OGET 8006	**Energy Trading Markets and Risk Management**	L	T	P	C
Version 1.0		4	0	0	4
Pre-requisites/Exposure	Econometrics Modeling, Econometrics Lab				
Co-requisites	Energy Pricing, Oil & Gas Economics				

Course Objectives

1. To have a clear understanding of the economic rationale for risk management in energy sector.
2. To know the basic techniques for the valuation of forwards, futures, and vanilla options (call and puts);
3. To master the various techniques of hedging practices in terms of energy risk.

Course Outcomes

On completion of this course, the students will be able to

CO1. Understand the concept of various derivative products such as futures, options, and swaps;
CO2. To apply hedging models in assessing price risk of various energy derivatives;
CO3. To analyse and estimate value at risk for various energy derivatives;
CO4. To comprehend various energy derivative products and their performance in Indian and Global Markets;
CO5. To integrate the understanding on various energy derivative products and their performance in Indian and Global Markets.

Catalog Description

Risk is inherent in modern enterprise risk management. Learning different risk management tools such as forwards, futures, options and swaps is necessary. In this course, the focus will be on to learn these tools and the application in Energy price risk management. Students will be applying their econometric skills in learning various risk management models for hedging. Practical application of business data analysis will be done in the class for integrating theories and real business data. Class participation is a fundamental aspect of this course. Students will be encouraged to actively take part in lab activities and to give an oral group presentation. Students will be expected to interact with media resources, such as, web sites, trading simulation games, Derivative software, and newspapers etc.

Course Content

Unit I: **6 lecture hours**

Fundamental Analysis - Fundamental analysis of economic factors which drive prices of various energy products, Introduction to the energy markets (India and International), Overview of energy trading (Physical and Derivatives), Risk Management in various Energy markets.

Unit II: 6 lecture hours

Introduction to Derivatives – Concept, Definition, Need and evolution of derivatives. Past price behaviour overview, reading futures prices, Growth of futures markets (Global and Indian) terminology, Types of Orders- Market Order, Limit Order, Stop Order Futures markets basics, Futures versus forward markets, Regulations (Indian commodity derivative markets and global derivative markets Basis, Convergence and Divergence, Normal Backwardation, Contango and Other hypothesis, Price Discovery, and market efficiency.

Unit III: 4 lecture hours

Technical Analysis – Introduction: Technical versus Fundamental Analysis. Trending/ Anti-trending, Relative Strength Index and Charting Capital Management, and Investment tips.

Unit IV: 8 lecture hours

Hedging – Introduction and Reasons for hedging, True vs selective hedging. Long and Short hedge examples, Who should hedge? Hedging versus Forward Contracting, Cross hedging, Estimation of Hedge Ratio and Interpretation.

Unit V: 15 lecture hours

Options – Options-Why Options? Type of Options (Americans, European, Asian, Exotic, Real etc.,) Call option (Buying/ Writing), Put(Buying/Writing) Options and Payoff, Option Strategies and Payoffs, including graphical analysis (Straddles, Strangles, Condor, Butterfly), Vertical Spreads-Bull and Bear Spreads using calls and puts, calendar spreads, Diagonal Spreads, Collars, Floors and Caps), Characteristics of Option values, Models of valuation (Black and Scholes Options Pricing Model), Effect of Time Decay and Volatility, Historical Vs Implies Volatility, Theory of Put Call Parity, Delta, Gamma, Theta-Meaning, Implications, and applications.

Unit VI: 9 lecture hours

Value at Risk- The VAR Measure, Historical Simulation, Model-Building Approach, Linear Model, Quadratic Model, Monte Carlo Simulation, Comparison of Approaches, Stress Testing and Back Testing.

Text Books

1. Kolb, Robert W. and Overdahl, James A. (2007), Futures, Options and Swaps, Fifth Edition, Wiley-Blackwell Publishers, India.

2. Hull John C., and Basu Sankarshan(2010), Options, Futures, and Other Derivatives, Seventh Edition, New Delhi

3. Edwards, Davis W (2010), Energy Trading and Investing, First Edition, McGraw- Hill, New York

4. Rajib, Prabina(2014), Commodity Derivatives and Risk Management, First Edition, PHI Learning, New Delhi

Reference Readings

1. Muralikrishna, C. and S. Mishra (2011) Communication Skills for Engineers, Pearson education. ISBN: 9788131733844.

2.Houthakker, H. S. (1992). Futures trading. In: M. M. P. Newman and J. Eatwell, (Eds.), The New Palgrave Dictionary of Money and Finance (Vol. 2, pp. 211-213).

3. Seidel, Andrew D, and Ginsberg, Philip M. (1983) Commodities Trading Foundations, Analysis and Operations, New Jersey, Prentice-Hall.

