

# Jet Aircraft Propulsion - Video course

## COURSE OUTLINE

Introduction to Aircraft Jet Propulsion.  
 Jet Engine Cycles : Thermodynamic Analysis of real cycles.  
 Compressors and Turbines.  
 Combustion Systems.  
 Intakes and Propelling Nozzles.  
 Aircraft Engine Installed Performance, Sizing & Matching.  
 Ramjets, Scramjets and Pulsejets.

## COURSE DETAIL

S.No	Topics	Instructor	Lectures
1	<b>Introduction to Aircraft Propulsion.</b>	<b>Bhaskar Roy</b>	<b>4 lectures</b>
1.1	The Gas Turbine Engine development for Aircraft Propulsion.		
1.2	How the jet engines makes thrust : conceptual basis.		
1.3	Jet engine performance parameters ; Thrust, SFC, Efficiencies.		
1.4	Simple Turbojet and Reheat engines: Low and High bypass Turbofan engines.		
1.5	Single and Multi-spool Gas Turbine based propulsive devices.		
2	<b>Real Cycle Thermodynamic Analysis.</b>	<b>A M Pradeep</b>	<b>4 lectures and 2</b>
2.1	<b>Introduction to Real Cycles.</b>		
2.1.1	Ideal and Real Brayton cycles.		



NP-TEL

# NPTEL

<http://nptel.iitm.ac.in>

## Aerospace Engineering

### Pre-requisites:

1. **Introduction to Aerospace Propulsion, or A course in Engineering Thermodynamics.**

### Additional Reading:

1. Oates Gordon C; *Aerothermodynamics of Aircraft Engine Components*, 1985, AIAA Education Series.
2. Mattingly J D; Heiser W H; Daley; *Aircraft Engine Design* AIAA Education series, 1987.

