Name: Enrolment No:	UPES UNIVERSITY OF TOMORROW

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

Course: Energy Audit **Semester : II**
Program: M Tech Energy Systems and Sustainability **Time : 03 hrs.**
Course Code: EPEC-7029 **Max. Marks : 100**
Instructions: Attempt all questions. Internal choice is given in question number 11.

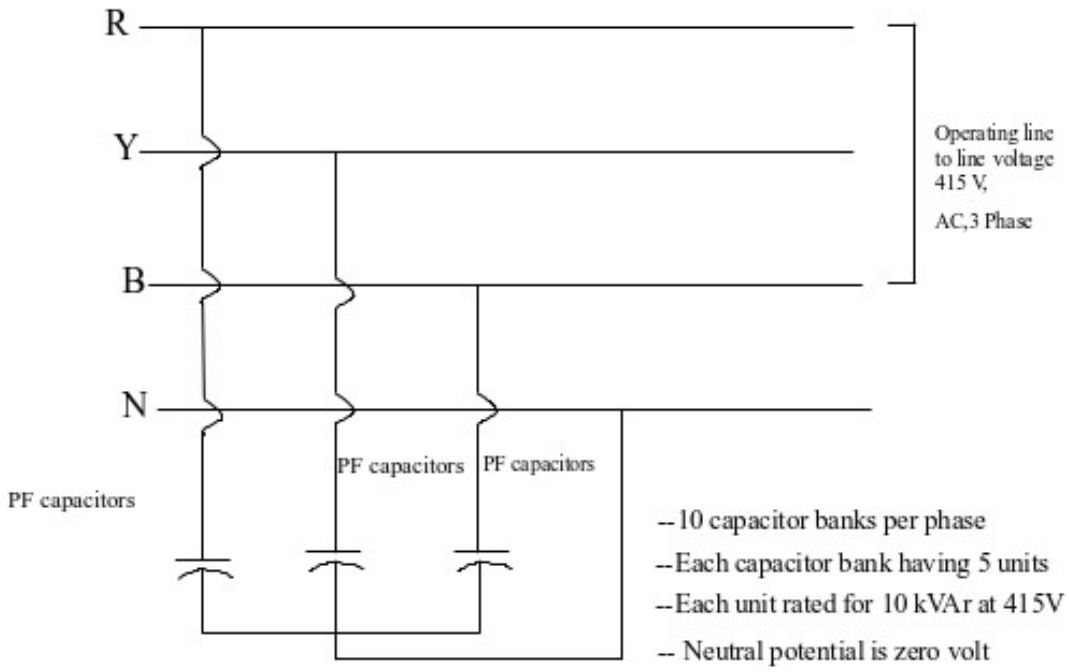
SECTION A
(5Qx4M=20Marks)

S. No.	Statement of question	Marks	CO
Q 1	State the key elements of an energy audit as defined in the Energy Conservation Act 2001.	**4**	**CO1**
Q2	A company consumes 5,000 tons of furnace oil per year (GCV =10,200 kCal/kg), as well as 29,651 MWh of electricity per year. Draw the pie-chart of percentage share of fuels based on consumption in kCal (1kWh = 860 kcal)	**4**	**CO2**
Q3	A process plant consumes of 125,000 kWh per month at 0.9 Power Factor (PF). What is the percentage reduction in distribution losses per month if PF is improved up to 0.96 at load end?	**4**	**CO3**
Q4	Differentiate between energy use and energy consumption.	**4**	**CO1**
Q5	List the key components of ISO-50001 Energy Management System.	**4**	**CO2**

SECTION B
(4Qx10M= 40 Marks)

Q6	With the help of case study explain the duties and responsibilities of Energy Auditor. List some of the challenges you may face during conducting the energy audit of large organisation along with your team (assume) and suggest the strategies to overcome the challenges.	**10**	**CO1**
Q7	As per the ISO-50001 Energy Management System standard clause 4.4.5 regarding Energy performance indicators, it is required that – • The organization shall identify EnPI's appropriate for monitoring and measuring energy performance. • The methodology for determining and updating the EnPI's shall be recorded and regularly reviewed. • EnPI's shall be reviewed and compared to the energy baseline regularly. Based on the above clause answer the following a. Explain the meaning of the above clause in detail. b. Identify the benefits that an organisation can achieve after implementing this clause. c. Discuss the procedure to implement this clause in the organisation.	**10**	**CO2**
Q8	Use CUSUM technique to develop a table and to calculate energy savings for 8 months period. For calculating total energy saving, average production can be taken as 7,500 MT per month. Refer to field data given in the table below.	**10**	**CO3**

