

Roll No: -----



## UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: M.Tech ASE-UAV

Subject (Course): Introduction to UAV

Course Code : ASEG 7007

No. of page/s: 03

Semester – I

Max. Marks : 100

Duration : 3 Hrs

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Note: 1) Mention Roll Number in the question paper.

2) No student will leave the room till one hour from the commencement of examination.

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### Section – A

(All the questions are compulsory)

(5 \* 4 = 20 Marks)

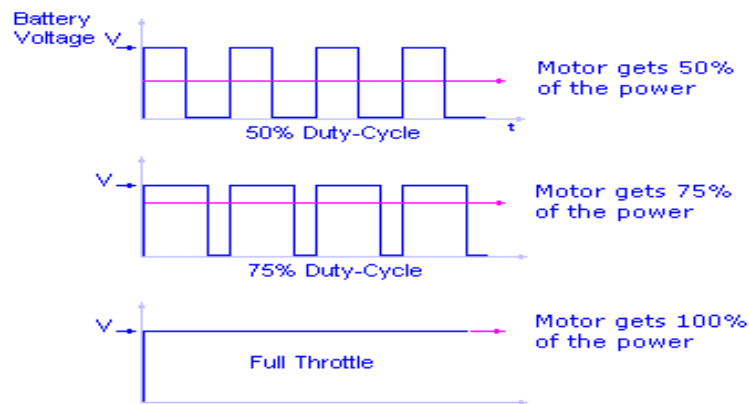
1. Discuss about the altitude and endurance of HALE, MALE and TUAV configurations.
2. List at least three properties of uplink and downlink communication used for UAVs.
3. Missiles have in built navigation and guidance system, also these systems are unmanned. Why missiles are not considered to be a UAV?
4. List out the at least three applications of UAVs in the following areas.
  - a. Civilian Roles
  - b. Military Roles
5. What are the *Launch, Recovery and Retrieval Equipment* generally used for an UAV?

### Section – B

(Answer all the questions)

(4\* 10 = 40 Marks)

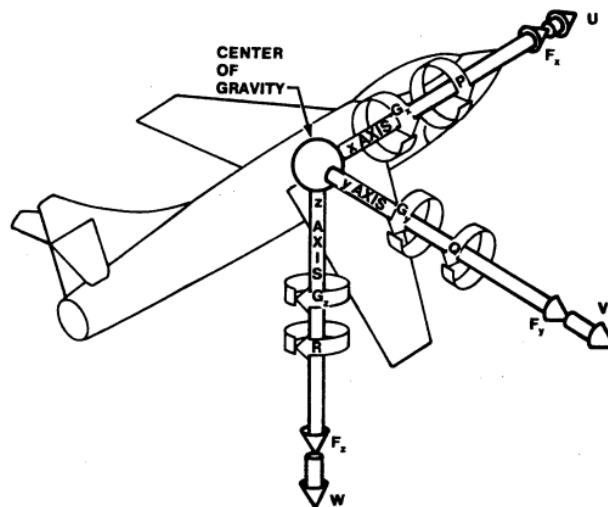
6. Sensors for measuring tape height, that is height above ground, include those measuring distance by timing pulses of radio, laser or acoustic energy from transmission to return. Design an Altitude hold Autopilot for a fixed wing UAV using the sensors mentioned above.
7. Holding station in a hover or near hover is often a requirement for a VTOL aircraft for take-off or for landing and also for several types of operations, current or projected, where surveillance from a fixed-point is required. List and explain in detail about the sensors used for hover-position-hold sensing for a VTOL UAV.
8. Explain the sampling and quantization process used for digitization of an image captured by the electro optic payload of an UAV.
9. The Electronic Speed Controller is based on Pulse Width Modulation (PWM), which means that the motor's rpm is regulated by varying the pulses' duty-cycle according to the transmitter's throttle position (as given in the figure). Considering the battery voltage to be 22V develop an algorithm for a BLDC motor to run at full throttle



**Section – C**  
(All the questions are compulsory)

(2\*20 = 40 Marks)

