23PEB302T					Unconventional Hydrocarbon Energy Resources					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To provide basic knowledge related to unconventional energy resources, its properties and its exploitation techniques.
- To familiarize students with the unique aspects of unconventional gas and oil reservoirs, including their (1) resources and economic significance (2) geologic occurrences, (3) controls on production rates, (4) drilling and completion practices, (5) reservoir management, and (6) present activity

6 Hrs.

UNIT 1 Introduction: Energy Facts

Global vis-à-vis Indian energy scenario – demand and supply, and future projection; relation between GDP and energy demand; introduction to conventional, unconventional, renewable, non-renewable energy resources in general, and unconventional hydrocarbon energy resources in particular; climate – Keeling curve; clean and sustainable energy resources; comparison between formations and mode of occurrences of various conventional and unconventional energy resources.

7 Hrs.

UNIT 2 Oil Shale, Shale Gas, and Tar Sand

Oil Shale: Definition and prospect, geological conditions for formation of oil shale, oil shale recovery technology, ex-situ and in-situ extraction processes of shale oil, various retorting processes, processes leading to maximization of shale oil production; Shale Gas: Definition and prospect, the conditions of formation of shale gas, debate over extraction of shale gas from the subsurface, environmental issues, American experience, Marcellus shale gas project – an example of success story of shale gas exploitation, methods of production, hydrofracturing, composition of fracking fluid, water management, shale gas – Indian perspective; Tar Sand: Definition and prospect, distinction between heavy oil and bitumen, mineralogy and properties of oil sand, elemental composition and properties of bitumen, methods of recovery of bitumen by mining and advanced in-situ processes.

6 Hrs.

UNIT 3 Gas Hydrate

Definition, History of Hydrate R&D, prospect, types of methane hydrate deposits, chemistry and structure of natural methane hydrate, Necessary Conditions for Methane Hydrate Formation, typical conditions of methane hydrate formation in nature vis-à-vis different gas hydrate stability zones, physical properties of hydrates and ice, geology of methane hydrates, exploration for methane hydrates – geological, geochemical and geophysical, gas hydrate – Indian perspective.

7 Hrs.

UNIT 4 Introduction to Coal Bed Methane

Definition and prospect, CBM, CMM, and AMM; an Overview on CBM vs. Conventional Reservoir –Gas Composition, Adsorption, Water Production, Gas Flow, Rock Physical Properties, Gas Content, Coal Rank, Gas Production. Fundamentals of Coal Geology: Genesis of Coal; Major Stratigraphic Periods of Coal Formation; Gondwana and Tertiary Coals of India; Influence of Coal Properties; Coal Chemistry – Molecular Structure, Macerals, Lithotypes, Functional Groups, Proximate Analysis, Ultimate Analysis; Significance of Rank – Definition and Measurement, Vitrinite Reflectance Measurement, Physical Properties, Volatiles Generated, Micropores; Cleat System and Natural Fracturing. Sorption: Principles of Adsorption – different types of isotherms, Langmuir Isotherm, Methane Retention; Effects of Ash and Moisture on Methane Adsorption. Decline Curves. Hydraulic Fracturing of Coal seams:

Max. 26 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- **CO1** - Understand the present global energy scenario, future need and various unconventional hydrocarbon resources
- **CO2** - Analyse the Geomechanical properties of unconventional reservoirs
- **CO3** - Outline the fundamental of hydraulic fracturing
- **CO4** - Characterize the unconventional reservoirs and discuss available production methods
- **CO5** - Apply safety and environmental features in hydraulic fracturing, gas production, and water production
- **CO6** - Critical-thinking and problem-solving approach towards unconventional resources and recovery

TEXT/REFERENCE BOOKS

1. Zou, C et al (2013) Unconventional Petroleum Geology, Elsevier;
2. Max, M. D. (2003) Natural Gas Hydrate in Oceanic and Permafrost Environments, Kluwer Academic Publication;
3. Nash, K. M. (2010) Shale gas Development, Nova Science Publishers, Incorporated;

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100 **Exam Duration: 3 Hrs**

Part A/Question: <Short Notes, Problems, Numerical> <5-7 > Marks (each)

Part B/Question: <Justification, Criticism, Long answers, Interpretation > <8-10> Marks (each)