Hall Ticket No | | | | | | | | | | | Question Paper Code: AAE011

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER-II

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

Regulations: IARE - R16

AIRCRAFT PERFORMANCE

(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)	Explain briefly Types of Air Data used for aircraft performance. Name the equipments operated by air system.	**[7M]**
	b)	Derive the expression for pressure variation with change of altitude in the standard atmosphere	**[7M]**
2.	a)	Explain about performance requirements of the aircraft. Name five performance parameters of aircraft and explain three of them.	**[7M]**
	b)	Explain about True Air Speed, Indicated Air Speed and Calibrated Air Speed. How these speeds are compared with each other? Which one is most suitable for the aircraft performance?	**[7M]**

UNIT – II

3.	a)	Describe and elaborate Cruise Technique – 1, 2 and 3. Explain the benefits and drawbacks of these techniques.	**[7M]**
	b)	Compare the wings of a crane and a crow. Give reasons for these two birds having different flight performance. Which one is most suitable for long endurance and range?	**[7M]**
4.	a)	Derive the jet aircraft range expression with the assumption that the cruise velocity is constant.	**[7M]**
	b)	Calculate the range and endurance of a propeller aircraft with 80.5 kmph head wind at sea level. The aircraft has the following characteristics: Wf =15 percent of total weight, η= 0.8, C = 2.2 N/HP-hr, W/S= 34, $C_D = 0.022+0.060C^2_L$	**[7M]**

UNIT – III

5.	a)	What is steepest gradient of descent? What is the maximum value of this gradient?	**[7M]**
	b)	Explain the importance of descent performance in aircraft operations. Differentiate between civil and military aircraft.	**[7M]**

6. a) Derive the high performance specific climb expression in terms of specific excess power. **[7M]**

b) For the propeller-driven, twin engine aircraft, determine the climb performance and ceiling for the weight W =40.5 kN, C_D= 0.024+0.0535 C^2_L, AR = 7, e = 0.85, $W_{T.O}$= 42.7kN, W_{fuel} = 6.5kN. **[7M]**

UNIT – IV

7. a) For the propeller-driven, twin engine aircraft, determine the climb performance and ceiling for the weight W =40.5 kN, C_D= 0.024+0.0535 C^2_L, AR = 7, e = 0.85, $W_{T.O}$= 42.7kN, W_{fuel} = 6.5kN. **[7M]**

b) Derive sustained turn-rate of the aircraft and also explain the turn rate and corner speed with the graphical representation **[7M]**

8. a) What is Cooper - Harper scale? What is the minimum thrust required for level flight? **[7M]**

b) Explain energy maneuverability methods of optimal climb trajectories and turns **[7M]**

UNIT – V

9. a) Explain about most sustained turn of the aircraft. How this turn is achieved by the pilot. Name the controls employed **[7M]**

b) Derive the ground run and airborne distances for the landing performance. Explain about each parameters and its importance **[7M]**

10. a) Derive and explain approximate expression for the ground distance with the wind which may be head or tail wind. **[7M]**

b) Calculate the total landing distance for an airplane at standard sea level, assuming that the landing weight is same as the takeoff gross weight of 33 tons. Assume runway is dry with brake on value of μ_r = 0.4. The approach angle is 3^0. Given $C_{L\ max}$=2.39, Wing loading (W/S) =76.84, G=0.588, k1= 0.02, C_L = 0.1 for ground roll. Assume other missing data. **[7M]**

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COURSE OBJECTIVES:

The course should enable the students to:	
I	Learn the different regimes of aircraft and performance requirements at different atmospheric conditions.
II	Understand the different type of velocities and gives differences between stall velocity and maximum and minimum velocities.
III	Estimate the time to climb and descent and relate between rate of climb and descent and time to climb and descent at different altitudes.
IV	Illustrate the velocity and radius required for different type of maneuvers like pull-up, pull down and steady turn.
V	Evaluate the equations of motion for an airplane in different flight modes like takeoff, cruise and landing.

COURSE OUTCOMES (COs):

CO 1	Understand the design mission, performance, standard atmosphere, aerodynamic and propulsive forces, different speeds and estimation methods of aircraft.
CO 2	Remember and describe the cruise performance of an airplane in relation with range and endurance with different types of engines also to understand effects of weight, altitude and temperature on performance.
CO 3	Determine and apply the concept of climb and descent performance and to calculate power for best climb and descent performance.
CO 4	Describe about aircraft maneuver performance in turn, pull-ups by considering limitations of power for military and civil aircrafts.
CO 5	Explore the methods to calculate take off and landing runway distances and to understand fuel planning, safety and environment effects of aircraft performance.

