INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**AEROSPACE PROPULSION AND COMBUSTION**				
Course Code	AAE551				
Programme	B. Tech				
Semester	VI	ME			
Course Type	Open Elective - I				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Mr. M Vijay Kumar , Assistant Professor				
Course Faculty	Mr. M Vijay Kumar , Assistant Professor				

COURSE OBJECTIVES:

I	Demonstrate with an overview of various aerospace propulsion systems and a sound foundation in the fundamentals of thermodynamics.
II	Distinguish the elementary principles of thermodynamic cycles as applied to propulsion analysis.
III	Prioritize an introduction to combustion& gas kinetic theory.
IV	Discover the knowledge of working knowledge of and the tools to measure various flight propulsion systems such as turbojets, turbofans, ramjets, rockets, air turbo-rockets and nuclear/electric propulsion systems.

COURSE OUTCOMES (COs):

CO 1	Gain knowledge about power plants and aircraft engines performance
CO 2	Assess the importance of various types engine components used in the aircraft
CO 3	Obtain an insight in the concept of propellers, inlets and various nozzles in aircraft
CO 4	Assess the significance of combustion inside the engines and its performance
CO 5	Estimate the flammability limits, premixed flames and their significance in the combustion

COURSE LEARNING OUTCOMES (CLOs)

S. No.	Description
AAE551.01	Apply knowledge and understand the essential facts, concepts and principles of thermodynamics.
AAE551.02	Understand the basic function of all aircraft engine components and how they work.
AAE551.03	Analyze classification of aircraft propulsion.
AAE551.04	Demonstrate different type's aircraft engine operating principle.
AAE551.05	Understand step by step procedure of engine parametric cycle analysis.
AAE551.06	Describe principle of operation of axial and centrifugal compressor.
AAE551.07	Understand different design of compressor and limitations of each method.
AAE551.08	Analyze performance characteristics of axial and centrifugal turbines.
AAE551.09	Analyze propeller performance and its types and explain their impact on engine performance.
AAE551.10	Describe operational modes of subsonic inlets and parameters influencing it.
AAE551.11	Describe theory of flow in isentropic nozzle and physics behind nozzle operation.
AAE551.12	Understand different nozzle operating conditions for convergent and divergent nozzle.
AAE551.13	Understand different types of combustion chamber and functions of all the components.
AAE551.14	Describe the effect of operating variables on performance.
AAE551.15	Analyze combustion chamber performance and parameters influencing them.
AAE551.16	Describe the effect of flame tube cooling and its applications.
AAE551.17	Understand different types of premixed flames.
AAE551.18	Explain the significance of flammability limits during combustion process.
AAE551.19	Describe theory of droplet combustion and turbulent combustion.
AAE551.20	Analyze the numerical methods of LNS & DNS and explain the parameters influencing them.

UNIT – I

ELEMENTS OF PROPULSION

PART - A (SHORT ANSWER QUESTIONS)

S. No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes (COs)	Course Learning Outcomes (CLOs)
1	List out different types of gas turbine engine.	Remember	CO 1	AAE551.01
2	Describe ramjet and turbojet engine.	Remember	CO 1	AAE551.01
3	Explore the type of engine that would be used in a helicopter	Remember	CO 1	AAE551.01
4	Highlight turboprop different from a turbojet.	Remember	CO 1	AAE551.01

