# INSTITUTE OF AERONAUTICAL ENGINEERING

**(Autonomous)**

**Dundigal, Hyderabad - 500 043**

## AERONAUTICAL ENGINEERING

## TUTORIAL QUESTION BANK

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| **Course Title** | **AIRCRAFT PERFORMANCE** | | | | |
| **Course Code** | AAE011 | | | | |
| **Programme** | B.Tech | | | | |
| **Semester** | V | Aeronautical Engineering | | | |
| **Course Type** | Core | | | | |
| **Regulation** | **IARE - R16** | | | | |
| **Course Structure** | **Theory** | | | **Practical** | |
| | **Lectures** | **Tutorials** | **Credits** | **Laboratory** | **Credits** |
| | 3 | - | 3 | - | - |
| **Chief Coordinator** | Dr. Yagya Dutta Dwivedi, Professor | | | | |
| **Course Faculty** | Dr. Prasanta Kumar Mohanta, Professor | | | | |

## COURSE OBJECTIVES (COs):

| **The course should enable the students to:** | |
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| 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 gives the relation 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. |

## COURSE OUTCOMES (COs):

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| 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)

**Students, who complete the course, will be able to demonstrate the ability to do the following:**

| CLO Code | At the end of the course, the student will have the ability to: |
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| 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. |

| UNIT – I | | | | |
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| **INTRODUCTION TO AIRCRAFT PERFORMANCE- THE FORCE SYSTEM OF THE AIRCRAFT** | | | | |
| **PART - A (SHORT ANSWER QUESTIONS)** | | | | |
| **S. No** | **Questions** | **Blooms Taxonomy Level** | **Course outcomes** | **Course Learning Outcomes (CLOs)** |
| 1 | Write about drag reduction methods. Name all methods and explain one method with required diagram. | Remember | CO1 | AAE011.01 |
| 2 | Draw a diagram and show all the forces acting on an aircraft while flying straight and level. | Understand | CO1 | AAE011.01 |
| 3 | What are the types of altitudes used for the study of standard atmosphere? Relate these altitudes with each other. | Remember | CO1 | AAE011.01 |
| 4 | Explain the aircraft operations safety and economy. Explain the role of safety and quality regulation authorities. | Remember | CO1 | AAE011.01 |
| 5 | Sketch the military combat aircraft and interceptor aircraft mission profile. | Remember | CO1 | AAE011.01 |
| 6 | Explain briefly Types of Air Data used for aircraft performance. Name the equipments operated by air system. | Remember | CO1 | AAE011.01 |
| 7 | Explain briefly Scheduled performance and operational performance of aircraft. | Remember | CO1 | AAE011.01 |
| 8 | Describe about the Static Pressure and Total Pressure. How these pressures are different? Explain. | Understand | CO1 | AAE011.01 |
| 9 | What are the main purposes of performance measurement? Which data are used for this purpose? | Understand | CO1 | AAE011.01 |
| 10 | What are the purposes for which the performance of an aircraft needs to be measured in flight? | Remember | CO1 | AAE011.01 |
| 11 | Describe about absolute aircraft performance. Name five important characteristics. | Remember | CO1 | AAE011.01 |
| 12 | What is a functional performance characteristic of an aircraft? Explain three of them. | Understand | CO1 | AAE011.01 |
| 13 | How many groups are there related to aircraft performance? Explain with suitable example. | Remember | CO1 | AAE011.01 |
| 14 | What are the roles of an aircraft? How many categories are there? Give the three names of each. | Understand | CO1 | AAE011.01 |
| 15 | Write the five important roles of the civil aircrafts. Name three civil aircrafts with their roles. | Understand | CO1 | AAE011.02 |
| 16 | What is Early Warning and Control System? Explain its function related to aircraft performance. | Understand | CO1 | AAE011.02 |
| 17 | What do you understand by Atmospheric Flight Mechanics? Which one is another type? | Understand | CO1 | AAE011.02 |
| 18 | What is Air data measurement? Explain briefly about this system and also give its applications on aircraft. | Understand | CO1 | AAE011.02 |
| 19 | Write five governing parameters of an aircraft while flying. Explain any two of them with suitable example. | Understand | CO1 | AAE011.02 |
| 20 | Differentiate between geo-potential height and geometrical height. Draw the diagram and show it. | Remember | CO1 | AAE011.02 |
| **PART - B (LONG ANSWER QUESTIONS)** | | | | |
| 1 | Describe with the help of a diagram the mission profile of a civil transport aircraft. What is involved in performance estimation? | Remember | CO1 | AAE011.01 |
| 2 | Define the following terms Static pressure, Total pressure and Impact pressure and write the relation among them. | Understand | CO1 | AAE011.01 |
| 3 | What is lapse rate? What is the value of lapse rate in troposphere? | Remember | CO | AAE011.01 |
| 4 | Describe with the help of a diagram the mission profiles of different types of aircrafts. | Remember | CO1 | AAE011.01 |
| 5 | Write the relation between sea level gravity and gravity at flying. How these terms are related? Write the expression and explain. | Remember | CO1 | AAE011.02 |
| 6 | Write a short note on Standard Atmospheric Flight Mechanics and its need in the field of aeronautical industry. | Understand | CO1 | AAE011.02 |
| 7 | What do you understand by Air data measurement? Explain briefly the effects of air data system on aircraft performance. | Remember | CO1 | AAE011.02 |

