Enrolment No./Seat No_____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VI EXAMINATION – SUMMER 2025**

**Subject Code: 3161919 Date: 30-05-2025**

**Subject Name: Energy Conservation and Management**

**Time: 10:30 AM TO 01:00 PM Total Marks:70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

**Marks**

**Q.1** **(a)** Explain: (1) Power factor (2) Energy audit (3) Non-commercial energy **03**

**(b)** Discuss sector wise energy consumption scenario in India. **04**

**(c)** List out the schemes of BEE. Discuss any two in detail. **07**

**Q.2** **(a)** Explain Benchmarking in short. **03**

**(b)** Explain working of Fluidized Bed Combustion (FBC) boiler with neat sketch. **04**

**(c)** Discuss detailed audit or ten step methodology for energy conservation. **07**

**OR**

**(c)** Discuss main features of the Energy Conservation Act, 2001 in detail. **07**

**Q.3** **(a)** Explain the terms: Payback period, Cashflow and Return on Investment. **03**

**(b)** What is ESCOs? Discuss the role of ESCOs. **04**

**(c)** Define the term Net Present Value (NPV). Using the net present value analysis technique, evaluate and comment on the NPVs of the two proposed projects shown in the table. The annual discount rate is 8% for each project. Also find the future value of the projects for the $7^{th}$ year. **07**

| | Project 1 | Project 2 |
|---|---|---|
| Capital cost (Rs.) | 20000 | 20000 |
| Year | Net annual saving (Rs.) | Net annual saving (Rs.) |
| 1 | 5000 | 5500 |
| 2 | 5000 | 5300 |
| 3 | 5000 | 5200 |
| 4 | 5000 | 5000 |
| 5 | 5000 | 4500 |
| 6 | 5000 | 4500 |
| Total net savings at the end of the $6^{th}$ year | 30000 | 30000 |

**OR**

**Q.3** **(a)** List out the elements of monitoring and targeting. **03**

**(b)** State the techniques used for data analysis. Explain any one using neat sketch. **04**

**(c)** The energy production data of an industry follows a relationship: **07**
Energy consumption = 0.5 P(Production)+220 in a year 2012. After installation of waste heat recovery system, the collected data for six months is given the table below:
Using CUSUM technique, calculate energy savings in terms of ton of oil equivalent (toe) and the saving in specific energy consumption achieved from waste heat recovery system. Also draw a CUSUM Chart for the data.

| 2012 – Month | Actual Energy Consumption, toe/month | Actual production, Ton/month |
|---|---|---|
| July | 590 | 760 |
| Aug | 605 | 820 |
| Sept | 670 | 940 |
| Oct | 582 | 750 |
| Nov | 512 | 610 |
| Dec | 540 | 670 |

**Q.4** **(a)** Explain the terms: Boiler efficiency, cogeneration, heat exchanger effectiveness. **03**
**(b)** Write a short note on Boiler blow down and how to calculate it. **04**
**(c)** Discuss the energy conservation opportunities for the boiler **07**

**OR**

**Q.4** **(a)** Differentiate between insulation and refractories. **03**
**(b)** What is the economic thickness of insulation. Discuss the factors affecting it. **04**
**(c)** List out the steam traps and explain any two steam traps with neat line sketches. **07**

**Q.5** **(a)** Classify the types of furnaces according to their use. **03**
**(b)** Write a note on energy efficiency measures in the industrial furnaces. **04**
**(c)** A counter flow double pipe heat exchanger using hot process liquid is used to heat the water. The water flows at 12 $m^3$/hr. The process liquid enters the heat exchanger at 200°C and leaves at 140°C. The inlet and exit temperature of water are 30°C and 100°C respectively. Specific heat of water is 4.2 kJ/kg°C. **07**
Determine:
(a) The heat transfer area, if overall heat transfer coefficient is 814 W/$m^{2o}$C.
(b) The percentage increase in area, if the fluid flows were parallel?

**OR**

**Q.5** **(a)** What is waste heat recovery and list out devices used for waste is recovery. **03**
**(b)** Differentiate between topping and bottoming cycle in cogeneration. **04**
**(c)** Explain working of heat pipe with neat sketch and discuss its two applications for waste heat recovery. **07**

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# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2024**

**Subject Code:3161919 Date:24-05-2024**

**Subject Name: Energy Conservation and Management**

**Time: 10:30 AM TO 01:00 PM Total Marks:70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | Explain in brief energy pricing. | **03** |
| | **(b)** | Explain silent features of Energy Conversation Act 2001 | **04** |
| | **(c)** | Explain long term energy scenario for India | **07** |
| **Q.2** | **(a)** | Write short note on energy security. | **03** |
| | **(b)** | Briefly explain essential elements of energy monitoring system. | **04** |
| | **(c)** | Explain need of energy sector reforms in India | **07** |
| | | **OR** | |
| | **(c)** | Write a short note on procedure for CDM (Clean Development Mechanism) Project cycle. | **07** |
| **Q.3** | **(a)** | Define:<br>a) Bench Marking<br>b) ESCOs<br>c) BEE | **03** |
| | **(b)** | Explain steps involved in CUSUM analysis. | **04** |
| | **(c)** | Give name and use of different energy audit instruments. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Explain benefits of energy monitoring and targeting. | **03** |
| | **(b)** | What do you mean by energy audit? Discuss types of energy audit briefly. | **04** |
| | **(c)** | List the energy saving opportunities in refrigeration air conditioning plant area. | **07** |
| **Q.4** | **(a)** | List the benefits of waste heat recovery system. | **03** |
| | **(b)** | Define energy management. State the benefits of energy management. | **04** |
| | **(c)** | Annual savings after replacement of boiler for three years is Rs. 5, 00,000, Rs. 5, 50,000, Rs. 6, 50,000. Total project cost is Rs 13.5 lakh. Considering cost of capital as 12%, what is the net present value of the proposal? | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Give tips for energy savings in pumps. | **03** |
| | **(b)** | List the various types of heat loses in furnace. | **04** |
| | **(c)** | An energy auditor recommended to replace an old air fan and incompetently designed air delivery duct system causing Rs 23 lakh a year in electricity cost by changing the system with a modern backward curved fan with adequately designed duct system for total investment costs of Rs 2.2 lakh. Expected electricity cost reduction is 5%. Considering over 15 years sustained savings, calculate 'IRR' | **07** |