5	Explore type of engine that powers most of today's airliners and why?	Understand	CO 1	AAE551.01
6	Illustrate the difference between ramjet and scramjet engine.	Understand	CO 1	AAE551.01
7	Describe bypass ratio.	Remember	CO 1	AAE551.01
8	elucidate thermal efficiency	Remember	CO 1	AAE551.01
9	Describe propulsive efficiency	Remember	CO 1	AAE551.01
10	State thrust equation for simple turbojet engine.	Remember	CO 1	AAE551.01
11	Describe specific thrust	Understand	CO 1	AAE551.01
12	Describe specific fuel consumption	Understand	CO 1	AAE551.01
13	Illustrate specific impulse	Understand	CO 1	AAE551.01
14	Describe need for after burner.	Remember	CO 1	AAE551.01
15	Explore the parameters influencing engine thrust	Remember	CO 1	AAE551.01
16	Describe air-breathing engine.	Remember	CO 1	AAE551.01
17	Narrate non-air breathing engine.	Remember	CO 1	AAE551.01
18	Summarize the factors that affect engine thrust.	Understand	CO 1	AAE551.01
19	Justify turbo fan has better propulsive efficiency.	Remember	CO 1	AAE551.01
20	Enumerate combined cycle engine	Remember	CO 1	AAE551.01
PART - B (LONG ANSWER QUESTIONS)				
1	Distinguish between turboprop, turbofan, and turbojet engines (Draw figures to illustrate their configurations).	Understand	CO 1	AAE551.02
2	Solve thrust equation for ideal turbofan engine and assumptions made	Understand	CO 1	AAE551.02
3	Construct and illustrate the functions of all the major components in turbojet engine.	Remember	CO 1	AAE551.02
4	Solve thrust equation for ideal turbojet engine and assumptions made by control volume approach	Remember	CO 1	AAE551.02
5	Demonstrate the factors affecting the performance of an aircraft?	Remember	CO 1	AAE551.02
6	Analyze the performance parameters of gas turbine engine.	Understand	CO 1	AAE551.02
7	Demonstrate the procedure for cycle analysis of ideal turbojet engine.	Remember	CO 1	AAE551.02
8	Analyze isentropic efficiency for all components of simple turbojet engine.	Understand	CO 1	AAE551.02
9	Construct the working of a turbo fan engine.	Understand	CO 1	AAE551.02
10	Construct the working of a turbo jet engine.	Understand	CO 1	AAE551.02

PART - C (PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)				
1	Demonstrate the combined cycle engine and explore any one of combined cycle engine with neat sketch.	Remember	CO 1	AAE551.03
2	The effective jet velocity from a jet engine 2700 m/s. The forward flight velocity is 1350 m/s and the flow rate is 78.6 Kg/s. calculate 1) The thrust 2) Thrust power Propulsive efficiency	Remember	CO 1	AAE551.03
3	Contrast and compare in detail about variation of pressure temperature and velocity across turbojet engine.	Remember	CO 1	AAE551.03
4	A turbojet power plant uses aviation kerosene having a calorific value of 43 MJ/kg. The fuel consumption is 0.18 kg per hour per N of thrust, when the thrust is 9 KN. The aircraft velocity is 500 m/s, the mass of air passing through the compressor is 27 kg/s. Calculate air fuel ratio and overall efficiency.	Remember	CO 1	AAE551.04
5	Distinguish air-breathing and non-air-breathing engines and describe about gas generator.	Understand	CO 1	AAE551.04
6	The following data apply to a turbojet aircraft flying at an altitude of 6.1 km where the ambient conditions are 0.458 bar and 248 K. Speed of aircraft: 805km/h Pressure ratio of compressor: 4:1 Combustion chamber pressure loss: 0.21 bar Turbine inlet temperature: 1100 K Intake duct efficiency: 95% Isentropic efficiency of compressor: 0.85 Isentropic efficiency of turbine: 0.90 Mechanical efficiency of transmission: 99% Nozzle efficiency: 95% Nozzle outlet area: 0.0935 m^2 L.C.V of fuel: 43 MJ/kg Find the thrust and SFC in kg/Nh of thrust. Assume convergent nozzle. Take C_{pa} = 1.005 kJ/kg K and r = 1.4, C_{pg} =1.147 kJ/kg K and r = 1.33.	Understand	CO 1	AAE551.04
7	Design the flight limit and operational limits for different engines with neat sketch.	Remember	CO 1	AAE551.04
8	A simple turbojet unit operates with a maximum turbine inlet temperature of 1200 K, a pressure ratio of 4.25:1 and mass flow of 25 Kg/s under design conditions, the following component efficiencies may be assumed. Isentropic efficiency of compressor: 87%. Isentropic efficiency of turbine: 91.5% Propelling nozzle efficiency: 96.5%. Transmission efficiency: 98.5%. Combustion chamber pressure loss: 0.21 bar. Assume C_{pa} = 1.005 KJ/Kg and r = 1.4 C_{pg} = 1.147 KJ/Kg and r = 1.33	Understand	CO 1	AAE551.04
9	A turbo prop aircraft flying at 600 km/h at an altitude where the ambient conditions are 0.458bar and -15^o C. Compressor pressure ratio 9:1. Maximum gas temperature 1200 K. The intake duct efficiency is 0.9 and total head isentropic efficiency of compressor and turbine is 0.89 and 0.93. Calculate the specific power output in Kj/kg, thermal efficiency of the unit taking mechanical efficiency of transmission as 98% and neglecting the losses other than specified. Assume that exhaust gases leave the aircraft at 600 km/h relative to the aircraft.	Remember	CO 1	AAE551.04
10	In an aircraft power plant, the gases expands through a turbine to an intermediate pressure and on leaving the turbine it expands from intermediate pressure to the back pressure, generating	Understand	CO 1	AAE551.04

