Name: **Enrolment No:**	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2023

Course: Energy Analytics and Modelling **Semester: III**
Program: MBA Power Management **Time : 03 hrs.**
Course Code: PIPM 8012P **Max. Marks: 100**

Instructions:

SECTION A
10Qx2M=20Marks (Answer All Question)

S. No.		**Marks**	**CO**
Q 1	What is Veracity of Data?	**2**	**CO1**
Q 2	Name 2 statistical tools used for Time Series Analysis.	**2**	**CO1**
Q 3	Name 2 Algorithms used for AI platform creation.	**2**	**CO1**
Q 4	What is PyPSA?	**2**	**CO1**
Q 5	Name 2 software languages used in Energy analytics	**2**	**CO1**
Q 6	Data Analytics uses ___ to get insights from data. a) Statistical figures b) Numerical aspects c) Statistical methods d) None of the mentioned above	**2**	**CO1**
Q 7	Linear Regression is the supervised machine learning model in which the model finds the best fit ___ between the independent and dependent variable. a) Linear line b) Nonlinear line c) Curved line d) All of the mentioned above	**2**	**CO1**
Q 8	Amongst which of the following is / are the types of Linear Regression, a) Simple Linear Regression b) Multiple Linear Regression c) Both A and B d) None of the mentioned above	**2**	**CO1**
Q 9	Amongst which of the following is / are the true about regression analysis? a) Describes associations within the data b) Modeling relationships within the data	**2**	**CO1**

	c) Answering yes/no questions about the data d) All of the mentioned above		
Q 10	Error is the difference between the actual value and Predicted value and the goal is to reduce this difference. a) True b) False	**2**	**CO1**

SECTION B

4Qx5M= 20 Marks

Q 1	Explain synergic model of smart grid.	**5**	**CO2**
Q 2	What is Big Data. Name two methodology for analysis of Big Data.	**5**	**CO2**
Q 3	Explain value chain of Data.	**5**	**CO2**
Q 4	What is Descriptive Analytics and its usage in Energy Sector?	**5**	**CO2**

SECTION-C

3Qx10M=30 Marks

Q 1	Analyze role and impact of generative AI in Energy Sector.	**10**	**CO3**
Q 2	Through Moving average method (2 months or 3 months) forecast the value for the 16th Month from the following data	**10**	**CO3**

Months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Value	13	11	14	18	21	18	16	16	15	14	14	18	10	19	20

Q 3	From the data below create electricity demand equation wrt Temperature	**10**	**CO3**

Demand of Electricity (MW)	**Temperature (C)**
1993	31
1875	29
1990	30
1937	32
1959	33
1911	29
1872	35
1913	30
1950	31
1940	30

SECTION-D

2Qx15M= 30 Marks

	Across the energy supply chain from generation to consumer, we can see that the trend toward investing in renewable energy has picked up pace as demand has grown for energy companies to actively pursue investments in energies with little or no environmental impact in the quest for decarbonisation. McKinsey estimates that by 2035, 50% of energy will be wind and solar. The move toward renewable energy has a distinct and significant impact on energy generation and distribution that needs to be carefully managed. Efficient use of data will therefore be critical to improving the		**CO4**

competitiveness and productivity of assets, both traditional and renewable generation.

Data efficiency in renewables

From the perspective of power generation from renewable sources, there are several challenges that companies need to tackle. The variable nature that fuels the renewable generation makes production less predictable. In that sense, access to the auction is more conservative and can lead to inefficiencies in the use of assets, as some of the energy produced may be discarded if it is not saleable in the intraday market. Effective use of data can have a direct impact on the cash flow of wind and solar generation companies in areas such as real-time decision making. With the right insights, energy production from renewable assets can be optimized and better predict the future of supply and demand. In addition, using data well can allow better decisions to be made, such as the possibility of bypassing the day-ahead market and going directly to the intraday market and having a better return per watt generated.

Organizations working in traditional energy generation will have to adjust costs by improving the efficiency of these plants. In this respect, several studies project that a proper use of advanced analytics implies savings of between 5% and 7.5%. This is due to an improvement in plant uptime, supported by predictive maintenance applications, coupled with optimization of the fuel consumption that powers these plants, as well as fine-grained performance monitoring that eliminates over-production. This need to improve production costs in the more traditional plants is becoming increasingly important if we add that more and more individuals are injecting energy into the system from solar panels. These actors are at both ends of the chain, as they produce and consume at the same time. This scenario suggests that in the not too distant future, there will be a large "long-tail" of producers that will have to be taken into account for any production forecasting model. For this reason, the need to have a data platform that allows for a fine-tuned analysis and prediction of supply and demand becomes a necessary tool to operate the business in a more efficient and profitable way.

