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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2019

Program/course: MBA OG **Semester – II**
Subject: FUNDAMENTALS OF REFINING **Max. Marks : 100**
Code : OGOG 7005 **Duration : 3 Hrs**
No. of page/s:4

Please answer all sections. Strictly answer in the chronological order. If so required explain using diagrams.

SECTION A **(15X2=30Marks)**

Following are selected statements. Please write / explain / justify with examples/ in 4-5 sentences:

1) Construct a Refinery plant layout. (Block diagram) with clear indication of Crude storage,OSBL & ISBL. **CO1**

2) What if in ADU crude is heated to 450 & 380 degree Celsius respectively. **CO1**

3) Analyze the components responsible for low smoke point in Kero? Suggest methods to improve it. **CO3**

4) Analyze economy of a process if catalysts are used in a refinery. **CO3**

5) Evaluate if the lubricant have high VI its impact in high heat summer and low temp. winter. **CO2**

6) Iso-Paraffin's the most important component in MS, how n-paraffins are converted toIso.Paraffin? **CO3**

7) Concept of cetane number for Diesel engines. **CO1**

8) Concept of Energy and utility island in a refiner. **CO1**

9) Diesel needs to improve it's Cetane number with some additives. **CO1**

10) Evaluate all four steps of LOBS manufacturing?
CO2

11) Conceptual difference between 87 and 93 Octane gasoline.
CO1

12) Critically calculate/evaluate WTI and Brent for a crack spread for 6-3-2-1 ratio . WTI =$69/bbl, Brent=$71/bbl, Gasoline=$2.513/gallon, Diesel = $1.893/ gallon. Fuel Oil = 1.623 / gallon. **CO3**

13) Conceptualize the effect of fouling in loss of energy in a refinery.
CO1

14)The present approach is: Refineries are integrated with petrochemicals. Critically evaluate aromatics for the economical reasons.
CO3

15) Concept of complexity of a refinery. **CO1**

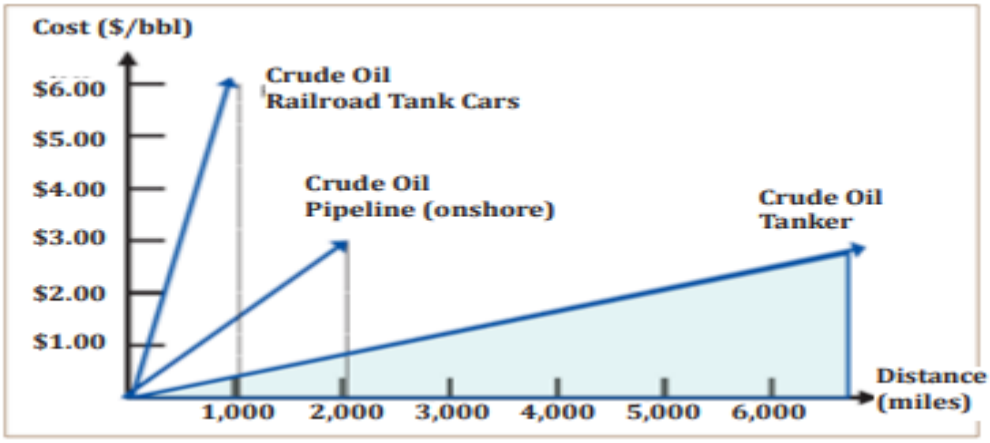
SECTION B (10X4=40Marks)

16. Illustrate the concept of - Opportunity crudes , which has no limitations and can be used in any refinery. one might be seeing the beginning of the reversal of the historical trend, with the emphasis moving from more complex to simpler refining operations.(5+5) **CO1**

17. What is the market structure of refining in India and determine the market structure of motor fuel sales in India using Porters five force Analysis. Explain the basics of Hydrocracker, with feed-stock and products analysis. (5+5) **CO3**

18. Apply following : Traditionally, proximity to market was the dominant consideration in locating a refinery. Refineries often have been co-located with petrochemical complexes in a symbiotic supplier-customer relationship that minimizes transport costs for refined products used as petrochemical feed stocks. Location dynamics are now more complex. Tidewater locations provide access to low-cost marine shipping. **Explain Marine Word Scale.** This criterion can trump proximity to market as the dominant consideration.