	kinetic energy for jet. All the power of turbine is absorbed in driving the associated compressor. In such a unit gas enters the turbine at 4.5 bar and 800^0C and expands therein to 1.75 bar. Turbine absorbs 75% of the available enthalpy drop. Expansion occurs through the jet from exhaust condition to 1.03bar. Assume that velocity of gas entering the turbine and jet is negligible. There is no heat loss and conversion of kinetic energy is 100% of available adiabatic enthalpy drop. Calculate 1) Temperature of the gas entering the jet 2) Velocity of gas leaving the jet. Assume C_p =1.05 KJ/Kg K and r = 1.38			
UNIT - II				
ELEMENTS OF PROPULSION				
PART - A (SHORT ANSWER QUESTIONS)				
1	Describe the function of a compressor.	Understand	CO 2	AAE551.05
2	Distinguish between axial and centrifugal compressor.	Understand	CO 2	AAE551.05
3	Enlist the different diffusers used in centrifugal compressor.	Understand	CO 2	AAE551.05
4	Describe about slip factor.	Understand	CO 2	AAE551.05
5	Describe compressor stall.	Understand	CO 2	AAE551.05
6	Narrate the term surge.	Remember	CO 2	AAE551.05
7	Describe about rotating stall.	Remember	CO 2	AAE551.05
8	State degree of reaction.	Remember	CO 2	AAE551.05
9	Illustrate different stage parameters of a compressor.	Understand	CO 2	AAE551.05
10	Describe flow coefficient.	Understand	CO 2	AAE551.05
11	Describe stage loading	Understand	CO 2	AAE551.05
12	Calculate the number of stages in axial flow compressor.	Remember	CO 2	AAE551.05
13	Describe blade efficiency.	Remember	CO 2	AAE551.05
14	Narrate the stage efficiency for compressor.	Remember	CO 2	AAE551.05
15	Describe about compressor cascade.	Remember	CO 2	AAE551.05
16	Demonstrate isentropic efficiency of a compressor.	Understand	CO 2	AAE551.05
17	Demonstrate polytropic efficiency of a compressor.	Understand	CO 2	AAE551.05
18	Describe the surge of a compressor.	Remember	CO 2	AAE551.05
19	Describe the term discharge in a compressor.	Understand	CO 2	AAE551.05
20	State and explore hysteresis in a compressor.	Understand	CO 2	AAE551.05