Intelligent network management

All of this introduces a new issue: grid management. The business of energy transmission and distribution has undergone little change in recent years but can be stressed by several factors. It is commonly the incorporation of many small producers distributed throughout the territory, and the increase in the rise of electric vehicles that are causing this strain.

The latter will drive changes in consumption habits such as charging electric vehicles at home and the injection of energy from solar panels on roofs, which will cause midday energy peaks and create more volatile daily demand patterns. To cope with these changes in demand and avoid overloads distribution companies will have to invest in optimizing the grid, which may put pressure on profitability and cash flows.

Investment is unavoidable, so the question becomes about smart investment. How do companies future-proof their assets as well as prepare themselves for the future?

That’s where data comes in. McKinsey estimates that the use of data-driven technologies can drive operating and maintenance cost savings of more than 12%. For example, predictive maintenance, based on machine learning, will enable utility companies to take preventative action that avoids large-scale power outages and costs. Today, the costs of sensors, data capture, and information storage have significantly decreased and are one tenth of what they were 10 years ago, leading to the proliferation of data that enables advanced analytics-driving efficiencies.

These efficiencies are achieved through remote inspection solutions, avoiding staff travel, and cutting resolution times. Furthermore, thanks to predictive maintenance and the optimization of asset management efficiency, aspects such as energy loss and increased service time of transformer plants are improved.

This is possible thanks to the implementation of IoT solutions boosted by the introduction of communication improvements such as 5G or the future 6G technology, which will have a transmission speed of 1,000Gbp/s, compared to the 600Mbp/s of 5G. Through these technologies, energy companies will be able to collect data and analyze it in real time, allowing them to optimize operating costs, even defining predictive maintenance policies that guarantee the level of service and savings.

Towards a better customer experience

Lastly, we examine retail companies, the energy marketers. The demand for energy in the retail market has been practically flat in recent years. Additionally, we are in a segment of the value chain where there is fierce competition and new competitors are more digital and more agile. The authority and the struggle to retain or capture customers has become the precedent for these companies, where knowing the customer experience in detail and seeking to maximize customer satisfaction has to be the priority. In this endeavor—the use of data, profiling customers 360°—is imperative, as with the liberalization of the market, customer churn rates of up to 25% have been observed according to analysts.

In this context, recently created companies have the advantage of having been born digital, but nevertheless with less financial muscle and with the challenge of finding the scale that will make them viable in the medium and long term. On the other hand, traditional, larger companies have huge cost structures, are less agile, and need digitization to compete. Solutions such as automated voice analytics in call centers,

	the integration of these analytics with communications systems like mobile applications or the corporate website, as well as automatic consumption analysis and energy price will allow companies to have a better understanding of customers, increasing lifetime value and reducing churn. Other aspects that can improve the efficiency of retail companies are better assessment of customer creditworthiness and consumption variation, minimizing defaults, and avoiding fraud. The impact of the use of different analytical techniques in this field increases the profitability of these companies by 5% to 10%, at the same time increasing the brand value by increasing customer satisfaction. The use of advanced analytics in corporate centers is less talked about and has an estimated return of between 8% and 9% reduction in operating costs. Within this group, we can find aspects such as improvements in the management and investigation of accidents at work as well as their prevention, or other aspects such as what is called "people analytics" in reference to the use of data analysis tools for management and decision-making in people management in the company. These include recruitment, training, performance management, and employee retention. Going into more technological aspects, the data platforms that must support this decision-making must be able to operate in a hybrid environment in which there is integration with the applications that reside in the company's own data centers, as well as the possibility of working in public cloud environments. Data governance is another key aspect in solving these problems, as the data life cycle is complex and diverse from the capture of the information when it is generated, until it is consumed in a system that exploits the final information. If we consider, these two points—hybridization and governance—unified data management can be a challenge if the appropriate technology is not in place. We are facing a paradigm shift where data analytics in energy use can be a differential factor in obtaining greater profitability, with lower production costs, a great increase in efficiency in generation, distribution, and transmission and, of course, an improvement in the loyalty of the end customer who can also benefit from savings in their bills and efficiency in their consumption.		
Q1	What is paradigm shift and role of analytics in Energy Sector	**15**	**CO4**
Q 2	Why growth of renewable energy sector is proportional to application of analytics.	**15**	**CO4**