COURSE LEARNING OUTCOMES (CLOs):

CLO Code	**At the end of the course, the student will have the ability to:**
AAE011.01	Remember the atmospheric conditions that are suitable for better performance of an aircraft.
AAE011.02	Understand the basics of mathematics, science and engineering for problem solving.
AAE011.03	Describe different atmospheric models that an aircraft encounters in its real-time flight.
AAE011.04	Apply and demonstrate different methods for the measurement of air data and their respective systems working principle.
AAE011.05	Remember mission profiles that an aircraft adapts depending upon its category and requirements.
AAE011.06	Understand different phases of design process from performance standpoint.
AAE011.07	Describe definition of aircraft performance for different categories of aircraft.
AAE011.08	Apply and demonstrate the force system of the aircraft and the development of equations of motion.
AAE011.09	Understand the performance of aircraft in cruising phase and appropriate conclusions are drawn.

AAE011.10	Illustrate the climb and descent performance of the aircraft and its performance parameters are measured.
AAE011.11	Evaluate the concept behind various methods that are employed during takeoff and landing phases depending upon its mission.
AAE011.12	Apply the factors that enhance the performance of aircraft during takeoff and landing.
AAE011.013	Understand the maneuver performance of typical transport and military aircrafts.
AAE011.14	Evaluate the parametric performance data analysis for different phases of aircraft and various methods of measurement.
AAE011.15	Illustrate the concept of flight planning, fuel planning and how it affects the performance of aircraft.
AAE011.16	Apply the propulsive force characteristics like thrust that affects the aircraft performance.
AAE011.17	Understand the flight measurement of performance, with detailed sections on airworthiness certification and the performance manual.
AAE011.18	Illustrate the calibration methods that are used for the aircraft instruments to derive air data.
AAE011.19	Evaluate the aerodynamic force characteristics like lift and drag that affects the aircraft performance.
AAE011.20	Apply the full equation of motion, which are developed and used in the expressions for maneuver performance.

MAPPING OF SEMESTER END EXAMINATION TO COURSE OUTCOMES

SEE Question No		Marks Allotted	CLO Code	Course Learning Outcomes	Course outcomes	Blooms Taxonomy Level
1	a	7	AAE11.01	Apply Remember and understand the atmospheric conditions that are suitable for better performance of an aircraft.	CO1	Remember
	b	7	AAE11.01	Adapt the basic Remember of mathematics, science and engineering for problem solving.	CO1	Understand
2	a	7	AAE11.04	Demonstrate different methods for the measurement of air data and their respective systems working principle.	CO1	Remember
	b	7	AAE11.03	Describe different atmospheric models that an aircraft encounters in its real-time practice.	CO2	Understand
3	a	7	AAE11.05	Describe mission profiles that an aircraft adapts depending upon its category and requirements.	CO2	Remember
	b	7	AAE11.07	Identify definition of aircraft performance for different categories of aircraft.	CO2	Evaluate
4	a	7	AAE11.06	Understand different phases of design process from performance standpoint.	CO2	Remember
	b	7	AAE11.08	Explain the force system of the aircraft and the development of equations of motion	CO2	Understand
5	a	7	AAE11.10	Illustrate the climb and descent performance of the aircraft and its performance parameters are measured.	CO3	Apply
	b	7	AAE11.09	Evaluate the performance of aircraft in cruising phase and appropriate conclusions are drawn.	CO3	Apply
6	a	7	AAE11.10	Illustrate the climb and descent performance of the aircraft and its performance parameters are measured.	CO3	Remember
	b	7	AAE11.12	Evaluate the factors that enhance the performance of aircraft during takeoff and	CO3	Apply

SEE Question No		Marks Allotted	CLO Code	Course Learning Outcomes	Course outcomes	Blooms Taxonomy Level
				landing.		
7	a	7	AAE11.13	Understand the maneuver performance of typical transport and military aircrafts.	CO4	Remember
	b	7	AAE11.14	Understand the parametric performance data analysis for different phases of aircraft and various methods of measurement.	CO4	Apply
8	a	7	AAE11.16	Understand the propulsive force characteristics like thrust that affects the aircraft performance.	CO4	Remember
	b	7	AAE11.17	Describes the flight measurement of performance, with detailed sections on airworthiness certification and the performance manual.	CO4	Apply
9	a	7	AAE11.11	Understand the concept behind various methods that are employed during takeoff and landing phases depending upon its mission.	CO5	Remember
	b	7	AAE11.19	Understand the aerodynamic force characteristics like lift and drag that affects the aircraft performance.	CO5	Understand
10	a	7	AAE11.20	Evaluate the full equation of motion, which are developed and used in the expressions for maneuver performance.	CO5	Remember
	b	7	AAE11.20	Evaluate the full equation of motion, which are developed and used in the expressions for maneuver performance.	CO5	Understand

Signature of Course Coordinator

Dr. Yagya Dutta Dwivedi, Professor **HOD, AE**