INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

AERONAUTICAL ENGINEERING

DEFINITIONS AND TERMINOLOGY QUESTION BANK

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

COURSE OBJECTIVES:

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

S.No.	QUESTION	ANSWER	Blooms Level	CO
MODULE-1				
1	What are UAS?	An unmanned aircraft system is a system, comprises a number of sub-systems which include the aircraft, its payloads, the control station(s), aircraft launch and recovery sub-systems where applicable and other sub-systems, etc.	Remember	CO 1
2	What is HALE?	HALE - High altitude long endurance UAV. Over 15 000 m altitude and 24+ hr endurance.	Understand	CO 1

3	Define MALE?	MALE – Medium altitude long endurance. 5000–15 000 m altitude and 24 hr endurance.	Remember	CO 1
4	What is TUAV?	TUAV – Medium Range or Tactical UAV with range of order between 100 and 300 km.	Remember	CO 1
5	What is MUAV?	MUAV or Mini UAV – relates to UAV of below a certain mass (yet to be defined) probably below 20 kg, capable of being hand-launched and operating at ranges of up to about 30 km.	Understand	CO 1
6	Define is MAV	Micro UAV or MAV, was originally defined as a UAV having a wing-span no greater than 150 mm. It is required to fly slowly, and preferably to hover and to 'perch'	Remember	CO 1
7	What is NAV?	NAV – Nano Air Vehicles. These are proposed to be of the size of sycamore seeds and used in swarms for purposes such as radar confusion.	Remember	CO 1
8	What is RPH?	RPH, remotely piloted helicopter or VTUAV, is an UAV, capable of vertical take-off and vertical landing	Remember	CO 1
9	Illustrate UCAV and UCAR?	UCAV - unmanned combat air vehicle. UCAR - Unmanned Combat Rotorcraft	Understand	CO 1
10	Expand DDD roles?	D- Dull Roll D- Dirty Roles D- Dangerous Roles	Understand	CO 1
11	List the elements of UAS?	Control station, Communications, Air vehicle, Navigation, Payloads, Launch and Recover, System Interfaces, Support equipment and Transportation are the sub-systems of	Understand	CO 1
12	Define Radar tracking?	The aircraft is fitted with a transponder which responds to a radar scanner emitting from the CS, so that the aircraft position is seen on the CS radar display in bearing and range.	Remember	CO 1
13	What is Radio tracking?	The radio signal carrying data from the aircraft to the CS is tracked in bearing from the CS, whilst its range is determined from the time taken for a coded signal to travel between the aircraft and the CS	Understand	CO 1
14	What are the different phases of UAS design?	a) The conceptual phase, b) The preliminary design phase, c) The detail design	Understand	CO 2
15	Define direct reckoning	With the computer-integration of velocity vectors and time elapsed,. If the mission is over land and the aircraft carries a TV camera surveying the ground, its position can be confirmed by relating visible geographical features with their known position on a map the aircraft position may be calculated	Remember	CO 2
MODULE-II				
1	Define 'Lift induced drag'	The horizontal component of the reaction force is a drag, known as the 'lift-induced drag',	Remember	CO 4
2	How do you calculate the lift induced drag for fixed wing aircraft?	$D_i = k_i.(L/b)^2/q\pi$ Or $D_i = k_i.(L/b)^2/\frac{1}{2}\rho\,\pi\,V^2$	Remember	CO 4