4. Tsay Ruey S. (2010) Analysis of Financial Time Series, Second Edition, U.K, John Wiley & Sons.

5. Ruppert, D. (2011) Statistics and Data Analysis for Financial Engineering, USA, Springer Pilipovic, D., Energy Risk: Valuing and Managing Energy Derivatives, McGraw-Hill, 2007

6. Burger, M. Graeber B, and Schindlmayr G., Managing Energy Risk: An Integrated View on Power and Other Energy Markets, John Wiley & Sons, 2007.

Modes of Evaluation: Quiz/ Project submission/ presentation/ Class room and case discussion/ Written Examination

Examination Scheme:

Components	Quizzes	Case Study and class discussion	Group Project Presentation/ Submission	ESE
Weightage (%)	20	20	10	50

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping between COs and POs		
	COURSE OUTCOMES (COs)	**POs**
CO 1	Understand the various derivative products such as futures, options, and swaps.	PO1, PO2,PO3, PO4, PO5, PO6, PO7, PO8, PSO9, PSO10, PSO11, PSO12, PSO13, PSO14
CO 2	To apply hedging models in assessing price risk of various energy derivatives.	PO1,PO2, PO3, PO4, PO5, PO6, PO7, PO8,PSO9,PSO10,PSO11, PSO12, PSO13,PSO14
CO 3	To estimate value at risk for various energy derivatives.	PO1, PO2,PO3, PO4, PO8, PO9, PSO10,PSO11, PSO12, PSO13, PSO14
CO 4	To comprehend various energy derivative products and their performance in Indian and Global Markets.	PO1, PO2,PO3, PO4, PO5, PO6, PO8, PSO9, PSO10, PSO12, PSO13, PSO14
CO 5	To analyse various energy derivative products and their performance in Indian and Global Markets.	PO1, PO2,PO3, PO4, PO5, PO6, PO8,PO9,PS10,PSO12, PSO13, PSO14

Program Outcome / Course Outcome mapping

Course Outcomes	**CO 1**	**CO 2**	**CO 3**	**CO 4**	**CO5**
PO 1	2	2	3	3	1
PO 2	2	2	2	2	3
PO 3	2	2	3	3	1
PO 4	2	2	3	3	1
PO 5	2	2	1	1	1
PO 6	2	2	1	1	1
PO 7	2	2	1	1	1
PO 8	2	2	3	3	2
PSO 9	3	2	3	3	2
PSO 10	3	2	3	3	2
PSO 11	2	2	3	3	2

PSO 12	2	2	3	3	3									
PSO 13	2	2	1	1	1									
PSO 14	2	2	3	3	2									

		Students will be able to develop and evaluate alternate managerial choices and identify optimal solutions.	Students will demonstrate effective application capabilities of their theoretical understanding of economic theories-Microeconomics, Macroeconomics and trade	Students will be able to exhibit effective decision making skills, employing analytical and critical thinking ability	Students will demonstrate effective oral and written communication skills in	Students will able to work effectively in teams and demonstrate team building capabilities	Students will exhibit leadership and networking skills.	Students will demonstrate sensitivity towards ethical and moral issues and have ability to address them in energy economics.	Students will demonstrate employability traits in line with the changing dynamics of renewable and non-renewable energy sectors.	Students will demonstrate strong conceptual knowledge of economic theory in the context of renewable and non-renewable energy sectors.	Students will demonstrate effective understanding of economics as it is applicable to energy markets, energy pricing, energy trading and risk management.	Students will demonstrate analytical skills in designing solutions for energy efficiency.	Students will exhibit the ability to evaluate working of energy policies.	Students will have domestic and global perspective towards legal frameworks and environmental regulations with respect to energy sectors.	Students will exhibit deployable skills pertinent to the renewable and non-renewable energy sectors.
Course Code	Course Title	PO 1	PO 2	PO 3	P O 4	PO 5	PO 6	PO 7	PO 8	PSO 9	PSO 10	PSO 11	PS1 2	PSO 13	PSO 14
OGET 8006	**Energy Trading Markets and Risk Management**	3	3	3	3	1	1	1	3	3	3	3	3	1	3

