio frequencies for radio communication. Give the radio frequency spectra.	Understand	CO 4	AAE506.16
3	What is LOS range? Discuss radio LOS derivation with necessary diagrams.	Understand	CO 4	AAE506.16
4	How communication range and height of operating UAV are related, discuss with the help of necessary diagram?	Understand	CO 4	AAE506.16
5	Explain radio frequency band designations systems with their frequency designations.	Understand	CO 4	AAE506.17
6	Comment on radio/microwave frequency allocation and different international organizations involved in it.	Remember	CO 4	AAE506.17
7	Write short notes on (i) Transmitter power output and receiver sensitivity, (ii) Antenna gain, (iii) Path loss, and (iv) Multi-path propagation.	Understand	CO 4	AAE506.18
8	Discuss 'Vulnerability' of UAV system and possible measures to reduce it.	Remember	CO 4	AAE506.18
9	Write detailed notes on multi-agent communication and interoperability.	Understand	CO 4	AAE506.19
10	Discuss communications data rate and bandwidth usage.	Understand	CO 4	AAE506.19
11	What are the different types of Antennas, discuss them briefly.	Understand	CO 4	AAE506.19
12	Explain NAVSTAR GPS mentioning different types and detailed services.	Understand	CO 4	AAE506.19
13	Write short notes on (i) Inertial navigation and (ii) Radio Tracking systems.	Remember	CO 4	AAE506.20
14	Discuss briefly the 'Way-point Navigation' for UAVs.	Remember	CO 4	AAE506.20
15	Write short notes on 'Navigation' systems for UAVs.	Remember	CO 4	AAE506.20

<b>Part – C (Critical Thinking Questions)</b>				
1	Why the communication is of paramount importance in UAS operations? Discuss the possible reasons for loss of communication during the operations.	Understand	CO 4	AAE506.16
2	What are the different ways of achieving communication between GCS and UAV, explain in detail?	Understand	CO 4	AAE506.16
3	What are the different radio frequencies for radio communication with the help of radio frequency spectra?	Understand	CO 4	AAE506.16
4	How line of sight range can be calculated, mention the variables involved with necessary diagram?	Understand	CO 4	AAE506.16
5	How line of sight radio range will vary with the height of UAV operation, discuss with necessary diagram?	Understand	CO 4	AAE506.17
6	What are the different ways in which UAV may be vulnerable and discuss how can they be reduced?	Remember	CO 4	AAE506.17
7	Discuss the importance of multi-agent communication and interoperability for UAVs.	Understand	CO 4	AAE506.18
8	Discuss the most usual types of antenna to be adopted for UAS, discuss them briefly with necessary diagrams.	Remember	CO 4	AAE506.18
9	What are the popular methods of position fixing and navigation between UAV and CS, discuss them in detail.	Understand	CO 4	AAE506.19
10	What are the different methods by which UAV controller may direct the UAV to any point within its range, discuss them briefly?	Understand	CO 4	AAE506.19

#### **UNIT-V**

#### **COMMUNICATIONS NAVIGATION**

<b>Part - A (Short Answer Questions)</b>				
1	Discuss the two parts of control and stability system of UAS?	Remember	CO 5	AAE506.21
2	What are the flight variables for HTOL aircraft?	Remember	CO 5	AAE506.21
3	How the aircraft heading is measured and monitored in UAV?	Understand	CO 5	AAE506.21
4	What is 'tape height'? Is it accurate for all ranges of speed?	Remember	CO 5	AAE506.21
5	Define 'pressure height'?	Remember	CO 5	AAE506.22
6	What is 'Directional airframe'? Give an example.	Remember	CO 5	AAE506.22
7	What are the different sensors used in UAS?	Remember	CO 5	AAE506.22
8	What is AFCS? List few components of automatic flight control system.	Remember	CO 5	AAE506.22
9	What is a transitional flight? Comment on it.	Understand	CO 5	AAE506.22
10	What is PSH? Give the advantages of PSH.	Understand	CO 5	AAE506.22
11	What are the two sets coordinate axes an FCS operates? Discuss them.	Remember	CO 5	AAE506.22
12	What are the systems used to measure airspeed of UAVs?	Remember	CO 5	AAE506.20