3	What are the components of the lift induced drag?	Span loading, air density and air speed	Understand	CO 4
4	Define 'Parasitic drag'?	Skin friction drag, form drag, interference drag, momentum drag and cooling drag collectively grouped as 'parasitic drag'	Understand	CO 4
5	How do you calculate the parasitic drag coefficient?	$C_{Dp} = D_p / {}^1\!/_2 \rho V^2 S$	Remember	CO 4
6	How can be parasitic drag estimated for any level flight condition?	$D_p = qC_{Dp}.S$	Remember	CO 4
7	What are the components of the parasitic drag?	Air density, air speed, wing area and aerodynamic head	Remember	CO 3
8	What is the expression for parasitic drag when the aircraft is operated at high incidence?	$D_p = \left(C_{Dp} + k_p C_L^2\right) qS$	Remember	CO 4
9	Define 'absolute minimum flight speed'	It is the minimum speed below which the wing can't produce sufficient lift to oppose the aircraft weight	Understand	CO 3
10	Give the expression to calculate V_{min} for a fixed wing aircraft?	$V_{min} = (2L/\rho S\ C_{lo.})^{1/2}$	Remember	CO 3
11	How do you calculate V_{min} for a flapping wing UAV?	$V_{min} = (2w/\rho C_{Lo})^{1/2}$	Remember	CO 3
12	Define disc for a rotary wing?	The larger the diameter of the circle (or disc) traced out by the rotary wing	Understand	CO 5
13	List few HTOL aircraft configurations	Canard, Delta, Tail-aft on Fuselage, Tail-aft on Booms and Flying-Wing.	Remember	CO 5
14	Give the names of few VTOL configurations	Single rotor, Co-axial rotor, Tandem rotor and Quad rotor	Understand	CO 5
15	What are the few hybrid aircraft configurations?	Aircraft which combines the capability of both VTOL and HTOL. Tilt-Rotor, Tilt-Wing, Tilt-Wing-Body and Ducted fan.	Understand	CO 5
MODULE-III				
1	What are the airframe options available for MAV?	Fixed-wing, rotary-wing, flapping-wing and ducted lift-fan	Remember	CO 8
2	Give two names of MAVs	MISQUITO and WASP	Remember	CO 8
3	Define NAV?	Nano air vehicles are aircrafts with dimensions of less than 5 cm in any direction, have an AUM of less than 10 g, including a payload of 2 g.	Understand	CO 8
4	Mention two examples of UCAV?	Northrop-Grumman X-47B and BAE Systems Taranis	Remember	CO 8
5	What are the important parameters of UCAV airframe?	The airframe should be of high wing loading, high thrust-to-weight ratio and low aspect ratio flying wings	Remember	CO 8
6	Give two examples of novel hybrid aircraft configurations.	The Sky Tote and Honeywell ducted-fan MAV	Remember	CO 8

7	How UAVs can be used for research purpose?	Using dynamically scaled UAV models of proposed full-size aircraft, the flight characteristics of the new aircraft can be assessed more cheaply, quickly and with less risk and waiting until a full-size prototype is built.	Understand	CO 8
8	Define 'disposable load fraction'	It is the ratio of disposable load to aircraft gross mass	Remember	CO 8
9	What are the three important design parameters for HALE and MALE UAVs?	(i) Low drag (ii) High disposable load fraction (iii) Efficient power-plant	Remember	CO 8
10	Why longer wing span is preferred for long range UAVs?	To reduce the induced drag at high altitude	Remember	CO 8
11	Define 'Span loading'	Span loading is the weight of the aircraft divided by its wing span	Understand	CO 8
12	Define 'aspect ratio of wing'	It is the ratio of the wing span to the mean chord of the wing. This is often better derived by dividing the square of the wing span by the wing area, i.e. b^2/S.	Remember	CO 8
13	What is 'sfc'?	Sfc- specific fuel consumption is the amount of fuel consumed by a vehicle for each unit of power output	Remember	CO 8
14	Give any two possible forms of airframes for MAVs.	Fixed wing and rotary wing or flapping wing.	Understand	CO 8
15	What are limiting factors of large wing area for HALE UAV?	(i) Take-off at a reasonable speed and length of run (ii) Acceptable minimum flight speed at altitude	Understand	CO 8
MODULE-IV				
1.	Why the maintenance of the communications does is of paramount importance in UAS operations?	Without the ability to communicate, the UAS is reduced merely to a drone system and loses the versatility and wide capability of the UAS	Understand	CO 9
2.	Mention few reasons for the loss of communication during UAS operations	a) Failure of all or part of the system b) Loss of line-of-sight (LOS) c) Weakening of received power, d) Intentional or inadvertent jamming of the signals.	Understand	CO 9
3.	What is 'data rate', how is it measured?	Data rate is the amount of data transferred per second by a communications channel and is measured in bytes per second (Bps)	Understand	CO 9
4.	Define 'bandwidth', how is it measured?	'Bandwidth' is the difference between the highest and lowest frequencies of a communications channel, and is measured in MHz or GHz as appropriate	Understand	CO 9
5.	Why the laser method of communication is abandoned?	Because of atmospheric absorption limiting the range and reducing reliability	Understand	CO 9
6.	For what kind of roles data transmission by	For special roles which require flight at low altitude, high data rate transmission and high	Remember	CO 9