1 – Weakly mapped
2 – Moderately mapped
3 – Strongly mapped

Model Question Paper

Name: **Enrolment No:**	

Course: OGET 8006 – Energy Trading Markets and Risk Management

Programme: MA Economics (EE) **Semester: ODD-2017-18**

Time: 3 hrs. **Max. Marks: 100**

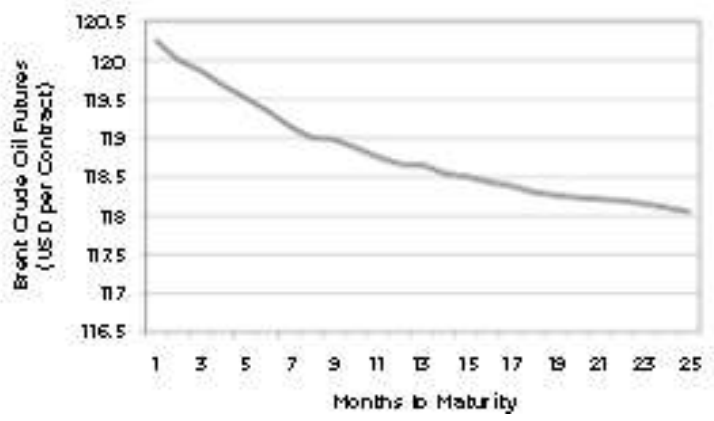
Instructions:

Attempt all questions from **Section A** (each carrying 2 marks); any **Four Questions** from **Section B** (each carrying 5marks)**. Two from Section C** (each carrying 15 marks)**. Section D is compulsory** (30 marks)

Section A (All Questions are Mandatory)

1	A call option gives the holder the right to_____an instrument whereas a put option gives the holder the right to___. A. exercise; confiscate B. sell; purchase C. purchase; sell D. transfer; sell	**[2]**	**CO 1**
2.	An investor can simultaneously be "in the money" yet have a negative not profit on the basis of A. having to cover the initial cost of the option. B. the absence of transaction costs. C. a failure to exercise an option. D. uncertainty in the price of the underlying instrument.	**[2]**	**CO 1**
3.	Selling a call differs from selling a put in that a A. put has possibly unlimited losses. B. call has possibly unlimited losses. C. put will sell for a lower price. D. call will sell for a lower price.	**[2]**	**CO 1**
4.	A major difference between a forward contract and a future contract is that only a future contract is A. a standardized contract that is traded over an exchange. B. available exclusively from commercial banks. C. limited to large contracts. D. available for any amount and maturity.	**[2]**	**CO 1**
5.	[…] risk in the natural gas market can be hedged with a […] A. operational/futures contract B. counter party/plain vanilla swap C. Regulatory/letter of credit D. Market price/forward contract	**[2]**	**CO 1**
6.	Name of the derivative product in energy derivative products traded in India.	**[2]**	**CO 1**
7.	If the crude oil returns are independently identically normally distributed and the annual volatility is 30%, then the daily VaR at the 99% (z =2.32635) confidence interval equal	**[2]**	**CO 2**

	to A. 2.41% B. 3.11% C. 4.40% D. 1.89%		
8.	According to put-call parity, buying put option on a stock is equivalent to: buying a put option on a stock is equivalent to: A. Buying a call option and buying the stock with funds borrowed at the risk-free rate. B. Selling a call option and buying the stock with funds borrowed at the risk-free rate. C. Buying a call option, selling the stock and investing the proceeds at the risk- free rate. D. Selling a call option, selling the stock and investing the proceeds at the risk- free rate.	**[2]**	**CO 4**
9.	A firm is going to buy 10,000 barrels of West Texas Crude Oil. It plans to hedge the purchase using the Brent Crude futures contract. The correlation between the spot and futures price is 0.72. The volatility of the spot price is 0.35 per year. The volatility of the Brent Crude futures price is 0.27 per year. What is the hedge ratio for the firm? A. 0.5554 B. 0.9333 C. 1.2099 D. 0.8198	**[2]**	**CO 3**
10.	On June 20, Caufield Refining estimates it will need to purchase 40,000 barrels of crude on October 12. Caufield decides to hedge price risk using a November NYMEX futures contract. The November futures price on June 20 is USD 77.00/bbl. On October 12, Caufield is ready to purchase its required crude oil and closes out the futures contract on that day; at this time the spot price is USD 80.10/bbl and the futures price is USD 78.50/bbl. What is the effective price paid per barrel? A. USD 78.50 B. USD 78.60 C. USD 80.10 USD 80.40	**[2]**	**CO 1**
	SECTION B (Attempt any **Four Questions) Short Notes** (Choose the correct choice of the following questions and explain the reason behind the correct answer)		
1.	Consider the following two option contracts: • Option 1: January 2017 daily call, strike price of USD 30.00, call value of USD 5.45 • Option 2: January 2017 monthly call, strike price of USD 33.00, call value of USD 6.00 What is the biggest challenge in estimating the implied volatility for these two contracts assuming the following parameters? • Valuation date: November 10, 2016 • Risk free rate: 4%	**[5]**	**CO 2**

