

Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NGLD501	Coal Bed Methane, Shale Gas and Gas Hydrate Exploration	3	0	0	3

Course Objective

The primary objective of the course is to introduce fundamental aspects of Coal Bed Methane, Shale Gas and Gas Hydrate such as origin, transport, formation, types, physical properties and depositional environments and exploration to the students.

Learning Outcomes

Upon completion of the course, students will be able to:

- Distinguish between different conditions of Coal Bed Methane, Shale Gas and Gas Hydrate based on physical, chemical and petrographical and other properties.
- Origin and effect of various depositional environments in shaping of various Coal Bed Methane, Shale Gas and Gas Hydrate type.
- Sorption Dynamics and kinetics for development of various types

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	AI & ML in Coal Bed Methane, Shale Gas and Gas Hydrate Exploration	1	Application of AI & ML in Coal Bed Methane, Shale Gas and Gas Hydrate Exploration
2	CBM generation: Coal bed methane, Shale gas generation and accumulation	3	Understanding of different conditions of CBM and Shale gas and their origin.
3	Sorption: Micropore, Mesopore and macropore, cleat system; Sorption principles, sorption isotherms types and interpretation; CO ₂ , CH ₄ and N ₂ adsorption desorption, hysteresis, Langmuir isotherm, Swelling and shrinkage of coal matrix, isotherm construction; Extended Langmuir Isotherm; Similarities of Adsorbed Methane and Liquid Behavior; Isotherm Construction; Isotherm for Recovery Prediction; Pore Geometry; Effects of ash and moisture on CH ₄ adsorption.	7	This unit will help student in understanding the pores and their features associated with coal and other porous materials and their implications
4	Gas content: CH ₄ content determination in coal/ shale beds.	2	This will help in distinguishing potential coal and shale beds;
5	CBM reservoir analysis: Difference between conventional gas reservoir and coal bed methane reservoir; Permeability; Depth effects of Permeability; Klinkenberg, Shrinkage and Stress Effects on Permeability; water composition as permeability indicator; relative Permeability; Face and Butt Cleat Permeabilities; Porosity and Diffusion in Micropore; Darcy flow in cleats; Sorption time; Gas in Place; Decline Curves; Reservoir Characterization Methods; Well spacing; Enhanced Recovery.	8	This will help in carrying out reservoir analyses of coal and shale beds.
6	Water production and disposal: Water types; Initial water production rates; Chemical content; Environmental Regulations; Water disposal techniques; Surface stream disposal; Injection wells; carbon dioxide sequestration.	7	To understand distribution of various coal and lignite basins and their characteristics.

7	Coalbed methane and shale gas basins: Potential Indian coalbed methane and shale gas basins and production.	2	This will help students in understanding of various coal and shale basins.
8	Hydraulic fracturing: Adjustments for hydraulic fracturing of coal seams; Inadequately stimulated wells; Efficiency of fracture length; Unique problems in fracturing of coal seams; Types of fracturing fluids : CBM and Shale Gas Exploration.	3	Students may understand Hydraulic fracturing
9	In-situ gasification: Advantages and disadvantages of UCG; Mechanism; Geological controls of UCG.	2	This will provide information about UCG.
10	Gas hydrate: Introduction to Gas hydrate, occurrence and origin; structure of gas hydrate, Types of gas hydrate Geological setting of Hydrate: Geological setting of Hydrate, Stability of gas hydrates; Gas hydrate reservoir	4	This will introduce about Gas Hydrate. This will provide geological conditions of gas hydrate and stability of gas hydrate reservoir.
11	Exploration of gas hydrate: Volume of gas in hydrate; inhibitors; Geological exploration of gas hydrate; Prospect and potentialities of gas hydrate in India.	3	This will stress on exploration of gas hydrate.
	Total	42	

Text Books:

1. Coalbed Methane and Coal Geology-Eds. R.Gayer and I. Harris, 1996.
2. Natural Gas Hydrates: Properties, Occurrence and Recovery- Cox, J.L. (ed.), Butterworth Publishers, 1983.
3. Shale Gas: Exploration and Environmental and Economic Impacts, 2017 AM Dayal and D. Mani (eds)

Reference Books:

1. Coalbed Methane: scientific, environmental and economic evaluation-Masatalerz and others, 1999.
2. Organic Petrology by GH Taylor and others, 1998 Edition.
3. Coal by D.W. van Krevelen (1993 Edition)
4. Gas Hydrates- Berecz, E. and M. Balla-Achs, Studies in Inorganic Chemistry Series No.4 Elsevier Science, Holland, (1977)
5. Natural Gas Hydrates: Occurrence, Distribution, and Detection - Paull, C.K. and W.P. Dillon, (eds.), AGU Geophysical Monograph Series, Volume 124, (2001).
6. Gas Hydrates: Challenges for the Future- Holder, G. and R. Bishnoi, (eds.), New York Academy of Science, New York, NY, (1999). 98 Amsterdam, The Netherlands, (2003).
7. Coal resources of India. Mem.GSI, vol.88, 1971
8. Coal Geology and Coal Technology by C.R. Ward.
9. Coal bearing depositional system by CFK Diessel, 1992 Edition.
10. Natural Gas Hydrates- Sloan, E.D., J. Happel, and M.A. Hnatow (eds.), New York Academy of Science- New York, NY, (1994).
11. Modern coal Mining by R.D. Singh, 1995.