### Hyperlinks:

1. <http://mme.iitm.ac.in/gphani/transport/tplinks>

### Coordinators:

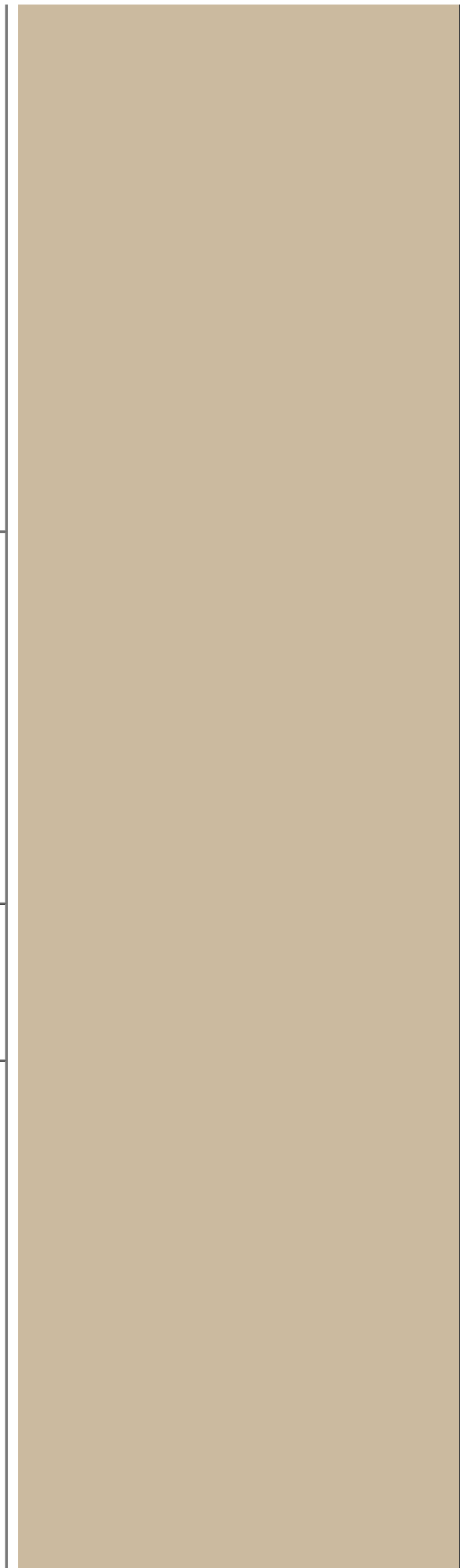
#### **Prof. A M Pradeep**

Department of Aerospace Engineering IIT Bombay

#### **Prof. Bhaskar Roy**

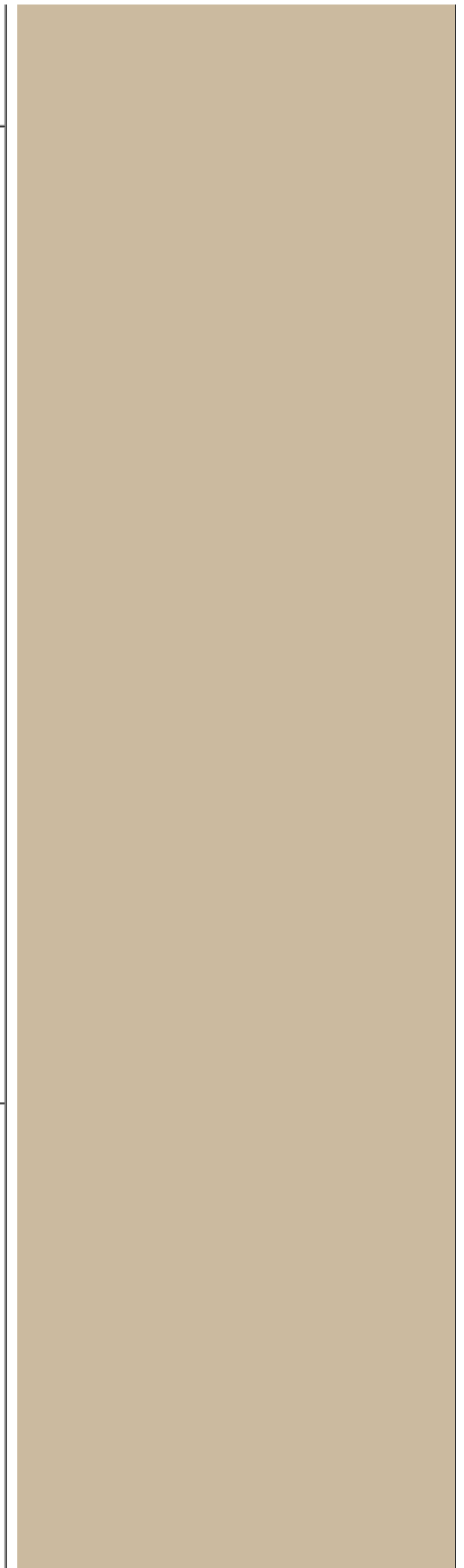
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			tutorials
2.1.2	Jet engine cycles for aircraft propulsion.		
2.1.3	Cycle components and component performance: Intake, Compressors & Turbines, Combustion chamber, Afterburner, Nozzle.		
2.1.4	Analysis of engine real cycles: Turbojet cycle, Reheat engine cycle, Turbofan engine cycle, Turboprop Engines.		
2.1.5	Advanced jet engine cycles: Variable cycle engines.		
3	<b>Fundamentals of Rotating components.</b>	Bhaskar Roy	2 lectures
3.1	Thermodynamics of Compressors and Turbines.		
3.2	Development of parameters for compressor and Turbines.		
4	<b>Compressors and Turbines.</b>		
4.1	<b>Axial and centrifugal Compressors:</b>	A M Pradeep	4 lectures and 1 tutorial
4.1.1	A simple two dimensional analytical model.		
4.1.2	2-D (cascade) analysis; Loss and Blade performance estimation.		
4.1.3	Simple Free Vortex theory.		
4.1.4	Single and Multi-stage Axial compressor characteristics.		
4.1.5	Elements of centrifugal		