PART - B (LONG ANSWER QUESTIONS)				
1	Demonstrate ramjet engine with a neat sketch	Remember	CO 2	AAE551.06
2	Simulate the work done and pressure rise by axial compressor	Understand	CO 2	AAE551.06
3	Analyze the velocity diagram for axial flow turbine	Remember	CO 2	AAE551.06
4	Demonstrate scramjet engine with a neat sketch	Remember	CO 2	AAE551.06
5	Distinguish the different thrust augmentation methods for improving the thrust of an engine with a neat sketch	Remember	CO 2	AAE551.06
6	Illustrate the performance characteristics of a turbine.	Remember	CO 2	AAE551.06
7	Summarize the performance characteristics of axial and centrifugal compressor.	Remember	CO 2	AAE551.06
8	Justify the need for turbine blade cooling and explain about different types of turbine blade cooling.	Remember	CO 2	AAE551.06
9	Obtain the relation for (a) Compressor stall (b) surge (c) rotating stall.	Remember	CO 2	AAE551.06
10	Categorize the limiting factors in turbine blade design.	Understand	CO 2	AAE551.06
PART – C (PROBLEM SOLVING AND CRITICAL THINKING)				
1	Design the nomenclature of a axial flow compressor with a neat sketch	Understand	CO 2	AAE551.07
2	A centrifugal compressor under test gave the following data: Speed : 11,500 rev/min Inlet total head temperate : 21^{o}C Outlet and inlet total head pressure : 4 bar, 1 bar Impeller diameter : 75 cm If the slip factor is 0.92, what is the compressor efficiency?	Understand	CO 2	AAE551.07
3	Design the nomenclature of a impulse turbine with a neat sketch	Remember	CO 2	AAE551.08
4	Determine the impeller diameters and the width at the impeller exit and the power required to drive the compressor, from the following given data: Speed: 12,500 rev/ min Mass flow rate: 15kg/s Pressure ratio: 4:1 Isentropic efficiency: 75% Slip factor: 0.9 Flow coefficient at impeller exit: 0.3 Hub diameter of the eye: 15 cm Axial velocity of the air at entry to and exit from the impeller: 150 m/s stagnation temperature at inlet: 295 K stagnation pressure at inlet: 1.0 bar Assume equal pressure ratio in the impeller and diffuser.	Remember	CO 2	AAE551.08
5	Explicit the slip factor and obtain the equation along a labeled diagram showing the compressor staging.	Remember	CO 2	AAE551.08
6	Air at 1.0132 bar and 288 K enters an axial flow compressor stage with an axial velocity 150 m/s. There are no inlet guide vanes. The rotor stage has a tip diameter of 60 cm and a hub diameter of 50 cm and rotates at 100 rps. The air enters the rotor and leaves the stator in the axial direction with no change in velocity or radius. The air is turned through 30.2^{o} as it passes through rotor. Assume a stage pressure ratio of 1.2. Assuming the constant specific heats and that the air enters the leaves the	Remember	CO 2	AAE551.08

	blade at blade angles. Determine 1) Construct the velocity diagram at mean dia for this stage 2) Mass flow rate 3) Power required 4) Degree of reaction			
7	Examine the profile loss and analyze the work done and pressure rise by radial flow turbine	Understand	CO 2	AAE551.08
8	A multi stage gas turbine is to be designed with impulse stages, and is to operate with an inlet pressure and temperature of 6 bar and 900 K and outlet pressure of 1 bar. The isentropic efficiency of the turbine is 85%. All the stages are to have a nozzle outlet angle of 75^o and equal outlet and inlet blade angles. Mean blade speed of 250 m/s and equal inlet and outlet gas velocities. Estimate the maximum number of stages required. Assume C_p = 1.15 kJ/ kg K, r = 1.33 and optimum blade speed ratio.	Remember	CO 2	AAE551.08
9	A 10 stage axis flow compressor provides an overall pressure ratio of 5:1 with an overall isentropic efficiency of 87%. When the temperature of air at inlet is 15^oC. The work is equally divided between the stages. A 50% of reaction is used with a blade speed of 210 m/s and a constant axial velocity of 170 m/s. Estimate the blade angles. Assume work done factor of 1.	Understand	CO 2	AAE551.08
10	In a single-stage impulse turbine the nozzle discharges the fluid on to the blade at an angle of 65^o to the axial direction and the fluid leaves the blades with an absolute velocity of 300 m/s at an angle of 30^o to the axial direction. If the blades have equal inlet and outlet angles and there is no axial thrust, estimate the blade angle, power produced per kg/s of the fluid and the blade efficiency.	Remember	CO 2	AAE551.08
UNIT-III				
INLETS, NOZZLES AND PROPELLER THEORY				
PART - A (SHORT ANSWER QUESTIONS)				
1	List out the propellers.	Understand	CO 3	AAE551.09
2	Compare different types of propellers.	Understand	CO 3	AAE551.09
3	Enlist the types of subsonic inlets.	Remember	CO 3	AAE551.09
4	State the function of a supersonic inlet.	Remember	CO 3	AAE551.09
5	Obtain the parameters required for selection of a propeller.	Remember	CO 3	AAE551.09
6	Describe the term nozzle.	Understand	CO 3	AAE551.09
7	Classify the types of nozzles.	Understand	CO 3	AAE551.09
8	Describe under-expanded nozzle.	Remember	CO 3	AAE551.09
9	Validate any three requirements a nozzle should fulfill.	Remember	CO 3	AAE551.09
10	Justify the starting of problem of supersonic inlet.	Remember	CO 3	AAE551.09
11	List out different operating conditions of subsonic inlet.	Remember	CO 3	AAE551.09