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| 8 | What do you understand by performance planning and fuel planning? How these parameters differ from each other? Explain with example. | Understand | CO1 | AAE011.01 |
| 9 | What is the meaning of off standard atmosphere? Explain briefly about design atmosphere model with suitable sketch. | Understand | CO1 | AAE011.01 |
| 10 | Derive the expression for the relation between temperature and height is in the standard atmosphere model and explain this with a neat sketch. | Understand | CO1 | AAE011.02 |
| 11 | Explain about performance requirements of the aircraft. Name five performance parameters of aircraft and explain three of them. | Remember | CO1 | AAE011.02 |
| 12 | Explain about atmosphere and its layers giving elevation and temperature graph. | Remember | CO1 | AAE011.02 |
| 13 | What is the off standard and design standard atmosphere? How these two are differed from each other? Explain with suitable examples. | Understand | CO | AAE011.03 |
| 14 | What are the parameters are measured by Air Data System? Explain the techniques to measure these data. | Remember | CO1 | AAE011.03 |
| 15 | What is Air Data Computer? How it works? How it gets inputs? Explain in detail. | Remember | CO1 | AAE011.03 |
| 16 | Explain with neat diagram about aircraft force system during straight and level flight and during pitch up at 30 degree. | Apply | CO1 | AAE011.03 |
| 17 | Explain how total drag of an airplane is estimated? Give mathematical equation and explain with diagram. Write the effect of aspect ratio on drag of the aircraft. | Understand | CO1 | AAE011.04 |
| 18 | Write about the factors which affect the drag. Explain each factor in detail. Write the formula for the drag and explain. | Apply | CO1 | AAE011.04 |
| 19 | Differentiate between power producing and thrust producing engines. Where these types are suitable? Explain with examples. | Understand | CO1 | AAE011.04 |
| 20 | Draw the plot of thrust required and flight velocity. Explain each point and its importance in flight performance. | Understand | CO1 | AAE011.04 |
| **PART - C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)** | | | | |
| 1 | With relevant sketches explain the characteristics of atmosphere. Explain the temperature, pressure and density variation in standard atmosphere. | Remember | CO1 | AAE011.02 |
| 2 | Explain with sketches the vertical development of the international standard atmosphere. | Remember | CO1 | AAE011.02 |
| 3 | Derive the relationship expression for geo-potential height (h) and geometrical height (hg). | Understand | CO1 | AAE011.02 |
| 4 | Derive the pressure-height relation in the stratosphere region. Explain about all governing parameters. | Remember | CO1 | AAE011.02 |
| 5 | Derive the relation for the measurement of equivalent airspeed and its significance with true air speed. | Remember | CO1 | AAE011.02 |
| 6 | Discuss the practical considerations of air data measurement. Name important equipments used in cockpit operated by air system. | Understand | CO1 | AAE011.02 |
| 7 | Derive the expression for pressure variation with change of altitude in the standard atmosphere. | Understand | CO1 | AAE011.03 |
| 8 | Explain about the three common altimeter datum settings that are used in the measurement of height with a neat sketch. | Remember | CO1 | AAE011.03 |
| 9 | Derive the full law calibration expression used for the measurement of airspeed in airspeed indicator. | Understand | CO1 | AAE011.03 |
| 10 | Explain briefly how the mach number and temperature are measured for the aircraft performance. | Understand | CO1 | AAE011.03 |
| 11 | Plot the international atmosphere with elevation and temperature. Explain salient features of this plot. | Remember | CO1 | AAE011.03 |
| 12 | 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? | Understand | CO1 | AAE011.03 |
| 13 | Derive expression for maximum lift to drag ratio (L/D). With respect to the coefficient of drag ($C_{D,0}$) at zero angle of attack. | Apply | CO1 | AAE011.03 |
| 14 | For a Gulf stream aircraft with total weight is 33000 kg, S= 88 $m^2$, $C_{D,0}$=0.015, K=0.08. If the velocity of the airplane is 122 m/s. Calculate the L/D ratio. Do the analysis of this aircraft with result obtained. (take standard conditions at sea level) | Apply | CO1 | AAE011.04 |
| 15 | For a Gulf stream aircraft with total weight is 36000 kg, S= 98 $m^2$, $C_{D,0}$=0.012, K=0.09. If the velocity of the airplane is 122 m/s. | Apply | CO1 | AAE011.04 |

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| | Calculate the maximum value of $C_L^{3/2}/C_D$, $C_L/C_D$, and $C_L^{1/2}/C_D$, as well as flight velocities at which they occurs. (Take standard conditions at sea level) | | | |
| 16 | Explain the aerodynamic relations of maximum $C_L^{3/2}/C_D$, $C_L/C_D$, and $C_L^{1/2}/C_D$. Write importance of these parameters and importance. | Apply | CO1 | AAE011.04 |
| 17 | What is stall velocity? What are the other velocities related to flight performance? Explain about all and write their importance. | Remember | CO1 | AAE011.03 |
| 18 | For a Gulf stream aircraft with total weight is 39000 kg, S= 108 $m^2$, $C_{D,0}$=0.015, K=0.07. If the velocity of the airplane is 122 m/s. Calculate the minimum power required and the velocity at which this occurs. (Take standard conditions at sea level). | Apply | CO1 | AAE011.04 |
| 19 | Explain about propulsive power and specific fuel consumption. Draw the diagram and show how specific fuel consumption is related to efficiency? | Understand | CO1 | AAE011.03 |
| 20 | Explain about minimum drag speed and minimum power speed by suitable diagram. Draw the plot of drag verses speed and show all important points related to performance. | Understand | CO1 | AAE011.03 |
| **UNIT – II** | | | | |
| **CRUISE PERFORMANCE** | | | | |
| **PART - A (SHORT ANSWER QUESTIONS)** | | | | |
| 1 | What do you understand by cruise performance? Write some important aspects of this performance. | Remember | CO2 | AAE011.05 |
| 2 | Describe about range and endurance of an aircraft. How these parameters are important for aircraft performance? | Remember | CO2 | AAE011.05 |
| 3 | How angle of attack is so important for assessing aircraft performance? How this affects the performance of an aircraft? | Remember | CO2 | AAE011.05 |
| 4 | Describe about wing loading. How the wing loading is deemed as one of the most important parameters for evaluating aircraft performance? | Remember | CO2 | AAE011.05 |
| 5 | What is service ceiling and absolute ceiling? How these two are differing with each other? | Understand | CO2 | AAE011.06 |
| 6 | Describe about stall speed or minimum steady flight speed for an airplane. | Remember | CO2 | AAE011.05 |
| 7 | Differentiate among VS, VS0 and VS1. Where these terms are used? Explain these terms with diagram. | Remember | CO2 | AAE011.05 |
| 8 | Describe about gliding. How this is achieved? | Remember | CO2 | AAE011.05 |
| 9 | What parameters are most required for better gliding? Explain with examples. | Understand | CO2 | AAE011.06 |
| 10 | Long wings of birds are more suitable for continental flight. Describe it with some mathematical evidence and formulations. | Remember | CO2 | AAE011.01 |
| 11 | Bird's wing tips are not in plane and smooth. Give your thought on this issue. | Remember | CO2 | AAE011.05 |
| 12 | For gliders which force is not essential? Explain with suitable force diagram. | Understand | CO2 | AAE011.06 |
| 13 | What is straight and level flight? Write equation for these conditions with suitable force diagram. | Understand | CO2 | AAE011.06 |
| 14 | What do you understand by accelerated and steady flight? What is the basic difference between these two flight conditions? | Remember | CO2 | AAE011.05 |
| 15 | Draw the force vectors for takeoff condition of an aircraft giving all necessary forces. | Remember | CO2 | AAE011.05 |
| 16 | What do you understand by shallow and steep angles of landing? Which angle is the best for Airbus 320 landing? | Understand | CO2 | AAE011.01 |
| 17 | Draw a diagram for Turn and Banking flight, showing angles and related forces. | Remember | CO2 | AAE011.01 |
| 18 | Describe with diagram about pullout/pull down flight condition. Explain the gravity force acting on aircraft and its importance. | Understand | CO2 | AAE011.06 |
| 19 | Define Critical Mach number and write its importance on flight mechanics. | Understand | CO2 | AAE011.06 |
| 20 | What is cruise technique 1? Explain with diagram and enumerate its | Understand | CO2 | AAE011.06 |