13	What are the difficulties with laser system based sensors?	Understand	CO 5	AAE506.20
14	How does dead reckoning system works?	Understand	CO 5	AAE506.20
15	What is the 'Kalman filter'?	Understand	CO 5	AAE506.21
16	How hover-position-hold sensing does varies at established base and away from base?	Remember	CO 5	AAE506.21
17	Write about different convertible rotor aircraft.	Remember	CO 5	AAE506.22
18	Write any two control commands of SMR.	Understand	CO 5	AAE506.22
19	Discuss canard airframe configuration.	Remember	CO 5	AAE506.21
20	What is the need for multiplier K for speed channel?	Remember	CO 5	AAE506.21
<b>Part - B (Long Answer Questions)</b>				
1	Draw HTOL aircraft basic AFCS and discuss.	Remember	CO 5	AAE506.21
2	Explain HTOL spatially stabilized configuration using AFCS.	Remember	CO 5	AAE506.21
3	Discuss the control and stability aspects of Single-main- rotor helicopter with AFCS diagram.	Understand	CO 5	AAE506.21
4	Discuss the control and stability aspects of Coaxial-rotor Helicopter with necessary AFCS.	Remember	CO 5	AAE506.21
5	Explain the control commands of hover flight and cruise flight of tilt rotor aircraft.	Remember	CO 5	AAE506.22
6	Discuss briefly the transition flight of tilt rotor aircraft.	Remember	CO 5	AAE506.22
7	Discuss briefly the payload control in UAS.	Remember	CO 5	AAE506.22
8	Discuss briefly the speed channel, the heading channel and the height channel.	Remember	CO 5	AAE506.21
9	Explain height and altitude sensors used for UAVs.	Understand	CO 5	AAE506.22
10	Discuss briefly the airspeed sensors.	Understand	CO 5	AAE506.22
11	Write a brief notes on 'Directional' airframe coaxial-rotor helicopter.	Remember	CO 5	AAE506.21
12	Write a brief notes on 'Symmetrical airframe coaxial-rotor helicopter.	Remember	CO 5	AAE506.23
13	Compare the stability and control aspects of SMR and CRH configurations.	Understand	CO 5	AAE506.21
14	Discuss 'Hover-position-hold sensing' for a VTOL aircraft.	Understand	CO 5	AAE506.23
15	Write brief notes on 'Autonomy' of UAVs operation.	Understand	CO 5	AAE506.23
<b>Part – C (Critical Thinking Questions)</b>				
1	How the stability of HTOL can be achieved using (i) The Speed Channel, (ii) The Heading Channel, and (iii) The Height or Altitude Channel, explain?	Evaluate	CO 5	AAE506.21
2	Discuss the aerodynamic stability and aerodynamically neutral stability designs of HTOL aircraft.	Remember	CO 5	AAE506.21
3	How can aircraft speed, rate of climb and engine power influence the stability of HTOL, explain with help of AFCS?	Evaluate	CO 5	AAE506.21
4	How complicated the stability and control of SMR, compare with fixed- wing aircraft?	Analyze	CO 5	AAE506.21

5	How the control and stability can be achieved for SMR helicopter, explain with necessary diagrams and examples.	Remember	CO 5	AAE506.22
6	Write the method of aerodynamic control of Coaxial-rotor helicopter using AFCS.	Remember	CO 5	AAE506.22
7	Differentiate 'Directional' Airframe Coaxial-rotor Helicopter (CRH) and Symmetrical Airframe Coaxial-rotor Helicopter.	Analyze	CO 5	AAE506.21
8	Discuss the techniques to control the Convertible Rotor Aircraft during different flying conditions.	Remember	CO 5	AAE506.21
9	What kind of different sensors are used to measure the height of UAV? Discuss them briefly.	Understand	CO 5	AAE506.23
10	Comment on different sensors used to measure airspeed of an UAV for HTOL and VTOL aircrafts.	Evaluate	CO 5	AAE506.23

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