12	Illustrate some of major design variables for the inlet.	Understand	CO 3	AAE551.09
13	Describe about inlet flow distortion.	Understand	CO 3	AAE551.09
14	Classify typical modes of supersonic inlet operation.	Remember	CO 3	AAE551.09
15	Categorize different types of subsonic inlets.	Remember	CO 3	AAE551.09
16	Categorize different types of supersonic inlets.	Remember	CO 3	AAE551.09
17	Describe the characteristic Mach number.	Understand	CO 3	AAE551.09
18	Express the condition for under expanded condition.	Understand	CO 3	AAE551.09
19	State the need for variable area nozzle.	Remember	CO 3	AAE551.09
20	Express the relation for impulse-to-weight ratio.	Remember	CO 3	AAE551.09
PART – B (LONG ANSWER QUESTIONS)				
1	Demonstrate the nomenclature of a propeller with a neat diagram.	Remember	CO 3	AAE551.10
2	Distinguish the difference forces acting on a propeller with a neat sketch.	Remember	CO 3	AAE551.10
3	List out performance characteristics of a propeller	Remember	CO 3	AAE551.10
4	Obtain the relation between minimum area and external deceleration area.	Remember	CO 3	AAE551.10
5	Illustrate the performance of ducted propellers with a suitable application.	Remember	CO 3	AAE551.10
6	Categorize different technique available for producing variable nozzle.	Remember	CO 3	AAE551.10
7	Demonstrate the theory of flow through nozzle and physics behind the operation.	Understand	CO 3	AAE551.10
8	Write short notes on convergent and divergent nozzle.	Remember	CO 3	AAE551.10
9	List out the various methods used for thrust reversal.	Understand	CO 3	AAE551.10
10	Describe in a brief note on nozzle choking.	Understand	CO 3	AAE551.10
PART – C (PROBLEM SOLVING AND CRITICAL THINKING)				
1	Narrate a brief note on nozzle choking and illustrate with a labeled diagram, the conditions.	Remember	CO 3	AAE551.11
2	Obtain the relation for area ratio and Mach number relation.	Remember	CO 3	AAE551.11
3	Evaluate different techniques available for producing variable mach number exit.	Remember	CO 3	AAE551.11
4	Examine the need for variable area nozzle and explain the methods used to attain in with a neat diagram.	Remember	CO 3	AAE551.11
5	Justify how thrust reversal achieved. Is thrust vectoring similar to thrust reversal?	Remember	CO 3	AAE551.11
6	Categorize different technique available for producing variable mach number exit.	Understand	CO 3	AAE551.12

