TEE-822 Gas Turbine Performance

Course Code: TEE-822

Title: Gas Turbine Performance

Credit Hours: 03

Objectives

1. The objectives of this course are:
   a. To develop fundamental understanding of gas turbine systems and their applications
   b. To understand the gas turbine design, off-design and transient performances
   c. To familiarize with gas turbine performance modeling and simulation
   d. To provide the students advanced academic background in gas turbine technology
   e. Outcomes
2. By the end of this course, students will be able to:
   a. Perform design and development activities on gas turbine technology
   b. Assess the results from quantitative evaluations of gas turbine off-design behavior
   c. Demonstrate how thermodynamic laws support a wide range of gas turbine engines
   d. Handle power plant performance related issues related to component deterioration, changes in the operating conditions and variation in type and quality of fuels
3. Contents with suggested contact hours

No.	Topics	Book	Contact Hours
1.	**Gas Turbine Technology** • History of gas turbine engines • Industrial power generation • Aircraft propulsion • Automotive and marine applications • Gas turbine manufacturers • Gas turbine fuels (furnace oil, diesel, natural gas) • Combustion in gas turbines • Mechanical design, materials and rotordynamics • Gas turbine design procedure and testing • Environmental issues • Future of gas turbine technology	SRC, WF, AR	9
2.	**Gas Turbine Power Cycles** • Shaft power cycles o Cycle with heat exchange o Cycle with intercooling o Cycles with reheat • Propulsion power cycles o Simple turbojet cycle o Turbofan engine o Thrust equation • Compressor/turbine isentropic and polytropic efficiencies • Combustion efficiency • Installation and component losses • Shaft power cycle efficiency • Integrated gasification combined cycle (IGCC) • Design point performance calculations	SRC, WF, AR	9
3.	**Gas Turbine Off-Design Performance** • Component characteristics	SRC, WF, SD	9

	○ Axial compressor and turbine performance ○ Compressor stall and surge ○ Non-dimensional Performance parameters • Equilibrium running of a gas turbine engine • Off-design performance characteristics ○ Effect of altitude ○ Effect of ambient temperature ○ Effect of work extraction ○ Effect of bleed extraction • Compressor part speed performance and control ○ Handling bleeds ○ Variable geometry vanes ○ Multi-spool or multi-shaft configurations • Gas turbine startup and shut down procedure • Transient performance		
4.	**Gas Turbine Performance Deterioration** • Causes of component performance deterioration ○ Compressor fouling ○ Variable geometry vanes issues ○ Hot end damages ○ Tip rubs and seal damages • Quantifying performance deterioration	WF, AR	6
5.	**Performance Modeling and Simulation** • Off-design performance modelling and matching ○ Single-shaft gas turbine matching ○ Gas generator and free turbine engine matching ○ Jet engine matching • Gas Turbine Simulation Program (GSP) ○ Performance simulation exercises	SRC, WF, GSP	9
6.	**Industry Guest lecture**		3
	Total		**45**

4. Details of lab work, workshops practice (if applicable). Computer lab for GSP/MATLAB

5. Recommended Reading (including Textbooks and Reference books).

S. No.	Title	Author(s)	Assigned Code	Remarks
1.	Gas Turbine Theory	H.I.H. Saravanamutto, G.F.C. Rogers, H. Cohen	SRC	Text book
2.	Gas Turbine Performance	P.P. Walsh, P. Fletcher	WF	Reference book
3.	Industrial Gas Turbines: Performance and Operability	A. M. Y. Razak	AR	Reference book
4.	Fluid Mechanics and Thermodynamics of Turbomachinery	S.L. Dixon	SD	Reference book
5.	Elements of Gas Turbine	J.D. Mattingly	JM	Reference book

	Propulsion			
6.	GSP Technical and User Manual	GSP Development Team	GSP	Reference book
7.	Technical Publications (GERS)	GE Publications	-	GE web portal

6. Details of online resources:
   Appropriate online resources will be provided.
7. Recommended journals:
   a. ASME Journal of Turbomachinery
   b. ASME Journal of Engineering for Gas Turbines and Power
   c. AIAA Journal of Propulsion and Power