	<table><tr><th>Month</th><th>Actual SEC, kWh/MT</th><th>Predicted SEC, kWh/MT</th></tr><tr><td>May</td><td>1311</td><td>1335</td></tr><tr><td>June</td><td>1308</td><td>1335</td></tr><tr><td>July</td><td>1368</td><td>1335</td></tr><tr><td>Aug</td><td>1334</td><td>1335</td></tr><tr><td>Sept</td><td>1338</td><td>1335</td></tr><tr><td>Oct</td><td>1351</td><td>1335</td></tr><tr><td>Nov</td><td>1322</td><td>1335</td></tr><tr><td>Dec</td><td>1320</td><td>1335</td></tr></table>		
Q9	As an energy auditor your first consignment is to conduct the energy audit in UPES. Discuss in detail your adopted strategy to conduct the energy audit along with the scope and the report format and the content of the report you will use to publish the performance of the organisation.	**10**	**CO1**
	SECTION-C **(2Qx20M=40 Marks)**		
Q10	As a certified ISO-50001 Energy Management System auditor you were asked to implement the ISO-50001 standard in Bidholi Campus of UPES. List down the evidences, documents and records you will look for so that campus can get certified.	**20**	**CO2**
Q11	A In a five star hotel building air conditioning system, Cold air at 23oc is supplied from air handling unit. The cold air flow rate is 20,000 M^3/hr at a density of 1.2 Kg/m^3 .The inlet and outlet enthalpy of the air are 105 KJ/Kg and 80 KJ/Kg. The COP of the system is 3.75. Hotel management wants to install Double effective VAR System .The saturated steam at 5kg/cm^2 will be supplied either from 500 KVA DG Sets exhaust gas boiler or from the existing LDO Fuel fired boiler. The plant is operating for 8760 hr. The investment VAR system is 20 lacs. The investment for waste heat boiler is 6 lacs. Power cost is Rs 4/kWh. As an energy auditor which option can be recommended to the hotel management? Option1: Supply steam from the existing LDO fired boiler to VAR system and avoid the investment of waste heat boiler Option2 - Supply steam from the waste heat boiler, which needed investment of waste heat boiler in addition to VAR system The steam consumption per TR will be 4.7 Kg/TR at 5kg/cm^2 pressure. The cost of LDO is Rs.16,800 Ton	**20**	**CO3**
	OR		
Q11	A process industry invites an energy auditor to suggest ways and means to reduce the maximum demand on the grid supply. The process industry has a contract demand of 3940 kVA with Electricity Supply Company. The average monthly maximum demand is recorded as 3250 kVA at the power factor of 0.9. The process industry has to pay minimum demand charges of 75% of the contact demand to the electricity supply company. After analyzing the electricity bill, the auditor studies the existing PF capacitors installation at the plant LT substation bus bar and observes the following connections.	**20**	**CO3**



The auditor observes that, there are 10 capacitor banks per phase, each bank comprises of 5 units of PF capacitors and each unit is rated for 10 kVAr at 415 V. Give your answer on the following

a. What is the optimum limit of Power factor improvement, so that plant avoids paying demand charges over and above the minimum demand charges?
b. What would be the annual maximum demand charge saving if the existing power factor is improved to optimum power factor (MD charges @ Rs. 300/- per kVA per month) ?
c. What is the additional PF capacitors kVARs requirement to achieve the desired PF?
d. What is the present operating capacity of PF capacitors installation at the LT substation bus bar?
e. Whether energy auditor would still recommend installation of extra power factor capacitors in the above situation to achieve the additional PF capacitors kVARs requirement with the existing capacitors installation at the LT bus bar? Support your answer with reasons.