7	Prove the equation for area ratio and Mach number relation.	Understand	CO 3	AAE551.12
8	Interpret the condition for convergent-divergent nozzle to deliver supersonic Mach number.	Remember	CO 3	AAE551.12
9	Describe about subsonic inlet function and modes of operation with neat sketch.	Remember	CO 3	AAE551.12
10	Describe nacelle and illustrate the subsonic inlet nomenclature with neat sketch.	Remember	CO 3	AAE551.12
UNIT-IV				
THERMODYNAMICS OF REACTING SYSTEMS				
PART – A (SHORT ANSWER QUESTIONS)				
1	Describe combustion chamber.	Understand	CO 4	AAE551.13
2	Describe about flame holder and its function.	Understand	CO 4	AAE551.13
3	Classify types of combustion chambers.	Understand	CO 4	AAE551.13
4	State the function of fuel injector.	Understand.	CO 4	AAE551.13
5	Define stochiometric ratio.	Remember	CO 4	AAE551.13
6	Describe calorific value of fuel.	Understand	CO 4	AAE551.13
7	Categorize different flame stabilization techniques.	Remember	CO 4	AAE551.13
8	Describe flame tube cooling.	Understand	CO 4	AAE551.13
9	List out combustion fuels used in the combustion chamber.	Remember	CO 4	AAE551.13
10	Describe combustion efficiency.	Remember	CO 4	AAE551.13
11	Describe equivalence ratio.	Remember	CO 4	AAE551.13
12	Illustrate the function of all the major components of combustion chamber.	Understand	CO 4	AAE551.13
13	Describe heat and temperature.	Remember	CO 4	AAE551.13
14	Describe the combustion intensity.	Remember	CO 4	AAE551.13
15	Describe flame stabilization.	Understand	CO 4	AAE551.13
16	Describe the function of liner in combustion chamber.	Remember	CO 4	AAE551.13
17	Illustrate the function of swirl vanes in combustion chamber.	Understand	CO 4	AAE551.13
18	Classify the different types of internal flow in straight walled diffuser.	Remember	CO 4	AAE551.13
19	Categorize between annular and cannular type combustion chamber.	Understand	CO 4	AAE551.13
20	Analyze the burning process that takes place inside the combustion chamber.	Remember	CO 4	AAE551.13

PART – B (LONG ANSWER QUESTIONS)				
1	Demonstrate about factors influencing combustion chamber design.	Understand	CO 4	AAE551.14
2	Narrate in brief about multiple can combustors with a neat sketch.	Remember	CO 4	AAE551.14
3	Illustrate different flow paths obtained in a combustion chamber in detailed.	Remember	CO 4	AAE551.14
4	Compare advantage and disadvantages of different types of combustion chamber.	Understand	CO 4	AAE551.14
5	Demonstrate flame stabilization in combustion chamber.	Remember	CO 4	AAE551.14
6	Narrate in brief about combustor generated emissions with a neat diagram.	Remember	CO 4	AAE551.14
7	Illustrate the difference between annular and annular type combustion chamber with a neat diagram.	Remember	CO 4	AAE551.14
8	Evaluate the factors affecting combustion chamber performance.	Understand	CO 4	AAE551.14
9	Describe about annual reverse flow combustor with a neat sketch.	Understand	CO 4	AAE551.14
10	Illustrate the functions of each component in gas turbine combustion chamber.	Understand	CO 4	AAE551.14
PART – C (PROBLEM SOLVING AND CRITICAL THINKING)				
1	List out different flame holders used inside a combustion chamber with a neat diagram.	Understand	CO 4	AAE551.15
2	Categorize the different types of combustion chamber with neat sketch.	Remember	CO 4	AAE551.15
3	Describe about can-annual combustor with a neat sketch.	Understand	CO 4	AAE551.15
4	State the concept of combustion stability With the help of neat diagram,	Understand	CO 4	AAE551.16
5	Describe about flame stabilization in combustion chamber.	Understand	CO 4	AAE551.16
6	Demonstrate 1.Combustion stability 2. Combustion intensity.	Understand	CO 4	AAE551.16
7	Classify combustion chambers and elaborate on each type of combustion chamber with highlights on each type.	Remember	CO 4	AAE551.16
8	Enumerate Buzz phenomenon in supersonic inlets and examine the importance of a swirl vane on a combustion chamber.	Understand	CO 4	AAE551.16
9	Describe the term equivalence ratio and list out advantages and disadvantages of the various types of combustion chamber.	Understand	CO 4	AAE551.16
10	Describe about 1. Pressure loss2. Combustion efficiency 3. Isentropic efficiency of a diffuser4. Combustion instability.	Remember	CO 4	AAE551.16
UNIT-V				
PREMIXED FLAMES				
PART - A (SHORT ANSWER QUESTIONS)				
1	Describe flame.	Remember	CO 5	AAE551.17
2	Narrate the flame structure.	Understand	CO 5	AAE551.17
3	Describe turbulent combustion.	Remember	CO 5	AAE551.17
4	Narrate the term quenching in premixed flames.	Understand	CO 5	AAE551.17