	fibre-optics is suitable option?	security from detection and data interception		
7.	Expand NAVSTAR GPS	Navigation Signal (/ Satellite) Timing and Ranging Global Positioning System	Understand	CO 9
8.	Give expression to calculate LOS Range?	$\text{LOS Range} = \sqrt{(2 \times (\text{EER}) \times H_1) + H_1^2} + \sqrt{(2 \times (\text{EER}) \times H_2) + H_2^2}$ H1- height of the radio antenna, H2 - height of air vehicle , EER- earth radius	Remember	CO 9
9.	Define 'System of Systems (SoS)'	Set of systems or system elements that interact to provide a unique capability that none of the constituent systems can accomplish on its own.	Understand	CO 9
10.	What are the three systems in use to designate frequency bands?	1. The International Telecommunication Union (ITU) 2. The Institute of Electrical and Electronics Engineering (IEEE) 3. The NATO and EU designations	Understand	CO 9
11	Define 'Line Loses in radio communications.	A loss of power will result from the escape of energy through imperfect shielding of the coaxial cables and imperfect line-couplers as the RF energy is sent to and from the antennae	Understand	CO 9
12.	What is the path loss in radio communications?	The loss of power that occurs to the signal as it propagates through free space from the transmitter to the receiver.	Understand	CO 9
13.	Define 'multi-path propagation'	Two signals displaced in time by microseconds are received at the image display, causing blurring of the image	Remember	CO 9
14	What are the two ways in which a UAV system may be vulnerable?	1. An enemy detection of the signal from either UAV or CS 2. the radio transmission between the CS and the UAV may be subject to inadvertent or intentional jamming of the signal.	Remember	CO 9
15	What are three types of anti-jam (AJ) measures?	1. High transmitter power, 2. Antenna gain/narrow beam-width, 3. Processor gain	Remember	CO 9
MODULE-V				
1.	What are the two parts of control and stability system of UAS?	1. AFCS 2. MUSCLES	Remember	CO 10
2.	What are the flight variables for HTOL aircraft?	a) Direction, b) Horizontal speed, c) Altitude, d) rate of climb	Remember	CO 10
3.	How the aircraft heading is measured in UAV?	The actual heading of the aircraft can be measured by a magnetometer- monitored attitude gyro and compared with the commanded heading.	Understand	CO 10
4.	Define 'tape height'	The height of an aircraft is recognised as its vertical distance above ground as measured	Remember	CO 10
5	What is 'pressure height'?	The height above mean sea level and by measuring the ambient air pressure outside the aircraft and comparing that with the ambient air pressure at mean sea level	Remember	CO 10

6.	What is 'Directional airframe'?	'Directional' implies that it has an airframe having a preferred axis of flight, i.e. along which it has the lowest aerodynamic drag	Remember	CO 10
7.	List few sensors used in UAS.	Vertical attitude gyros, heading gyros, angular rate gyros, height and altitude sensors ,airspeed sensors and linear accelerometers.	Remember	CO 10
8	List few components of automatic flight control system.	Airspeed sensors, Altimeter, Throttle actuator, heading gyro and yaw rate gyro.	Remember	CO 10
9	What is a transitional flight?	The transition between hover flight and cruise flight	Understand	CO 10
10	Give the advantages of PSH.	More compact aircraft for transport, more versatile operation of the payload , lower gust response and lower detectable signatures for stealth operation.	Remember	CO 10
11	What are the two sets coordinate axes an FCS operates?	1. Aircraf based 2. Payload based	Remember	CO 10
12	What are systems used to measure airspeed of UAVs?	1. Pitot-static tube 2. GPS 3.Omnidirectional air-data system	Remember	CO 10
13	What are the difficulties with laser system based sensors?	May cause eye damage, may also lose function when operating over still water or certain types of trees	Understand	CO 10
14	How does dead reckoning system works?	DR systems work on the basis you know where you are at the start of the mission and you then use time, speed and direction measurements to calculate your current position	Understand	CO 10
15	What is the function of 'Kalman filter'?	Mixes the signals, but provides an element of modelling of the individual sensor errors, which enables the filter to give improved navigation during periods of GPS signal loss/degradation	Understand	CO 10

Signature of the Faculty **HOD, AE**