    Large, complex refineries located on tidewater have cost advantages that overcome the higher transportation cost of exporting products to distant markets, and are now more common. Using following data, explain two Refineries (1) IOC Mathura (2) HPCL , Mumbai , for their supply of petroleum products to NCR (Delhi) and Ahmdabad (Gujrat) respectively. [**Hint-Use closest approx. distance**] (5+5) **CO4**



19. Evaluate with the reasoning that still diesel is the preferred fuel in India along with its implications in various sectors of our economy? [Hint: APM]. Diesel hydro-treater is most commonly used in the refineries, explain the process, critically evaluate with specification the new challenges for Euro VI norms for diesel. Explain the process of LPG recovery in a refinery. (5+5) **CO3 & CO1**

SECTION C **(10X3=30Marks)**

20. Consider a hypothetical refinery, manufacturing products like Naphtha, Gasoline , Kerosene and Diesel to name a few totaling 90 million tonne per year. It purchases crude at $ 55 per barrel .The percentage break up of composition for gasoline in the product is 20%. Fuel Loss: 5%, Energy Cost: 5%, Operational Loss: 5%.

Let the price of natural gas = $3.00 per mmbtu for hydrogen generation for Hydrocracking operation. Consider a change in operational situation necessitating the increase of gasoline percentage to 30% . Normally the crude input is 100 MT/year.

Following is the Product Slate/Year :

Petroleum Products	Without Hydrocracker	With Hydrocracker
Naptha	30 MT	30 MT
Gasoline	20 MT	26 MT
Diesel	20 MT	20 MT
Kerosene	30 MT	30 MT

With Hydrocracker Calculate the change in Netback price as a result of increase in gasoline production.

(10) **CO4**

21. Imagine there are two crude oil sources one is Heavy, Waxy and Sour Crude (API Gravity 20) and other is Light, Sweet, and low sulphur Crude (API Gravity 35) with price of $ 65 and $70 per barrels. Assume you as a refiner with 10 MMTPA capacity, what ratio will you mix to get optimum crude basket? Calculate for “Gross Product Worth” of the various petroleum products coming out of your refinery (Assume the current Indian Market Price, 5% loss due to energy and other operational losses) and show the NRM of your refinery . (10) **CO2, CO3**

22. Case Study:

In an old refinery has following secondary units: ADU, VDU , Thermal Cracking. Visbreaking,

Because of their relative simplicity of design and straightforward thermal approach, visbreaking processes will not be ignored or absent from the refinery of the future. However, new and improved approaches are important for the production of petroleum products. These will include advances in current methods, minimization of process energy losses, and improved conversion efficiency. In addition, the use of additives to encourage the preliminary deposition of coke-forming constituents is also an option. Depending upon the additive, disposal of the process sediment can be achieved by a choice of methods. Thermal Cracking is Cracking at elevated temperatures in the absence of catalyst eg: Vis-breaking, delayed coking, Fluid coking etc. Delayed Coking and Vis-breaking uses Technology for the bottom of the barrel upgradation; means of disposing of low value resids by converting part of the resids to more valuable liquid and gas products. Vis-breaking is essentially a mild thermal cracking operation at mild conditions where in long chain molecules in heavy feed stocks are broken into short molecules thereby leading to a viscosity reduction of feedstock. A given conversion in vis-breaker can be achieved by two ways:

- *High temp., low residence time cracking: Coil Visbreaking.*
- *Low temp., high residence time cracking: Soaker visbreaking.*

Illustrate with diagram the advantage of having a Soaker drum. (10)

CO2,CO3,CO4

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SECTION A **(15X2=30Marks)**

Following are selected statements. Please write / explain / justify with examples/ in 4-5 sentences:

1) Concept of a Refinery plant layout for Outside and Inside battery limits. Show pipelines **CO1**
2) What if in VDU crude is heated only to 300 degree . **CO1**

3) Analyze the components responsible for high cetane in Diesel? Suggest methods to improve it. **CO3**

4) Analyze economy of a process if reforming are used in a refinery. **CO3**

5) Evaluate if the lubricant has high viscosity index for giesel its impact in low temp. winter. **CO2**

6) N-Paraffin's the most important component in Diesel, show its impact in diesel quality? **CO3**

7) Concept of octane number for MS engines. **CO1**

8) Concept and benefit of Energy and utility island in a refiner. **CO1**

9) Kero needs to improve it's flame height , . **CO1**

10) Evaluate hydrofining step LOBS manufacturing?
CO2

11) Conceptual difference between low and high diesel index.
CO1

12) Critically calculate/evaluate WTI and Brent for a crack spread for 3-2-1 ratio . WTI =$67/bbl, Brent=$69/bbl, Gasoline=$2.213/gallon, Diesel = $1.793/ gallon.
CO3