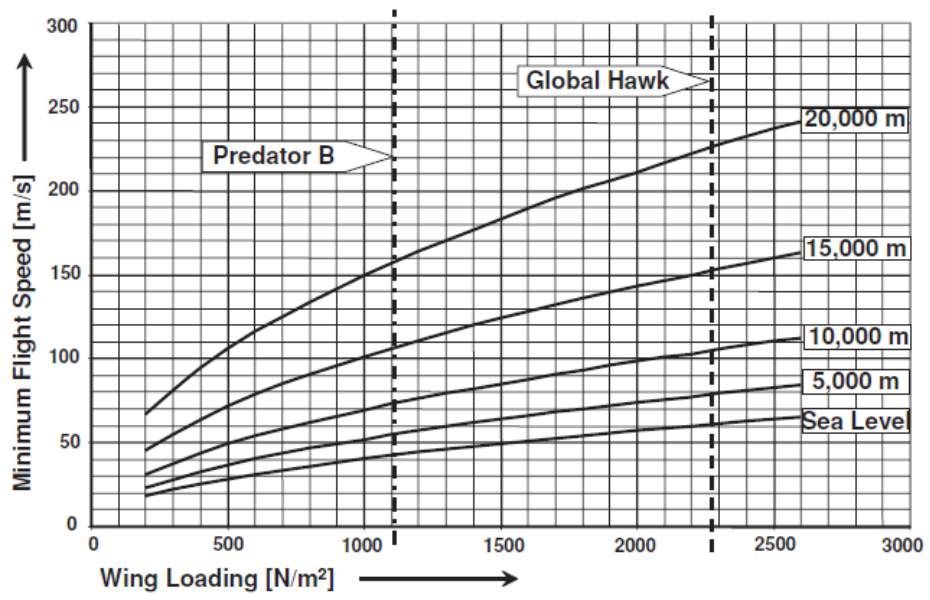
10. The performance of an aircraft can adequately be described by assuming the fixed wing UAV is a point mass concentrated at the aircraft's center of gravity (CG). The flying qualities of an UAV, on the other hand, cannot be described in such a simple manner. The flying qualities of an UAV must, instead, be described analytically as motions of the aircraft's as well as motions of the airframe about the CG, both of which are caused by aerodynamic, thrust and other forces and moments. Derive the equations of motion for a fixed wing UAV.



11. For a Fixed wing UAV
- Explain effect of wing tip vortices in detail.
  - Draw a well labeled drag polar and explain it in detail.

OR

What is meant by wing loading? Discuss about the below figure with respect to wing loading of predator and Global Hawk UAV.



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### Section – A

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1. Expand the following

- |                |               |
|----------------|---------------|
| a. RPV -----   | k. FOV -----  |
| b. UCAR -----  | l. TTP -----  |
| c. NAV -----   | m. HALE ----- |
| d. AFCS -----  | n. MALE ----- |
| e. CS -----    | o. SAR -----  |
| f. MPCS -----  | p. DGCA ----- |
| g. UXB -----   | q. FAA -----  |
| h. INS -----   | r. UAS -----  |
| i. LLLTV ----- | s. TUAV ----- |
| j. CCD -----   | t. FPV -----  |

2. Discuss the factors to be considered for selecting non dispensable payloads.

3. “UAVs are designed to perform DDD roles”, explain.

4. How does the payload range varies for an UAV selected based on the performance of the payload, driven by the needs of the operational task.

5. What are the three main airframe configurations and their types, explain with help of a chart

**Section – B**  
**(All Questions are Compulsory)**

**(4 \* 10 = 40)**

6. Economic impacts plays huge role in UAV with respect to first cost and operating cost. Compare the economics for developing a manned aircraft and UAV for a remote sensing application; explain how the UAVs have economic benefit.
7. Explain Unmanned Aircraft System Basis in detail. List out and explain navigation systems used other than GPS and INS. What is the role of “other system interfaces” in case of an UAV application in military roles.
8. List out the images obtained from electromagnetic spectrum; explain what types of images are obtained in visible and radio range of electromagnetic spectrum. How are these images captured by the electro optic payloads attached to the UAVs?
9. How the selection of system done while manufacturing an Unmanned Aerial Vehicle. What are the various categories of UAV to be considered in the selection of UAV? List out at least one existing UAV in each category.

**Section – C**  
**(All the questions are compulsory)**

**(2\*20 = 40 Marks)**

10. For the development of a fixed wing UAV
  - a. Design challenges to be considered in designing the fixed wing UAV in conceptual phase
  - b. Discuss and tabulate the detail design phase for development of a fixed wing UAV.
  - c. Sketch the on board and ground station embedded system.
11. Fundamentally, an aircraft remains ‘afloat’ simply by accelerating an adequate mass of air downwards and, as Newton discovered, the reaction force in the opposite direction opposes the gravitational force which constantly tries to bring the aircraft back to ground. For an aircraft travelling with forward velocity  $V$  and deflected air velocity  $u$ . Why does a disparity of aerodynamic pressure occurs between the upper and lower surfaces of its wings, whether of the fixed or rotating variety?

OR

How the sensor’s analog values are converted to digital values for the autopilot in an UAV? Also, explain the sampling and quantization process that occurs during the conversion process.