

Course Name: Underground Coal Gasification & Surface Gasification with Applied Thermodynamics: Methods, Technology, Applications

Course Instructor: Dr. Hari Vuthaluru, Associate Professor, WA School of Mines: Minerals, Energy and Chemical Engineering, Curtin University, Australia

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Objectives: The objective of this course is to provide candidates with a comprehensive understanding of underground coal gasification (UCG) and surface gasification methods, technologies, and their applications. Candidates will learn the principles and techniques involved in converting coal into a gaseous fuel underground or on the surface. The course aims to equip candidates with the knowledge to evaluate the feasibility, environmental impacts, and economic potential of UCG and surface gasification projects.

Course Contents:

Introduction to Underground Coal Gasification (UCG): Principles and advantages of UCG, UCG process and reactions, UCG technology and equipment overview

Geology and Geophysical aspects of UCG basins: Exploration methods and Basin Management

Review of Ideal Gas, Ideal gas mixtures and mixing rules: 3.1 Real gas behavior, 3.2 Real gas equations of state, 3.3 Property relations for mixtures and Psychrometry

Geomechanics in UCS: Wellbore stability, Stress estimation and Subsidence monitoring

Applied Thermodynamics: Combustion: Combustion reactions – Stoichiometry, First law analysis, Heat calculations, Adiabatic flame temperature

Surface Gasification Techniques: Overview of surface gasification methods, Fixed-bed gasification, Fluidized-bed gasification, Entrained-flow gasification

UCG and Surface Gasification Process Design: Gasifier design and operation parameters, Gasification kinetics and thermodynamics, Process optimization and control strategies

Environmental Considerations: Environmental impacts of UCG and surface gasification, Carbon capture and storage (CCS) in gasification projects, Air and water pollution control in gasification processes

Economic Feasibility and Applications: Economic evaluation of UCG and surface gasification projects, Market opportunities and potential applications, Techno-economic analysis and project planning

Integration with Energy Systems: Integration of UCG and surface gasification with power generation, Syngas utilization and downstream processes, Co-production of fuels and chemicals from gasification products

Case Studies and Industry Applications: Analysis of real-world UCG and surface gasification

Reference Text books:

"Underground Coal Gasification and Combustion" by Alexander Y. Klimenko and Vladimir S. Litvinenko

"Coal Gasification and Its Applications" by David A. Bell and Brian F. Towler

"Gasification of Unconventional Feedstocks" by Vivek V. Ranade, Ajay K. Dalai, and Sreekala Bajwa