	• Underlying value: USD 28.00 a. The options are based on different time intervals (daily vs monthly) b. The option quotes have different strike prices c. The option quotes are both for call options Winter power options are highly volatile due to seasonality factors		
2.	Roger has constructed a portfolio of crude oil option contracts that he has delta hedged. Over a one month period, Roger observes that his portfolio is not performing as expected and he is concerned that the change in portfolio delta, relative to the change in the underlying price of oil, is too high. Which of the following portfolio risk characteristics should Roger neutralize so that his hedge strategy more effectively responds to changes in the underlying price of oil? a. Beta b. Gamma c. Theta d. Vega	**[5]**	**CO 3**
3.	Which of the following statistical tests is used to demonstrate that model errors are normally distributed and independent of any previous steps used within the modeling process? a. Q-Q plot b. Autocorrelation test c. Mean-squared error d. R-Squared	**[5]**	**CO 2**
4.	Which of the statements best explains the shape of the Brent Crude Oil forward price curve illustrated below?  a. Higher physical storage costs are causing crude oil futures to trade in contango.	**[5]**	**CO 3**

	b. Global economic growth is driving demand for crude oil higher causing the crude oil futures to trade in contango. c. Growing concern that global crude oil supplies are in permanent decline is causing crude oil futures to trade in backwardation. Uncertainty over short-term crude oil supplies has placed a premium on physical inventory causing crude oil futures to trade in backwardation.		
5.	Steve Dolan is a power manager at Upstate Electric. He is negotiating a one-day contract to sell 100 MW of electricity at USD 55/MWh for a 24-hour period and has been asked to calculate the Value-at-Risk (VaR) for the contract. If the daily volatility of electricity prices is 2%, what is the daily VaR on the contract assuming a 95% confidence interval? a. USD 180 b. USD 3,447 c. USD 4,330 d. USD 5, 412	**[5]**	**CO 3**
	SECTION C (Attempt any **Two Questions) Long Question Type**		
7.	The spot price of crude oil is ₹3000 per barrel. In the futures market, 3-m and 6-m contracts are trading at ₹3215 and ₹3200, respectively. The cost of carry, inclusive of storage and insurance, is 15% p.a. If the cost of carry model applies, find the following: a. Fair price of the futures contracts for three months and six months. What action can an arbitrageur take in this situation? b. If at the end of three months the spot price were ₹3500 and the futures market stood corrected, what would the profit to the arbitrageur be? If at the end of three months the spot price were ₹2700 and the futures market stood corrected, what would the profit to the arbitrageur be?	**15**	**CO 2,3,4**
8.	Today is 24 March; A refinery needs 1075 barrels of crude oil in the month of September. The current price of crude oil is ₹3000 per barrel. September futures contracts at MCX are trading are trading at ₹3200. The firm expects the price to go up further, and even beyond ₹3200 in September. It has the option of buying the stock now. Alternatively, it can hedge through a futures contract. The size of the futures contract is 100 barrels. i) If the cost of capital, insurance, and storage is 15% p.a., examine whether it is beneficial for the firm to buy now. ii) Instead, if the upper limit to buying price is ₹3200, what strategy can the firm adopt? iii) If the firm decides to hedge through futures, find out the effective price	**15**	

	it would pay for crude oil if at the time of lifting the hedge the spot and futures prices are A) ₹2900 and ₹2910, respectively, ₹3300 and ₹3315, respectively		
9.	A cocoa merchant holds a current inventory of cocoa worth $10 million at present prices of $ 1,250 per metric ton. The standard deviation of returns for the inventory is 0.27. She is considering a risk minimization hedge for her inventory using the cocoa contract of the coffee, cocoa, and sugar Exchange. The contract size is 10 metric tons. The volatility of the futures is 0.33. For the particular grade of Cocoa in her inventory, the correlation between the futures and spot cocoa is 0.85. Compute the risk-minimization hedge ratio and determine how many contracts she should trade.	**[15]**	**CO1,3,4**
	SECTION D		
10.	A 2-month call option on a Crude oil contract per barrel with a strike price of ₹2100 is selling for ₹140, when the share is trading at ₹2200. Find out the following: a. What is the intrinsic worth of the call option? b. Why should one buy the call for a price in excess of the intrinsic worth? c. Under what circumstances would the option holder exercise his call? d. At what price of the asset would the call option holder break even? e. If the price of the crude oil becomes ₹2150 (lower than the break-even price) should the option holder exercise the call option? f. What is the payoff to the holder and the writer if the price of the crude oil is ₹2000, ₹2250, and ₹2500 on the date of expiry of the option?	**[30]**	**CO 4, 2, 3**