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| | significance in aircraft flight performance. | | | |
| **PART - B (LONG ANSWER QUESTIONS)** | | | | |
| 1 | Explain minimum drag speed and minimum power speed and describe their importance in the aircraft performance studies. | Remember | CO2 | AAE011.05 |
| 2 | Explain the total airplane drag and types, drag reduction methods. | Understand | CO2 | AAE011.06 |
| 3 | Explain with neat diagram the forces involved for straight and level flight. Which forces are equal to each other in this flight conditions? | Remember | CO2 | AAE011.05 |
| 4 | Elaborate and describe Cruise Technique - 1 and explain the advantages and disadvantages. | Remember | CO2 | AAE011.05 |
| 5 | Describe and elaborate Cruise Technique - 2 and explain the benefits and drawbacks of this technique. | Remember | CO2 | AAE011.05 |
| 6 | Compare all the cruise techniques and write the relevant results from all the three techniques. | Remember | CO2 | AAE011.05 |
| 7 | Discuss and elaborate Cruise Technique – 3 with relevant equations and graphs. | Understand | CO2 | AAE011.06 |
| 8 | Explain the effect of alternative fuel flow laws. How these laws are necessary for flight performance of an aircraft. Describe in details. | Remember | CO2 | AAE011.05 |
| 9 | Derive the endurance formula for a piston engine aircraft. Explain each term in detail. | Describe | CO2 | AAE011.07 |
| 10 | Derive the range expression for a jet powered aircraft. Explain each term in detail. | Describe | CO2 | AAE011.07 |
| 11 | 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? | Understand | CO2 | AAE011.06 |
| 12 | What are the Equations of Motion in straight and level flight? Derive the Equations of Motion in straight and level flight and explain each term. | Apply | CO2 | AAE011.08 |
| 13 | Derive the equations of motions for the airplane in translational motion through three dimensional spaces over a flat earth. | Apply | CO2 | AAE011.08 |
| 14 | Describe the importance of thrust required and derive expression for this using analytical method. | Describe | CO2 | AAE011.07 |
| 15 | Explain about thrust to weight ratio, wing loading and drag polar related to aircraft performance. How these parameters are useful for the study of aircraft performance? | Understand | CO2 | AAE011.06 |
| 16 | Derive the expression for maximum endurance and range for propeller driven airplane. | Apply | CO2 | AAE011.01 |
| 17 | Derive the expression for maximum endurance and range for jet propelled airplane. | Apply | CO2 | AAE011.08 |
| 18 | What do you understand by endurance and range? How these parameters are calculated for aircraft? | Understand | CO2 | AAE011.06 |
| 19 | Write different methods to calculate cruise performance. Compare different methods with its advantages and disadvantages. | Understand | CO2 | AAE011.06 |
| 20 | What do you understand by cruise performance with mixed power plant? How this method is different that the individual methods? Explain with diagram. | Understand | CO2 | AAE011.06 |
| **PART – C (PROBLEM SOLVING AND CRITICAL THINKING)** | | | | |
| 1 | Describe the constant altitude, constant mach number cruise method. Draw the plots for both the conditions and explain giving examples. | Understand | CO2 | AAE011.06 |
| 2 | Explain the constant angle of attack, constant altitude cruise method. Draw the plots for both the conditions and explain by drawing neat sketch. | Understand | CO2 | AAE011.06 |
| 3 | With drawing relevant graphs, explain the thrust variation with Mach number and bypass ratio. How these parameters are affecting aircraft performance? | Describe | CO2 | AAE011.07 |
| 4 | Explain the constant angle of attack, constant Mach number cruise method. Draw the plots for both the conditions and explain by drawing neat sketch. | Describe | CO2 | AAE011.07 |
| 5 | Obtain the expression for minimum drag speed and explain with relevant graphs. | Describe | CO2 | AAE011.07 |
| 6 | Discuss the effect of Mach number on lift and drag coefficient with relevant graphs. | Understand | CO2 | AAE011.06 |
| 7 | Explain the following terms Gradient of Climb & Rate of climb. | Understand | CO2 | AAE011.06 |

