GUJARAT TECHNOLOGICAL UNIVERSITY

AERONAUTICAL ENGINEERING
FUNDAMENTALS OF JET PROPULSION
SUBJECT CODE: 2160102
B.E. 6thSEMESTER

Type of course: Engineering Science.

Prerequisite: Aircraft Science

Rationale: Jet Propulsion signifies the need of each component of jet engines and their physical significance which offers to students the knowledge required to understand the working of jet engines and rocket engines in aircraft industries.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	1	0	4	70	20	10	30	0	20	150

Content:

Sr. No	Topics	Teaching Hrs.	Module Weightage
1.	**Fundamentals of Gas Turbine Engines for Aircraft Power Plant:** Introduction and Basic review of thermodynamic concepts and Gas turbine cycle with regeneration, reheating and intercooling, 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 comparison, advantages, disadvantages , limitation of turbojet, turbofan and turboprop engine, Numerical	**10**	**30 %**
2.	**Diffusers / Inlets:** 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. 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, Supersonic Inlets , design construction and working, Numericals	**06**	**10 %**

3	**Gas Turbine Combustion Chamber/Burner:** Introduction and types of burners – Can burner, Annular burner, Cannular burner, Relative advantages and disadvantages of different types of burners, zones of combustion chamber, requirements of combustion chamber, design criteria of combustion chamber, pressure losses, combustion intensity and combustion efficiency, flame stabilization and flame holder Critical Design parameters of combustion chamber Materials for combustion chamber	**05**	**15%**
4	**Nozzle Theory:** 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	**06**	**15 %**
5	**Ramjet Propulsion:** 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, Numericals	**05**	**20%**
6	**Rocket Propulsion:** Introduction to rocket propulsion and operating principle, Classification of rocket propulsion system, Introduction to solid propellant rockets and liquid propellant rockets	**04**	**10%**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
40%	**30%**	**20%**	**05%**	**05%**	**-**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Gas turbine theory by V V Ganesan
2. Gas turbines and propulsive systems by P.R.Khajuria and S.P.Dubey
3. Fundamentals of compressible fluid flow by S.M.Yahya

Course Outcome:

After learning the course the students should be able to

1. Understand basics of jet engines and rocket engines.
2. Understand the need of components of jet engines.
3. Comprehend the concept of fluid flow.

List of Tutorial:

1. Introduction to gas turbine cycles
2. Introduction to jet engines
3. Numerical based on gas turbine cycles.
4. Numerical based on turbojet engines
5. Numerical based on nozzles
6. Numerical based on diffuser
7. Numerical based on ramjet engine
8. Thrust augmentation techniques
9. Rocket propulsion

Major Equipments needed:

Jet engine

List of Open Source Software/learning website: http://nptel.iitm.ac.in/courses.php

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.