5	Describe premixed flame.	Remember	CO 5	AAE551.17
6	Describe droplet combustion.	Understand	CO 5	AAE551.17
7	Describe flame propagation	Understand	CO 5	AAE551.17
8	Describe non premixed flame.	Understand	CO 5	AAE551.17
9	Describe flammability.	Understand	CO 5	AAE551.17
10	Categorize the difference between premixed flame and non premixed flame.	Understand	CO 5	AAE551.17
11	Describe combustion.	Understand	CO 5	AAE551.17
12	Obtain the relation for premixed flame.	Remember	CO 5	AAE551.17
13	List out types of flames	Understand	CO 5	AAE551.17
14	Describe diffusion flame.	Understand	CO 5	AAE551.17
15	Describe DNS.	Remember	CO 5	AAE551.17
16	Demonstrate the numerical technique used in propagating a flame.	Understand	CO 5	AAE551.17
17	Describe LES.	Understand	CO 5	AAE551.17
18	Narrate the term quenching.	Remember	CO 5	AAE551.17
19	Classify the types of quenching process.	Understand	CO 5	AAE551.17
20	List out the different flammability limits.	Understand	CO 5	AAE551.17
PART – B (LONG ANSWER QUESTIONS)				
1	Demonstrate the different flame propagation techniques to stabilize the flame.	Remember	CO 5	AAE551.18
2	Narrate in brief about droplet combustion with a neat sketch.	Remember	CO 5	AAE551.18
3	Classify the different flammability limits to obtain the assured flame.	Remember	CO 5	AAE551.18
4	Illustrate the process of LES briefly with a suitable example.	Remember	CO 5	AAE551.18
5	Categorize the different theories used to get flame propagation.	Remember	CO 5	AAE551.18
6	Describe about droplet combustion and list out the advantages and disadvantages over generalized combustion.	Remember	CO 5	AAE551.18
7	Demonstrate the laminar jet diffusion flame with a neat diagram.	Remember	CO 5	AAE551.18
8	Illustrate the chemical structure of premixed flames with a neat graph.	Understand	CO 5	AAE551.18
9	Illustrate the clear difference between DNS and LES techniques used for premixed flames.	Understand	CO 5	AAE551.18
10	Evaluate the process of quenching and list its advantages over normal combustion process.	Remember	CO 5	AAE551.18
PART – C (PROBLEM SOLVING AND CRITICAL THINKING)				
1	Solve the laminar premixed flame propagation with equations.	Remember	CO 5	AAE551.19

2	Demonstrate the Ranking hugoniot relation with a suitable application.	Remember	CO 5	AAE551.19
3	Narrate in detail about Burke-Schumann theory in the process of obtaining flame propagation.	Understand	CO 5	AAE551.19
4	Analyze the turbulent premixed flame propagation with equations.	Remember	CO 5	AAE551.20
5	Illustrate the process of DNS briefly with a suitable example.	Remember	CO 5	AAE551.20
6	Demonstrate about droplet combustion with a neat diagram.	Remember	CO 5	AAE551.20
7	Illustrate the quenching process with a suitable diagram.	Understand	CO 5	AAE551.20
8	Describe about Burke-Schumann theory.	Remember	CO 5	AAE551.20
9	Obtain the relation for turbulent combustion with a neat diagram.	Remember	CO 5	AAE551.20
10	Illustrate the process of LES briefly with a suitable example.	Understand	CO 5	AAE551.20

Prepared by:

Mr. M. Vijay Kumar, Assistant Professor **HOD, AE**