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| | Derive the equation for rate of climb of an aircraft. | | | |
| 8 | Compare range and endurance obtained for all cruise techniques. Derive the maximum range and endurance condition. | Understand | CO2 | AAE011.06 |
| 9 | Derive the range and endurance expression for aircraft with power producing engines. | Describe | CO2 | AAE011.07 |
| 10 | Derive the range and endurance expression for aircraft with mixed power plants. | Apply | CO2 | AAE011.08 |
| 11 | Explain about the effects of head wind and tail wind on the range and endurance of the aircraft. Draw the diagram and explain about the effect of wind. | Demonstrate | CO2 | AAE011.08 |
| 12 | Formulate the range expression of propeller driven airplane by considering head and tail wind conditions | Describe | CO2 | AAE011.07 |
| 13 | "The maximum range, in the presence of wind, is not obtained at Em but at a different L/D". Discuss this issue and give your opinion on this statement with necessary formula and plot. | Understand | CO2 | AAE011.06 |
| 14 | Draw a combined plot of maximum range velocity with respect to head wind and tail wing and explain the effects of wind direction on the range of an aircraft. | Understand | CO2 | AAE011.06 |
| 15 | Derive the expression for the range of the aircraft having turboprop engine. How this range differs from turbojet engine? | Apply | CO2 | AAE011.08 |
| 16 | For a commercial aircraft with total weight is 30000 kg, S= 90 $m^2$, $C_{D,0}$=0.012, K=0.09. If the velocity of the airplane is 140 m/s. Calculate the minimum power required and the velocity at which this occurs. (Take standard conditions at sea level). | Apply | CO2 | AAE011.08 |
| 17 | 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? | Apply | CO2 | AAE011.08 |
| 18 | The natural flyers like insects are low Reynolds number flyers. Give the flight performance parameters of such flyers. How these flyers get best performance out of it? Explain with substance. | Apply | CO2 | AAE011.08 |
| 19 | Calculate the range and endurance of a propeller aircraft with 80.5 kmph head wind at sea level. The aircraft has the following characteristics:<br>*Wf* =15 percent of total weight, η= 0.8, C = 2.2 N/HP-hr, W/S= 34, $C_D$= 0.022+0.060$C^2_L$. | Apply | CO2 | AAE011.08 |
| 20 | Derive the jet aircraft range expression with the assumption that the cruise velocity is constant. | Demonstrate | CO2 | AAE011.08 |
| **UNIT-III** | | | | |
| **CLIMB AND DESCENT PERFORMANCE** | | | | |
| **PART - A (SHORT ANSWER QUESTIONS)** | | | | |
| 1 | What do you understand by Energy Height? Explain it's importance for aircraft performance. | Understand | CO3 | AAE011.09 |
| 2 | Explain in detail, with relevant formulae about specific excess power. Explain with thrust - velocity diagram. | Understand | CO3 | AAE011.09 |
| 3 | What is equation of motion of aircraft in steady cruise condition? Explain each term with detail. | Describe | CO3 | AAE011.09 |
| 4 | What is climb performance based on CAS? Explain with forces on aircraft in this condition. | Remember | CO3 | AAE011.09 |
| 5 | Explain the about all types of Aerodynamic forces during climbing Flight with neat diagram. | Illustrate | CO3 | AAE011.10 |
| 6 | Describe about steady rate of climb and derive the equation for rate of climb. | Understand | CO3 | AAE011.09 |
| 7 | Show graphically, the effect of minimum drag speed of flight path control. | Understand | CO3 | AAE011.09 |
| 8 | What are the important phases of descending flight? Explain the equations for rate of sink during glide condition. | Understand | CO3 | AAE011.10 |
| 9 | Define the term total energy climb. Explain its importance for aircraft flight performance. | Understand | CO3 | AAE011.10 |
| 10 | Discuss about climb gradient of an aircraft with thrust producing engines. | Understand | CO3 | AAE011.10 |
| 11 | What do you understand by descent performance in aircraft operation? Explain its importance in aircraft performance. | Remember | CO3 | AAE011.09 |

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| 12 | Describe minimum fuel climb. What is its importance in flight performance of an airplane? | Remember | CO3 | AAE011.09 |
| 13 | Describe optimal climb. What is its importance in flight performance of an airplane? | Remember | CO3 | AAE011.09 |
| 14 | What is pitch power table? How this table is useful for flight operations? | Remember | CO3 | AAE011.09 |
| 15 | How the Rate of climb (ROC) is decided? What is maximum ROC for any airplane? | Remember | CO3 | AAE011.09 |
| 16 | Describe the best lift to drag ratio of any flyer. At what angle of attack this is found maximum. | Understand | CO3 | AAE011.09 |
| 17 | What happens when any aircraft fly at best L/D ratio? Write the effected parameters. | Remember | CO3 | AAE011.09 |
| 18 | Describe rule of three. How it is used during descent of flight? Explain with example. | Understand | CO3 | AAE011.09 |
| 19 | What is steepest gradient of descent? What is the maximum value of this gradient? | Remember | CO3 | AAE011.10 |
| 20 | Describe the specific total energy. How this is useful for aircraft performance? | Remember | CO3 | AAE011.10 |
| **PART – B (LONG ANSWER QUESTIONS)** | | | | |
| 1 | Discuss how each of the aerodynamic characteristics affects the performance characteristics of the airplane? | Understand | CO3 | AAE011.10 |
| 2 | Explain about climb gradient and climb rate of an aircraft with power producing engines. | Understand | CO3 | AAE011.09 |
| 3 | Explain about climb gradient and climb rate of an aircraft with thrust producing engines. | Understand | CO3 | AAE011.09 |
| 4 | Why climb performance is one of the critical areas in both the design and operation of an aircraft? | Understand | CO3 | AAE011.10 |
| 5 | Discuss the effect of Mach number on lift and drag coefficient with relevant graphs. | Understand | CO3 | AAE011.10 |
| 6 | Explain the importance of descent performance in aircraft operations. Differentiate between civil and military aircraft. | Understand | CO3 | AAE011.09 |
| 7 | Explain the concept of high performance climb. Differentiate between civil and military aircraft. | Understand | CO3 | AAE011.09 |
| 8 | What are the phases of descending flight? Explain them in brief for military and civil aircraft. | Understand | CO3 | AAE011.10 |
| 9 | What are the effects if descent is done at airspeed less than minimum drag speed explain briefly? | Understand | CO3 | AAE011.09 |
| 10 | State the two approaches of climb that generally followed and brief them with example. | Understand | CO3 | AAE011.09 |
| 11 | Explain the limitations of the descent for the transport aircrafts and how it defers from the military fighter aircraft? | Apply | CO3 | AAE011.09 |
| 12 | Derive the expression for the Maximum Climb Angle by using analytical approach for jet propelled airplane. | Apply | CO3 | AAE011.12 |
| 13 | Derive the expression for the Maximum Climb Angle by using analytical approach for a propeller driven airplane. | Apply | CO3 | AAE011.12 |
| 14 | Draw a plot of power verses velocity and show the maximum excess power of climb for a propeller driven airplane. | Understand | CO3 | AAE011.12 |
| 15 | Describe about absolute ceiling, service ceiling and self ceiling for an airplane. How these ceilings are useful for study of the flight performance of an airplane? | Understand | CO3 | AAE011.01 |
| 16 | Draw the diagram of shallow and deep climb angles and write the equations of motion in both nconditions.What is the correct relationship between the true airspeed for (i) minimum sink rate (ii) minimum glide angle at a given altitude. | Understand | CO3 | AAE011.11 |
| 17 | When Airplane performs a straight steady climb with a 20% climb gradient. Calculate the load factor. | Apply | CO3 | AAE011.12 |
| 18 | “Lift to Drag ratio is called the efficiency of the wing”. How this is affecting climb rate, glide and descent performance? Explain. | Understand | CO3 | AAE011.11 |
| 19 | For climbing three parameters are essential known as PAT (Power, Attitude and Trim). Explain these with diagram. | Understand | CO3 | AAE011.11 |
| 20 | Write the factors affecting aircraft performance during climb and descent | understand | CO3 | AAE011.09 |