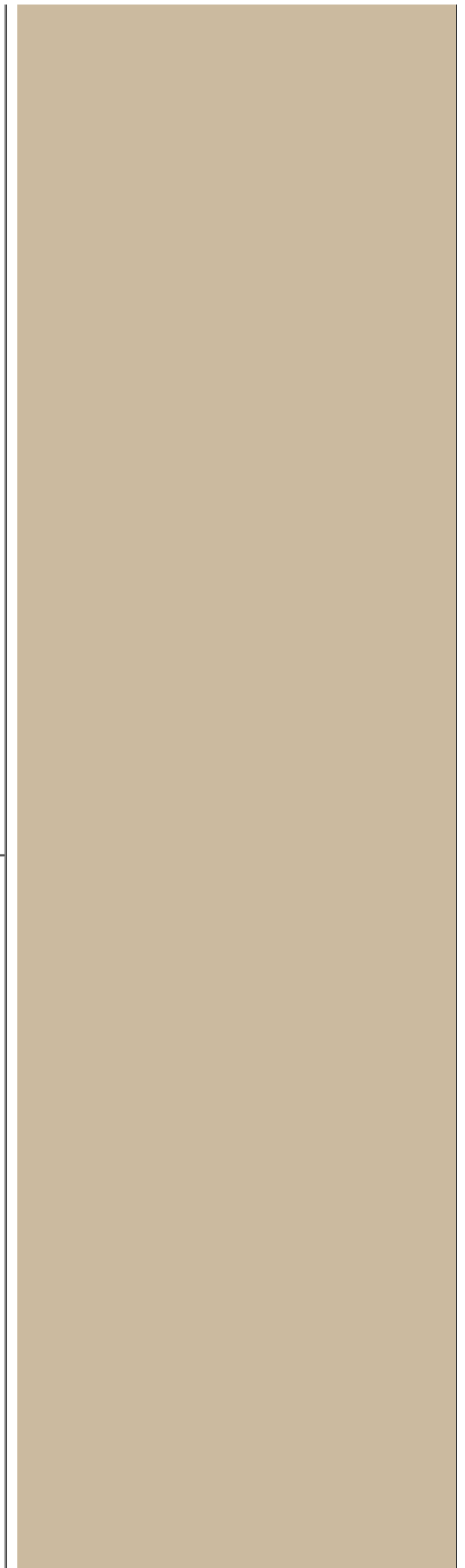


	compressor.		
<b>4.1.5.1</b>	Inlet Duct; Impeller; Slip factor and Concept of Rothalpy.		
<b>4.1.6</b>	Centrifugal Compressor Characteristics: Surging and Choking.		
<b>4.2</b>	<b>Axial and Radial flow turbines.</b>	<b>Bhaskar Roy</b>	<b>3 lectures and 1 tutorial</b>
<b>4.2.1</b>	Introduction.		
<b>4.2.2</b>	Turbine stage : Turbine Blade 2-D (cascade) analysis; Work Done, Degree of Reaction, Losses and Efficiency.		
<b>4.2.3</b>	Multi-staging of Turbine.		
<b>4.2.4</b>	Turbine Cooling Technology.		
<b>4.2.5</b>	Radial Turbine Aerodynamics and Thermodynamics.		
<b>4.2.6</b>	Losses in radial turbine and efficiency.		
<b>5</b>	<b>Combustion Systems.</b>		
<b>5.1</b>	Introduction : Various types of combustion chambers in aircraft engines.		
<b>5.2</b>	Combustion Mechanism and Important Combustion parameters.		
<b>5.3</b>	Development of a practical combustion system and design parameters.		
<b>5.4</b>	Pressure losses ; Combustion efficiency; Combustion intensity.		
<b>5.5</b>	Combustion Stability limits and Instability.		

5.6	Fuels and their properties and Fuel injection systems.		
6	<b>Intakes and Propelling Nozzles.</b>	<b>A M Pradeep</b>	<b>4 lectures and 1 tutorial</b>
6.1	<b>Intakes.</b>		
6.1.1	Requirements of an Intake for Powerplant: Transport, Military Aircraft.		
6.1.2	Subsonic Intakes, Transonic and Supersonic Intakes.		
6.1.3	Axi-symmetric and Assymmetric Intakes.		
6.1.4	Aircraft Intake design considerations.		
6.2	<b>Propelling Nozzles.</b>		
6.2.1	Energy conversion in a Nozzle.		
6.2.2	Nozzle design considerations: fixed and variable geometry nozzles.		
6.2.3	C-D nozzle and their use.		
7	<b>Engine Installed Performance, Sizing &amp; Matching.</b>	<b>Bhaskar Roy</b>	<b>4 lectures and 1 tutorial</b>
7.1	Introduction to engine component sizing.		
7.2	Installed Performance of Engine.		
7.3	Dimensional analysis for component matching.		



7.4	Engine - Design Point Operations.		
7.5	Engine Off Design Operations.		
7.5.1	Single Shaft Engine.		
7.5.2	Two-Shaft : Turbojet & Turbo-prop, Turbo-shaft Engines.		
7.5.3	The Engine Operating Lines		
7.5.4	Operational details of multiple shaft engines.		
7.6	Aircraft Engine component matching:		
7.6.1	Intake-Compressor matching; Turbine-Nozzle matching.		
7.6.2	Compressor -Turbine matching : Single and Multi-spool.		
7.6.3	Free Turbine and Unducted Fan / Propeller matching.		
8	<b>Ramjets, Pulsejets and Scramjets.</b>		
8.1	Use of Ramjets and Pulsejets in Aircraft propulsion.	<b>A M Pradeep and Bhaskar Roy</b>	<b>4 lectures and 1 tutorial</b>
8.2	Operating Principles.		
8.3	Thermodynamic Cycle.		
8.4	Performance Parameters.		
8.5	Design and Performance of a Ramjet.		
8.6	Flow in Diffusers, Combustors and Nozzles.		



8.7	Principles of Scramjet Engines.		
9	Future of Aircraft Propulsion.	A M Pradeep and Bhaskar Roy	1 lecture
Total No of Lecture and Tutorial (33+7)			40 hours

**References:**

1. Kroes Michael J; Wild Thomas W; *Aircraft Powerplants*; 2010(7 Ed), Tata-Mcgraw-Hill.
2. Hill Philip, Peterson Carl, *Mechanics and Thermodynamics of Propulsion*, 1992, Addison Wesley,.
3. Roy Bhaskar, *Aircraft Propulsion*, 2008, Elsevier (India),
4. Mattingly J D , *Elements of Propulsion - Gas Turbines and Rockets*, 2006, AIAA Education series.
5. El-Sayed Ahmed, *Aircraft Propulsion and gas Turbine Engines* , 2008, Taylor and Francis (CRC press).
6. Saravanamuttoo, H.I.H., Rogers G.F.C., Cohen H. *Gas Turbine Theory*, 2001, Pearson.