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	**Introduction to Aircraft Propulsion.**	**Bhaskar Roy**	**4 lectures**
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	**Real Cycle Thermodynamic Analysis.**	**A M Pradeep**	**4 lectures and 2**
2.1	**Introduction to Real Cycles.**		
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:

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

5.6	Fuels and their properties and Fuel injection systems.		
6	**Intakes and Propelling Nozzles.**	**A M Pradeep**	**4 lectures and 1 tutorial**
6.1	**Intakes.**		
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	**Propelling Nozzles.**		
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	**Engine Installed Performance, Sizing & Matching.**	**Bhaskar Roy**	**4 lectures and 1 tutorial**
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	**Ramjets, Pulsejets and Scramjets.**	**A M Pradeep and Bhaskar Roy**	**4 lectures and 1 tutorial**
8.1	Use of Ramjets and Pulsejets in Aircraft propulsion.		
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**

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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 Wesly,.
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.