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| **PART – C (PROBLEM SOLVING AND CRITICAL THINKING)** | | | | |
| 1 | Discuss how each of the aerodynamic characteristics in turn affect the performance characteristics of the airplane. | Understand | CO3 | AAE011.11 |
| 2 | Discuss on the aspects of minimum fuel climbs. | Understand | CO3 | AAE011.11 |
| 3 | Explain briefly the methods to measure the best climb performance. | Understand | CO3 | AAE011.09 |
| 4 | Derive expressions for climb gradient and climb rate for aircraft with thrust producing engines. | Understand | CO3 | AAE011.11 |
| 5 | Discuss the effect of wind on climb and descent performance. | Understand | CO3 | AAE011.11 |
| 6 | Derive the expression for load factor as a function of Lift, Thrust and bank angle. | Understand | CO3 | AAE011.01 |
| 7 | Discuss on the effect of wind on climb and descent performance. | Understand | CO3 | AAE011.09 |
| 8 | Explain in detail, with relevant formulae Climb rate, Climb gradient, Thrust producing engines and Minimum fuel climbs. | Understand | CO3 | AAE011.11 |
| 9 | Explain about Limit load factor and ultimate load factor with relevant diagram. | Understand | CO3 | AAE011.11 |
| 10 | Derive the high performance specific climb expression in terms of specific excess power. | Remember | CO3 | AAE011.01 |
| 11 | Given an airplane mass of 50000 kg, Lift/Drag ratio 10, thrust per engine 60, 000N, assume g=10 m/s$^2$. For a straight, steady, wings level climb of a twin engine airplane. Calculate the all engine climb gradient. | Apply | CO3 | AAE011.12 |
| 12 | Determine the range of the following propeller-driven aircraft, with the following data, at a constant airspeed of 80.5 m/s at 2440 m altitude:<br>$W_1$ =82.29 kN, $W_{fuel}$ = 26.69 kN, $S$ = 87 m$^2$, $\eta_p$ = 0.85, $C$ = 2.0 N/HP-hr, $C$= 0.0192 +0.047$C^2_{L.}$ | Apply | CO3 | AAE011.12 |
| 13 | An F-86 aircraft has the following characteristics:<br>$C_D$ = 0.0159 +0.075 $C^2_L$ (clean), $W_1$ =63 kN, q =9.2kN/m$^2$, S = 27 m$^2$, $W_f$ =13 kN , Rate of fuel flow (Wf) = 4.5 kN/hr<br>Calculate:<br>a. The range at constant velocity starting at 7620 m.<br>b. The final altitude at the end of this range | Apply | CO3 | AAE011.12 |
| 14 | Calculate the range for the aircraft in Example 5.2 for the constant altitude flight at 25,000 ft. Data are given below<br>$C_D$ = 0.0159 +0.075 $C^2_L$ (clean), $W_1$ =63 kN, q =9.2kN/m$^2$, S = 27 m$^2$, $W_f$ =13 kN , rate of fuel flow(Wf) =4.5 kN/hr. | Apply | CO3 | AAE011.12 |
| 15 | Derive the expression for rate of climb (ROC) for an aircraft. Show that the thrust to weight ratio and wing loading are the two major performance characteristics that influence the ROC. | Apply | CO3 | AAE011.01 |
| 16 | Derive the mathematical expression for glide velocity for unpowered flight. What relation is found between wing loading glide velocity? | Apply | CO3 | AAE011.12 |
| 17 | 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. | Apply | CO3 | AAE011.12 |
| 18 | Fir a high performance aircraft with a thrust to weight ratio of 0.9 and $L/D_{max}$ of 10. Calculate the maximum climb angle of the aircraft. | Apply | CO3 | AAE011.12 |
| 19 | An aircraft has the following characteristics:<br>W= 16 kN, S= 42 m$^2$, $T_0$ = 26.7 kN, CD=0.014+0.05 $C^2_L$, if its thrust assumed to be constant and its climb at 95 m/s in a shallow angle, calculate:<br>a) Angle of climb<br>b)Rate of climb<br>c) Maximum angle of climb<br>d) Maximum rate of climb | Apply | CO3 | AAE011.12 |
| 20 | An aircraft has the following characteristics:<br>W= 16 kN, S= 42 m$^2$, $T_0$ = 26.7 kN, CD=0.014+0.05 $C^2_L$, if its thrust increased to 7.2 kN and its climbing speed corresponding to $E_{m.}$ Calculate path angle and rate of climb. | Apply | CO3 | AAE011.12 |
| **UNIT IV** | | | | |
| **AIRCARFT MANEUVER PERFORMANCE** | | | | |
| **PART – A (SHORT ANSWER QUESTIONS)** | | | | |

