

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. SEMESTER: VI Aeronautical Engineering

Subject Name: **Fundamentals of Jet Propulsion**

Subject Code: **160102**

Teaching Scheme				Evaluation Scheme		
Theory	Tutorial	Practical	Total	University Exam (Theory) (E)	Mid Sem Exam (Theory) (M)	Practical (I)
4	1	0	5	70	30	50

Sr. NO.	Course Contents	Total Hrs
1.	<p>Fundamentals of Gas Turbine Engines for Aircraft Power Plant:</p> <ul style="list-style-type: none"> • Introduction and Basic review of thermodynamic concepts and Thermodynamics cycle, air breathing and non-air breathing propulsion system • Various method to improve efficiency and work output of gas turbine • Fundamentals of gas turbine engine use as aircraft power plant • Fundamental thrust equation • Factors affecting the thrust • Effect of pressure temperature and velocity on thrust • Thrust augmentation techniques • Different types of aircraft power plant i.e. turbojet, turbofan, turbo prop and turbo shaft engine • Performance characteristics of turbojet engine • Performance characteristics of turbofan engine and by pass ratio • Performance characteristics of turboprop engine • Performance comparison, advantages, disadvantages , limitation of turbojet, turbofan and turboprop engine 	11
2.	<p>Diffusers / Inlets:</p> <ul style="list-style-type: none"> • Introduction to inlets, subsonic and supersonic inlets • Inlet Types - internal compression inlet, external compression inlet and mixed compression inlet • Subsonic inlets - Design variables, inlet total pressure ratio, inlet sizing, inlet flow distortion, Nacelle and interference drag. Diffuser • Boundary layer separation and features of external flow near a subsonic inlet • internal flows and stalling in subsonic inlets • relation between minimum area ratio and internal deceleration ratio, • diffuser performance – pressure recovery and efficiency • Supersonic Inlets , design construction and working • Starting problem in supersonic inlets – Over speeding inlet air and Shock swallowing methods by area ratio variation 	11

	<ul style="list-style-type: none"> • Modes of supersonic inlet operation 	
3.	<p>Gas Turbine Combustion Chamber/Burner:</p> <ul style="list-style-type: none"> • Introduction and required characteristics of combustion chamber • Design criteria of combustion chamber • Primary combustor and principal elements • Types of burners – Can or Tubular burner, Annular burner, Cannular burner • Relative advantages and disadvantages of different types of burners • Terminology and some definitions – Arrhenius equation, equivalence ratio, combustion loading parameter, space heat release rate, reaction rate parameter, cooling effectiveness, pattern factor, profile factor • Combustion and Dilution • Combustion chamber performance • Flame stabilization and flame holder • Cooling – Flame tube cooling and linear cooling • Critical Design parameters of combustion chamber • Materials for combustion chamber 	8
4.	<p>Nozzle Theory:</p> <ul style="list-style-type: none"> • Basic review of thermodynamics and one dimensional isentropic flow • Area –Mach relation and types of nozzle • Exhaust velocity of nozzle • Mass flow rate through nozzle and choking of nozzle • Area ratio of nozzle • Effect of back pressure, Optimum expansion, under expansion and over expansion nozzle • Various nozzle configurations • Different Types of Nozzle • Actual mass flow rate through nozzle and equilibrium conditions 	10
5.	<p>Ramjet Propulsion:</p> <ul style="list-style-type: none"> • Introduction and operating principle • Advantages, disadvantages, limitations and comparison with jet engines • Subcritical, critical and super critical operation, • Ramjet performance • Simple design calculation of ramjet engine • Introduction to scramjet and preliminary concepts in supersonic combustion 	6
6.	<p>Rocket Propulsion:</p> <ul style="list-style-type: none"> • Introduction to rocket propulsion and operating principle • Classification of rocket propulsion system • Thrust equation • Definitions of performance parameters and design factors and relationship between them • Propellant classification • Liquid propellant rocket engine and their components • Solid propellant rocket motor and their components 	14

	<ul style="list-style-type: none">• Hybrid rocket• Thrust reversal and Thrust Vectoring Control Techniques• Cooling of thrust chamber for solid rocket motor and liquid rocket engine• Relative advantages and disadvantages of solid and liquid propellant rockets• Selection criteria of solid rocket motor and liquid propellant rocket engine• Advanced propulsion systems	
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Text Books:

1. Gas Turbine by V. Ganeshan TMH Publication
2. Mechanics and Thermodynamics of Propulsion by Philip G. Hill and Carl Peterson, Addison Wesley Longman Inc.
3. Rocket Propulsion Elements by Sutton , John Wiley & Sons Inc., New York

Reference Books:

1. Gas turbine theory: Cohen & Rogers
2. Gas turbine: Khajooria & Dubey
3. Fundamentals of Rocket and Missile Propulsion: M.J.Zucrow