13) Conceptualize the effect of acid (TAN) of energy in a refinery.
CO1

14)The present approach is: Refineries are integrated with petrochemicals. Critically evaluate olefins for the economical reasons.
CO3

15) Concept of NCI of a refinery. **CO1**

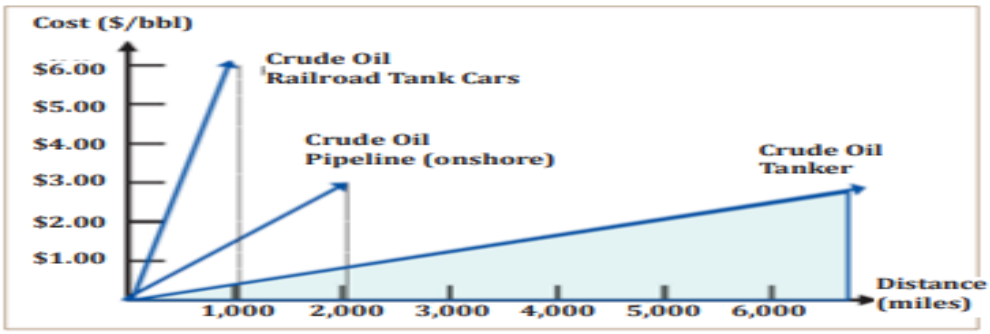
SECTION B (10X4=40Marks)

16. Illustrate the concept of – Bad quality crudes , (low API, high Sulphur) which has no limitations. Can this be used in any refinery. Concept of Crude basket and its benefits.

17. What is the market structure of refining in India and determine the market structure of motor fuel sales in India using Porters five force Analysis. Explain the basics of FCC, with feed-stock and products analysis. **CO3** (5+5)

18. Apply following : Traditionally, proximity to market was the dominant consideration in locating a refinery. Refineries often have been co-located with petrochemical complexes in a symbiotic supplier-customer relationship that minimizes transport costs for refined products used as petrochemical feed stocks. Location dynamics are now more complex. Tidewater locations provide access to low-cost marine shipping. **Explain Marine Word Scale.** This criterion can trump proximity to market as the dominant consideration.

    Use closest approx. distance , for a Large, complex refineries located near NCR (Mathura) have cost advantages that overcome the higher transportation cost (crude pipeline from Mumbai) to closer distant NCR markets. Using following data, explain two Refineries (1) IOC Mathura (2) BORL, BINA , for their supply of petroleum products to NCR (Delhi) and MP, Chhattisgarh respectively. (5+5) **CO4**



19. With impact of MS and diesel fuel , Critically evaluate with the reasoning that still diesel is the preferred fuel in India . Impact of administered price mechanism in petro retail, its impact in various sectors of our economy? Diesel hydro-treater is most commonly used in the refineries, explain the process, critically evaluate with specification the new challenges for Euro IV norms for diesel. (5+5) **CO3 & CO1**

SECTION C **(10X3=30Marks)**

20. Consider a hypothetical refinery, manufacturing products like Naphtha, Gasoline , Kerosene and Diesel to name a few totaling 90 million tonne per year. It purchases crude at $ 58 per barrel. The percentage break up of composition for gasoline in the product is 20%. Fuel Loss: 5%, Energy Cost: 5%, Operational Loss: 5%.

Let the price of natural gas = $3.00 per mmbtu for hydrogen generation for FCC operation. Consider a change in operational situation necessitating the increase of gasoline percentage to 100% . Normally the crude input is 100 MT/year. Following is the Product Slate/Year :

Petroleum Products	Without FCC	With FCC
Naptha	30 MT	30 MT
Gasoline	15 MT	30 MT
Diesel	15 MT	20 MT
Kerosene	30 MT	30 MT

With FCC Calculate the change in Netback price as a result of increase in gasoline production.

(10) **CO4**

21. Calculate for "Gross Product Worth" of the various petroleum products coming out of your refinery. Imagine there are two crude oil sources one is Heavy, Waxy and Sour Crude (API Gravity 20) and other is Light, Sweet, and low sulphur Crude (API Gravity 35) with price of $ 60 and $70 per barrels. Assume you as a refiner with 20 MMTPA capacity, what ratio will you mix to get optimum crude basket? (Assume the current Indian Market Price, 5% loss due to energy and other operational losses) and show the NRM of your refinery . (10) **CO2, CO3**

22. Case Study:

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Illustrate with diagram the advantage of having a Coil Visbreaker. (10) **CO2,CO3,CO4**