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| 1 | Describe about Maneuver and Turning performance. Why it is essential as part of airplane performance? | Understand | CO4 | AAE011.13 |
| 2 | Write notes on Military aircraft maneuver performance. Is the maneuvering of the military fighter should be more than civil aircrafts? | Understand | CO4 | AAE011.13 |
| 3 | Give two reasons which limit the aircraft maneuver performance. | Understand | CO4 | AAE011.13 |
| 4 | What are the different types of maneuver? | Understand | CO4 | AAE011.13 |
| 5 | Discuss the range of maximum positive structural load limit n1for different aircrafts. | Understand | CO4 | AAE011.13 |
| 6 | Define the term lateral acceleration. | Understand | CO4 | AAE011.13 |
| 7 | State the expression for radius of turn in pull up maneuver. | Understand | CO4 | AAE011.13 |
| 8 | Write the equation of motion of an aircraft undergoing longitudinal maneuver. | Understand | CO4 | AAE011.13 |
| 9 | Define the term specific excess power. | Remember | CO4 | AAE011.13 |
| 10 | Define the term linear acceleration? | Remember | CO4 | AAE011.13 |
| 11 | Describe about pull-ups and draw the diagram to explain about it. | Understand | CO4 | AAE011.13 |
| 12 | Describe about pull-ups and draw the diagram to explain about it. | Understand | CO4 | AAE011.13 |
| 13 | Give limits of load factor to fighter and transport aircraft. Which is more and why? | Understand | CO4 | AAE011.13 |
| 14 | What is linear acceleration? Explain for aircraft perspective. | Remember | CO4 | AAE011.13 |
| 15 | What are the limitations of the structural boundaries of the airplane? Explain with sketch. | Remember | CO4 | AAE011.13 |
| 16 | Describe about airspeed boundary for V-n diagram. Give its limitations. | Understand | CO4 | AAE011.13 |
| 17 | What is pop-up maneuver? Where this maneuver is used? Explain. | Illustrate | CO4 | AAE011.14 |
| 18 | Write the basic conditions for pull-up maneuver. Explain in short. | Illustrate | CO4 | AAE011.14 |
| 19 | What is high “g” maneuver? Upto what limit a human can withstand “g” maneuvers? | Illustrate | CO4 | AAE011.14 |
| 20 | What do you understand by sustained turn? How this maneuver is performed? | Understand | CO4 | AAE011.14 |
| | **PART – B (LONG ANSWER QUESTIONS)** | | | |
| 1 | Describe the equations of motion of an aircraft undergoing lateral maneuver or level turn and derive an expression for radius of turn. | Understand | CO4 | AAE011.13 |
| 2 | Discuss with the help of a diagram the maneuver boundaries for turning performance. | Remember | CO4 | AAE011.13 |
| 3 | 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. | Remember | CO4 | AAE011.13 |
| 4 | Describe the pull-up maneuvers with neat sketches and also explain the importance of V-n diagram. | Understand | CO4 | AAE011.13 |
| 5 | Explain briefly with a neat sketch about pull up maneuver. Derive the expression for this. | Understand | CO4 | AAE011.13 |
| 6 | Explain briefly with a neat sketch about pull down maneuver. Derive the expression for this. | Understand | CO4 | AAE011.13 |
| 7 | Derive the expression for turning velocity during maneuvering flight of an airplane. | Remember | | AAE011.13 |
| 8 | Explain briefly about the factors that are limiting the radius of turn and rate of turn. | Understand | CO4 | AAE011.13 |
| 9 | Explain briefly the lateral maneuver or the level turn of an aircraft. Explain with mathematical equations. | Understand | CO4 | AAE011.13 |
| 10 | Write notes on Military aircraft maneuver performance. Is the maneuvering of the military fighter should be more than civil aircrafts? | Understand | CO4 | AAE011.13 |
| 11 | Explain the concepts of<br>a) Buffeting<br>b) Sonic boom | Understand | CO4 | AAE011.14 |
| 12 | Draw the V-n diagram and explain its important point. How this diagram is significant for pilot operating the plane? | Understand | CO4 | AAE011.14 |

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| 13 | What is the maximum load factor on an aircraft? Write formula for the maximum load factor and explain each term. | Understand | CO4 | AAE011.14 |
| 14 | What is the relation between load factor (n) and glide ratio (L/D)? Is it directly or inversely proportional? Explain its effects on maneuvering performance. | Illustrate | CO4 | AAE011.14 |
| 15 | Derive expression for minimum turn radius by giving necessary equations and explain all the parameters. | Understand | CO4 | AAE011.13 |
| 16 | What is maneuvering diagram? Explain with a plot of turn rate and true air speed (TAS) with different turn radius and loan factors. | Understand | CO4 | AAE011.15 |
| 17 | What is spiral flight? When this flight is performed? What controls are applied to get this maneuver? Explain with diagram. | Evaluate | CO4 | AAE011.15 |
| 18 | Draw the force diagram of turning climbing flight and explain about each force which is acting on the aircraft. | Evaluate | CO4 | AAE011.15 |
| 19 | Explain about most sustained turn of the aircraft. How this turn is achieved by the pilot. Name the controls employed. | Evaluate | CO4 | AAE011.15 |
| 20 | Describe turning flight in horizontal plane. Draw a sketch and show all the forces involved in this condition | Evaluate | CO4 | AAE011.15 |
| **PART – C (PROBLEM SOLVING AND CRITICAL THINKING)** | | | | |
| 1 | Describe the equations of motion of an aircraft undergoing lateral maneuver or level turn and derive an expression for radius of turn. | Understand | CO4 | AAE011.13 |
| 2 | Discuss with the help of a diagram the structural boundaries for maneuver envelope. | Remember | CO | AAE011.13 |
| 3 | Discuss with the help of a diagram the airspeed boundaries for maneuver envelope. | Understand | CO4 | AAE011.13 |
| 4 | Write notes on Instantaneous turns, Sustained turns and Military aircraft maneuver performance. | Understand | CO4 | AAE011.13 |
| 5 | Explain briefly about the extreme case of pull up maneuver called as 'Cobra'. | Understand | CO4 | AAE011.13 |
| 6 | Discuss the difference between military and transport aircraft maneuver performance. | Illustrate | CO4 | AAE011.14 |
| 7 | An airplane with a wing area of 20 $m^2$ and a weight of 19,620 N dives with engine switched off, along a straight line inclined at 60° to the horizontal. What is the acceleration of the airplane when the flight speed is 250 kmph? If the airplane has to pull out of this dive at a radius of 200 m, what will be the lift coefficient required and the load factor? Drag polar is given by: $C_D = 0.035 + 0.076C^2$ and the maneuver takes place around an altitude of 2 km. | Apply | CO4 | AAE011.16 |
| 8 | Define load factor. What are its values in (a) level flight (b) free fall (c) in a turn of radius 200 m at a speed of 100 m/s and (d) at the bottom of a loop of radius 200 m at a speed of 100 m/s? | Evaluate | CO4 | AAE011.15 |
| 9 | Explain briefly the longitudinal maneuver of an aircraft. Writ its importance for flight mechanics. | Understand | CO4 | AAE011.13 |
| 10 | Explain briefly the parameters that are influencing the turning performance of a jet airplane. | Understand | CO4 | |
| 11 | An airplane has a jet engine which produces a thrust of 24,525 N at sea level. The weight of the airplane is 58,860 N. The wing has an area of 28 $m^2$, zero-lift angle of – 2.2° and a slope of lift curve of 4.6 per radian. Find<br>(a) the radius of a correctly banked 4g level turn at the altitude where □ = 0.8 and the wing incidence is 8°,<br>(b) time required to turn through 180° and<br>thrust required in the maneuver if the drag coefficient at this angle of attack be 0.055. | Apply | CO4 | AAE011.16 |
| 12 | An aircraft has the following characteristics:<br>$C_{Lmax}$ = 1.5, $S$ = 11.6 $m^2$ , $W$ = 907 kg, $n_1$ = 4, $C_D = 0.02 + 0.05C_L^2$ , $T$ = 136 kg for all flight speed at sea level (turbojet), ε= 0. Calculate the minimum time added to perform a constant altitude $180^0$ turn. | Apply | CO4 | AAE011.16 |
| 13 | Consider a light aircraft with the following characteristics:<br>W = 1360 kg, S =25 $m^2$, $C_{Lmax}$= 1.2, $C_D = 0.025 + 0.06C_L^2$, $h$ =1524 m. The aircraft is in a $45^0$ steady, banked, gliding turn. Calculate the glide performance for one full turn. | Apply | CO4 | AAE011.16 |
| 14 | Draw the turn maneuverability energy diagram for an aircraft and explain its salient features. How these features are significant for | Evaluate | CO4 | AAE011.16 |

