Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM & ENERGY STUDIES

End Semester Examination (Online) – July, 2020

Program: M.A. Energy Economics
Semester: II
Subject/Course: Oil and Gas Economics **Max. Marks: 100**
Course Code: **Duration: 3 Hours**

IMPORTANT INSTRUCTIONS

1. *The student must write his/her name and enrolment no. in the space designated above.*
2. *The questions have to be answered in this MS Word document.*
3. *After attempting the questions in this document, the student has to upload this MS Word document on Blackboard.*

		Marks	COs
	Refer the excerpts of the case study and answer the following questions (Q1. And Q2.) The conventional oils that dominated the twentieth century may differ from one another in color, thickness, sulfur content, and other impurities, but they are a relatively homogeneous lot, flowing from relatively easily accessible deposits in limited locations around the world. The makeup and geography of tomorrow's oil, however, will be dramatically different from the black gold that gushed forth at Spindletop, Texas, back in 1901. As conventional crude oil supplies have peaked and leveled off globally in recent years, oil has begun to transition, as shown in figure 2. Many current forms of oil that were once considered unconventional are now grouped into the conventional category, from ultra-deep oil in the Gulf of Mexico to Maya heavy oil in Mexico. These and other new transitional oils are being developed as well—from shale rocks saturated with oil over a broad, continuous area, with the fabric of the rock itself trapping the hydrocarbons in place. This oil transition is in turn giving way to an oil transformation. Non-flowing oils are being produced from non-crude sources in processes that require emergent technologies, as is happening with the oil sands in Alberta, Canada, Venezuela's Orinoco belt, and eventually the kerogen (an oil precursor) in oil shales in U.S. mountain states, Western Europe, and beyond. Ultimately, oil need not be a building block in liquid fuels, which can also be converted from biological materials, natural gas, or coal. Over time, oils themselves are expected to change: what they are, where they are located, how much they cost, how much carbon and other impurities they contain, what byproducts they yield, what wastes they leave behind, what their greenhouse gas emissions are, and how to handle them. Given this shift, when it comes to managing new sources		

of petroleum, the past will not necessarily serve as a good indication of the future.

Still, according to the U.S. Department of Energy, although new liquid hydrocarbon supplies have been acknowledged, unconventional oils have yet to be strictly defined. Generally speaking, unconventional oils cannot be produced, transported, and/or refined using traditional techniques. They require new, highly energy intensive production techniques and new processes to deal with their inaccessible placements or unusual compositions.

Tight shale oil

This heterogeneous bundle of resources not only represents a departure from conventional oil, new oils differ widely from one another as well. The spectrum of new oils runs the gamut: some of tomorrow's liquid hydrocarbons are akin to today's oil, others will evolve but remain more oil-like, and still others will be synthesized from coal or natural gas.6 Transitional oils, for example, tend to have conventional makeups but are difficult to extract. These include tight oils, which is oil trapped in shale that can be accessed by hydraulic fracturing or fracking, a procedure by which rock formations are fractured by injecting fluids to force them open, allowing oil (and gas) to flow out. Ultra-deep oils that are buried as remotely as 10 miles below the water's surface are also considered transitional. More coal-like oils include semisolid extra-heavy oils such as bitumen in tar and oil sands, kerogen in oil shale, and liquid oils derived from coal itself.

Conventional Crude Oils

Conventional oils are hydrogen-rich compounds with relatively short hydrocarbon chains, fewer carbon atoms—C1 to C60—and lower molecular weights than most unconventional oils (around 200). Since hydrogen packs all of the energy while carbon goes along for the ride, conventional oils tend to deliver more productivity with less waste than unconventional oils.

There can be a great deal of variation within that range—there is no one formula for crude oil. Instead, these natural resources range from high-quality "light, sweet" crudes to lower-quality "heavy, sour" crudes The density of the oils is measured on a scale known as API gravity—the lighter the oil, the higher the gravity; the heavier the oil, the lower the gravity. Heavier oils are tricky to extract, requiring gas injection and other invasive techniques due to their high, molasses-like viscosities that approach those of unconventional oil. Other factors being equal, the lower the API gravity, the more expensive the oil is to extract and process, and the lower the price the oil will bring. Transitional oils are oils with conventional compositions that are extracted by unconventional means. As conventional oils become less accessible, new, more technical, energy-intensive methods are being developed for their recovery, from ultra-deep wells drilled miles below the sea to fracturing shale rock in order to tap oil trapped in low-permeability siltstones, sandstones, and carbonates deep in the earth.

But no two source rocks are alike. Therefore, no two shale oils are exactly alike. The lighter and sweeter the oil, the less involved the processing and the higher the yield of high-value petroleum products, including gasoline, diesel, and jet fuel. But the more extensive the recovery method, the more energy is required for extraction, which means that these oils tend to result in higher carbon emissions and other societal impacts.

Unconventional Oils

Lacking a clear definition, unconventional oils are typically identified by their characteristics. The heavier the oil is—for example, oil sand (bitumen) and oil shale (kerogen)—the more carbon laden, higher in sulfur, and filled with toxic impurities. Unconventional oils are typically much heavier and sourer than even the lowest-quality conventional oil.

An array of unconventional solid, liquid, and gaseous hydrocarbons can be processed into petroleum products, as shown in Figure 3. But these extraheavy, impure oils require very large energy inputs to upgrade and preprocess into synthetic crude oil that is then processed by a refinery. Some new oils are effectively solid and must be removed through mining or heated in place (in situ) until they flow. These new oils tend to be less valuable than conventional crude, which is readily transformed into the most marketable petroleum products by today's standards.