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| | determination of the performance of an aircraft? | | | |
| 15 | Derive the mathematical equation for the rotation rate for the modest thrust to weight ratio. Explain each term in detail related to aircraft performance. | Evaluate | CO4 | AAE011.15 |
| 16 | Consider a light aircraft with the following characteristics: W = 3,000 Kg, S = 225 $m^2$, $C_{Lmax}$ =1.2, $C_D = 0.025 + 0.06C^2_L$, h= 5,000 m. The aircraft is in a $45^0$ steady, banked, gliding turn. Calculate the glide performance for one full turn. | Apply | CO4 | AAE011.16 |
| 17 | An airplane has the following characteristics: V =120 kmph., EAS, h= 10,000 m, W = 3,400 kg, W/S = 24 $kg/m^2$, L/D =10, Ta = 6,200 kg. It makes a $90^0$ turn in 18 seconds maintaining altitude and incidence angle. Calculate the load factor, bank angle, radius of turn, and the thrust horsepower required. | Apply | CO4 | AAE011.16 |
| 18 | Derive the expression for highest possible level turn. For having highest turn what are the two parameters which play important role. | Evaluate | CO4 | AAE011.15 |
| 19 | Calculate the minimum turn radius, load factor , velocity and Coefficient of lift at sea level for Airbus 310: Details are given: K=0.08, W/S=76.84, T/W= 0.37, $C_{D,0}$= 0.015(missing data can be assumed). | Apply | CO4 | AAE011.16 |
| 20 | Calculate the minimum turning rate, loan factor, velocity of Boeing 727-200 aircraft with given detail at sea level: K=0.08, W/S=76.84, T/W= 0.37, $C_{D,0}$= 0.015 (missing data can be assumed). | Apply | CO4 | AAE011.16 |
| **UNIT-V** | | | | |
| **TAKE-OFF AND LANDING-SAFETY REQUIREMENS – FLIGHT PLANNING** | | | | |
| **PART - A (SHORT ANSWER QUESTIONS)** | | | | |
| 1 | Discuss on the aspects of take-off performance safety factors. | Understand | CO5 | AAE011.17 |
| 2 | Explain the need of 'trip fuel' and 'the diversion fuel. What are the circumstances when these terminologies are used? | Understand | CO5 | AAE011.17 |
| 3 | Analyze the performance of the aircraft during landing. Name the parameters which play major contribution to calculate landing characteristics. | Remember | CO5 | AAE011.17 |
| 4 | Explain how the takeoff distances are classified into according their operation of performance. | Understand | CO5 | AAE011.17 |
| 5 | Derive the ground run distance for takeoff performance. | Remember | CO5 | AAE011.01 |
| 6 | Explain the concept of take off performance safety factors. | Understand | CO5 | AAE011.17 |
| 7 | Discuss about the abandon landing. What are the circumstances when abandon landing is performed? | Understand | CO5 | AAE011.17 |
| 8 | Describe about the term Flight Planning. When the flight planning is undertaken? | Evaluate | CO5 | AAE011.19 |
| 9 | Explain the terms Trip fuel and Diversion fuel. Why these terms are so important to study performance? Explain | Understand | CO5 | AAE011.17 |
| 10 | Derive the ground run distance for landing performance. What is the importance of ground run? Why it is needed? | Illustrate | CO5 | AAE011.01 |
| 11 | Explain about terminal phases of an aircraft. Write names of all phases used for aircraft from start to end. | Illustrate | CO5 | AAE011.18 |
| 12 | Briefly describe about takeoff and landing phases. How the distance of the runway is important in these phases? | Understand | CO5 | AAE011.17 |
| 13 | What is ground run distance? How this distance is calculated for a passenger aircraft? | Remember | CO5 | AAE011.17 |
| 14 | Differentiate between ground run distance and airborne distance. Which distance is important for runway length consideration? | Understand | CO5 | AAE011.17 |
| 15 | Describe engine failure accountability for an aircraft. How this accountability is found out? | Understand | CO5 | AAE011.17 |
| 16 | Describe about conventional takeoff and landing. Write all approaches while doing landing and takeoff. | Understand | CO5 | AAE011.17 |
| 17 | What is RTOL? Explain its need for landing. What are the occasions when pilot follow this method of landing? | Remember | CO5 | AAE011.17 |
| 18 | Differentiate between STOL, VTOL and STOVL. Explain the need of these in modern age of aeronautics. | Understand | CO5 | AAE011.17 |

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| 19 | What is minimum control speed? Which scenario this speed can be dangerous for producing sufficient control of an airplane? | Understand | CO5 | AAE011.17 |
| 20 | Describe rotation speed of an aircraft. Where this term is significant? | Understand | CO5 | AAE011.17 |
| **PART - B (LONG ANSWER QUESTIONS)** | | | | |
| 1 | Analyze the performance of the aircraft during takeoff. Name the parameters which play major contribution to calculate takeoff characteristics. | Remember | CO5 | AAE011.01 |
| 2 | Explain the current performance classifications of a Civil Transport aircrafts. How this differs from Military aircrafts? | Understand | CO5 | AAE011.01 |
| 3 | Explain on the engine failure speed and refusal speed. | Understand | CO5 | AAE011.01 |
| 4 | Explain about safety and quality regulatory body in India. Write the role and responsibilities of DGCA and FAA. | Understand | CO5 | AAE011.01 |
| 5 | Explain the take-off performance measurement. Derive its equations and explain with suitable mathematical equations. | Understand | CO5 | AAE011.01 |
| 6 | Explain Flight Planning and discuss the importance. Who is responsible for flight panning? | Remember | CO5 | AAE011.01 |
| 7 | Explain the effects on the takeoff distances of the below flight variables.<br>a) Aircraft weight b) Head wind<br>c) Atmosphere effects d) Runway conditions | Understand | CO5 | AAE011.01 |
| 8 | Discuss the four phases of the flight planning with a neat sketch. | Understand | CO5 | AAE011.01 |
| 9 | Explain in brief the methods to measure the aircraft performance. | Understand | CO5 | AAE011.17 |
| 10 | Aircraft achieve altitude fairly quickly on takeoff, so why the long slow descent for landing? Explain with neat diagram. | Illustrate | CO5 | AAE011.18 |
| 11 | Describe about coefficient of lift at liftoff. What is the optimal value for this parameter? | Understand | CO5 | AAE011.17 |
| 12 | Elucidate about minimum unstick speed. How this speed is related with airborne? | Understand | CO5 | AAE011.17 |
| 13 | Expound about aircraft takeoff safety speed for an aircraft. How this safety speed is achieved during takeoff and how it is decided by the pilot? Explain in detail about this speed. | Remember | CO5 | AAE011.17 |
| 14 | Draw the landing path and total landing distance diagram. Explain all necessary terminology used in this diagram. | Understand | CO5 | AAE011.17 |
| 15 | Explain about Approach distance, Flare distance and Ground Roll used for landing of an airplane. Differentiate all these distances by showing a neat diagram. | Understand | CO5 | AAE011.17 |
| 16 | Draw the force diagram for approach landing and flare conditions of landing. | Illustrate | CO5 | AAE011.18 |
| 17 | Write about factors which are affecting take off time of an airplane. Write necessary equations for this time and explain in detail about significance of each term. | Understand | CO5 | AAE011.01 |
| 18 | Explain the effects on the landing distances of the below flight variables.<br>a) Aircraft weight<br>b) Headwind | Illustrate | CO5 | AAE011.18 |
| 19 | Derive and explain approximate expression for the ground distance with the wind which may be head or tail wind. | Understand | CO5 | AAE011.17 |
| 20 | Explain the effects on the landing distances of the below flight variables.<br>a) Atmosphere effects<br>b) Runway conditions | Remember | CO5 | AAE011.18 |
| **PART – C (PROBLEM SOLVING AND CRITICAL THINKING)** | | | | |
| 1 | Draw the fuel planning chart and explain its significance. How fuel planning is done by the pilot. | Illustrate | CO5 | AAE011.18 |
| 2 | Explain takeoff and landing performances with a neat sketch. Derive the expression for landing distance. | Illustrate | CO5 | AAE011.18 |
| 3 | Derive the ground run and airborne distances for the landing performance. Explain about each parameters and its importance. | Understand | CO5 | AAE011.17 |
| 4 | Derive the ground run and airborne distances for the takeoff performance. Explain about each parameters and its importance. | Evaluate | CO5 | AAE011.19 |
| 5 | Explain the effect of flight variables on the landing performance. Explain about each parameters and its importance. | Evaluate | CO5 | AAE011.19 |

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| 6 | Explain the effect of flight variables on the takeoff performance. Name all necessary flight variables for these conditions. | Understand | CO5 | AAE011.17 |
| 7 | Discuss briefly the space available and space required for take-off of an aircraft. | Evaluate | CO5 | AAE011.19 |
| 8 | Discuss briefly the space available and space required for landing of an aircraft. Explain about each parameters and its importance. | Understand | CO5 | AAE011.17 |
| 9 | Explain the four phases of the flight planning briefly. Give the phases and draw the diagram and explain. | Understand | CO5 | AAE011.17 |
| 10 | Explain fuel planning and how the weight is categorized depend on the fuel planning. | Understand | CO5 | AAE011.17 |
| 11 | How runway slope (uphill) and runway friction coefficient on the ground do affect the ground run distance? Explain with suitable diagram and mathematical expression. | Evaluate | CO5 | AAE011.19 |
| 12 | Derive the expression for the aircraft Ground Roll. How the ground roll is related with free stream velocity and time? | Understand | CO5 | AAE011.17 |
| 13 | Carryout approximate analysis of the Ground Roll and derive equation for this. | Evaluate | CO5 | AAE011.19 |
| 14 | Derive the mathematical expression for approach and flare landing of the aircraft. Draw force diagram and explain these in detail. | Evaluate | CO5 | AAE011.19 |
| 15 | A twin-engine jet aircraft has the following characteristics at sea level: Details are given below. Missing data can be assumed. W = 22.68 tons, T =2268 - 3.28 V per engine, S =140 $m^2$ ,$C_{Lmax}$ = 1.5 , $C_D$= 0.02 +0.05$C^2_{L,}$Calculate the take-off distance on a smooth, dry concrete runway (μ=.02) at sea level for no-wind conditions. | Apply | CO5 | AAE011.20 |
| 16 | A twin-engine jet aircraft has the following characteristics at sea level: Details are given below. Missing data can be assumed. W = 22.0 tons, T =2200 - 3.28 V per engine, S =140 $m^2$ ,$C_{Lmax}$ = 1.5 , $C_D$= 0.02 +0.05$C^2_L$ , d=0.05. Determine the transition distance and the total takeoff distance on a smooth, dry concrete runway (μ=.02) at sea level for no-wind conditions. | Apply | CO5 | AAE011.20 |
| 17 | A twin-engine jet aircraft has the following characteristics at sea level: Details are given below. Missing data can be assumed. Where, W = 25.0 tons, T =2500 - 3.28 V per engine, S =150 $m^2$ ,$C_{Lmax}$ = 1.6, $C_D$= 0.02 +0.05$C^2_L$ , d=0.05, determine the take-off distance with 28 kmph headwind. | Apply | CO5 | AAE011.20 |
| 18 | An aircraft weighs 105,000 N, has a wing area of 75 $m^2$ and is traveling at 100 m/s at 6100 m altitude. Estimate the time to accelerate this aircraft to a speed of 250 m/sec if its thrust is increased to a constant value of 40,000 N. $C_D = 0.018 + 0.055C^2_L$ | Apply | CO5 | AAE011.20 |
| 19 | A twin jet aircraft is taking off from a concrete runway (μ = 0.04). The take-off polar is $C_D = 0.075 = 0.04C^2_{L,}$ With S = 54.8 $m^2$ , AR = 6, W = 266,880 N, $C_{Lmax}$ = 2.7, T/engine= 80,064 N = const, $T_{idle} = 0.07T$. Calculate: a. The ground run b. The ground run with one engine failing at 100 mph. c. The head wind required to reduce the ground run in b to that obtained in a—that is, what head wind is required to compensate for the loss of one engine? | Apply | CO5 | AAE011.20 |
| 20 | 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 $\mu_r$ = 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. | Apply | CO5 | AAE011.20 |

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