Oil sands are a combination of quartz sand, clay, water, trace minerals, and a small (10–18 percent) share of bitumen, and their sulfur content can be in excess of 7 percent. Bitumen is made up of organic components ranging from methane—the simplest organic molecule—to large polymeric molecules having molecular weights in excess of 15,000. This extremely complex hydrocarbon mixture can be synthetically processed into oil.7 However, it cannot be transported to market by pipeline without adding diluting agents—such as gas-processing condensates including the diluent pentanes plus—to meet pipeline density and viscosity limitations. A large portion of Alberta's bitumen production is currently upgraded to synthetic crude oil and other products before shipment to refineries.

Oil shale is "immature oil" that has not been in the ground long enough to form oil. It is mostly composed of clay, silt, and salts, with a small (12 percent) share of insoluble organic matter (kerogen) and even smaller (3 percent) share of soluble bitumen.8 The organic kerogen, once extracted and separated from the oil shale, can be processed into oil and gas. Like oil sands, oil shale has similarly high sulfur content—up to 7 percent.

Heavy Oils

In the latter part of the twentieth century, as conventional oils started to become more heterogeneous, their geography became increasingly more diversified. Heavy oils in California, Venezuela, China, Indonesia, the Middle East, and along the Alberta-Saskatchewan border initiated the oil transition.

Tight and Transitional Conventional Oils

Conventional oils are also being found in difficult-to-reach places. Ultra-deep oil in the Gulf of Mexico, for example, can be trapped many miles below the ocean floor. Oils have been discovered under 4 miles of water, salt, sand, and rock as well. Deep pre-salt fields—generally high-quality oil located in deep-sea areas under thick layers of salt and requiring large-scale investment to extract—are offshore of Brazil and West Africa. They are the first of their kind being drilled around the globe.

In North America, tight shale oils are being fracked in the northern Bakken (spanning North Dakota, Montana, Saskatchewan, and Manitoba); in Eagle Ford, Barnett, and the Permian basin in Texas and New Mexico; in the Cardium play in Alberta; in the Miocene Monterey and Antelope deposits in California; in Mowry-Niobrara in Wyoming and Colorado; in Oklahoma's Penn Shale; in Montana's Exshaw Shale; and in Utica Shale in Colorado, Wyoming, and New

Mexico. Additional transitional tight shales are being probed for oil (and gas) in New York, Maine, Mississippi, Utah, and Alaska's North Slope and Cook Inlet.There is an even-greater potential for new tight oils on a global scale in China,Australia, the Middle East (especially Israel), Central Asia (Amu Darya Basin and the Afghan-Tajik Basin), Russia, Eastern Europe, Argentina, and Uruguay. New oil conditions in the Arctic are unlike any other and will require drilling in some of the coldest waters, far from civilization, amid areas of high environmental sensitivity and unpredictable weather. Still, the Arctic Circle nations, including Russia, the United States, Canada, Norway, and Denmark—with one-sixth of the world's landmass and spanning 24 time zones—may constitute the geographically largest unexplored prospective area for petroleum remaining on earth.13 The United States Geological Survey has assessed the area north of the Arctic Circle and concluded that about 13 percent of the world's undiscovered oil and 30 percent of the world's undiscovered gas may be found there.

Extra-heavy Oils

The bitumen contained in oil sands is the most prevalent extra-heavy oil. The province of Alberta, Canada—including the Athabasca Wabiskaw-McMurray, Cold Lake Clearwater, and Peace River Bluesky-Gething regions—has the globe's largest deposits of bitumen. Outside of Canada, 21 other countries have bitumen resources, including Kazakhstan (in the North Caspian Basin), Russia (in the Timan-Pechora and Volga-Ural basins), Venezuela, and Africa, including the Republic of Congo, Madagascar, and Nigeria. In the United States, oil sands are deposited in at least a dozen states, including (in relative order) Alaska, Utah, Alabama, California, Texas, Wyoming, Colorado, and Oklahoma. However, the U.S. and other nations' oil sand reserves are currently considered to be far smaller in

	volume than Canada's reserves and may also be less easily recovered due to different physical and chemical compositions. Extra-heavy oil (non-bitumen) is recorded in 166 deposits worldwide, the largest in eastern Venezuela's Orinoco Oil Belt. The deposits are found in 22 countries, with thirteen of the deposits located offshore.		
Q.1	Define the types of unconventional oils and explain the origin of each; understand the broad categories of unconventional oils, including which are commercially viable and which are more speculative.	**20**	**CO1**
Q.2	Explain how oils are categorized as light or heavy; sweet or sour; and how these designations affect refining decisions and refining profitability.	**20**	**C04**
Q.3	You are a geophysicist of an organization ABC Pvt. Ltd. who is into the business of Exploration and Production. The organization has recently acquired a block in KG Basin KGB-12D4. Due to the non-availability of the technical staff, your organization has recruited a set of engineers from IIT-Mumbai. Your director (Technical) has asked you to make an induction course material on various activities involved in Exploration and Production. Illustrate and explain the same accordingly.	**20**	**CO3**
Q.4	State the reason behind the current ongoing decline in world crude oil prices and its impact on the world economy.	**20**	**CO4**
Q.5	Discuss the demand and supply dynamics of the oil and gas industry.	**20**	**CO2**

ANSWERS