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | State the three primary strategic objectives of Prototype Carbon Fund (PCF). | **03** |
| | **(b)** | Explain sensitivity analysis. | **04** |
| | **(c)** | Write short note on climate change and development of UNFCC. | **07** |

OR

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | How does the Bachat Lamp Yojna work? | **03** |
| | **(b)** | State the roles and responsibilities of COP (Conference of the Parties). | **04** |
| | **(c)** | Write short note on Energy Management Information Systems. (EMIS) | **07** |

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# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2023**

**Subject Code:3161919 Date:14-07-2023**

**Subject Name:Energy Conservation and Management**

**Time:10:30 AM TO 01:00 PM Total Marks:70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | Define i) Renewable Energy ii) Non-Renewable Energy iii) Per Capita energy consumption | **03** |
| | **(b)** | Define Energy Conservation and explain its importance. | **04** |
| | **(c)** | Write short note on Energy Conservation Act-2001. | **07** |
| **Q.2** | **(a)** | List benefits of Energy Monitoring and Targeting. | **03** |
| | **(b)** | Differentiate between i) Simple payback period and Return on Investment ii) Energy Monitoring and Targeting | **04** |
| | **(c)** | Write brief note on technique used to represent the difference between base line and actual energy consumption over the base line period of time with sample chart. | **07** |
| | | **OR** | |
| | **(c)** | Explain role of the ESCOs in detail. | **07** |
| **Q.3** | **(a)** | Define Energy Management and state its objective. | **03** |
| | **(b)** | List factors affecting refrigeration and air conditioning system performance and explain any one from it. | **04** |
| | **(c)** | List out key instruments used for energy audit and explain their function. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Define Energy Audit and explain its need in short. | **03** |
| | **(b)** | Explain Economic thickness of insulation. | **04** |
| | **(c)** | Classify Energy audit and explain the each phases of energy audit in detail. | **07** |
| **Q.4** | **(a)** | Define Present value and Net present value. | **03** |
| | **(b)** | Compare topping cycle and bottoming cycle for cogeneration. | **04** |
| | **(c)** | The following data are collected for a boiler using furnace oil as the fuel. Calculate the efficiency of the boiler using indirect method.<br>Ultimate Analysis: Carbon=84, Hydrogen=12, Nitrogen=0.5, Oxygen= 1.5, Sulphur= 1.5, Moisture= 0.5<br>GCV of fuel = 1000 Kcal/Kg, Fuel Firing Rate= 2648.125 Kg/Hr, Surface temperature of Boiler = 90 $m^2$, Humidity = 0.025 Kg/Kg of dry air.<br>Consider theoretical air required is 13.92 Kg/Kg of oil, Mass of dry flue gas 21.36Kg/Kg of oil. | **07** |

Flue gas analysis: Flue gas temperature = 190 °C, Ambient temperature =30 °C, $CO_2$% in flue gas by volume = 10.8, $O_2$% in flue gas by volume= 7.4.
Take Cp of flue gas as 0.23 Kj/KgK and of moisture/water content as 0.45 Kj/KgK.

**OR**

**Q.4** **(a)** Define Internal Rate of return (IRR) and state its advantages. **03**

**(b)** Distinguish between Regenerative and recuperative type heat exchanger. **04**

**(c)** Calculate efficiency of coal fired boiler using indirect method. **07**
Boiler steam generation: 20 TPH, Steam pressure: 66 Kg/$Cm^2$.
Flue Gas: $O_2$ in flue gas =9%, CO in flue gas = 800 ppm, Average Flue gas temperature = 180 °C.
Atmospheric air: Ambient temperature:29.3 °C, Humidity in ambient air: 0.01977 Kg/Kg dry air
Fuel Analysis: Carbon=53.65%, Hydrogen=3.25%, Nitrogen=1.11%, Oxygen= 8.68%, Sulphur= 0.34%, Moisture= 14.43%, Ash Content =18.54%, GCV of Coal =4291 Kcal/Kg.
Consider theoretical air requirement is 7.0 Kg/Kg of coal and Actual mass of dry flue gas is 1.7 Kg/Kg of coal.
Ash Analysis: Unburn in bottom ash=0.11%, Unburnt in fly ash=4.89%, GCV of bottom ash=889 Kcal/kg, GCV of fly ash= 395 Kcal/Kg. For moisture/water content in take Cp=0.45 Kj/KgK & for flue gas Cp=0.24 Kj/KgK.
Also consider heat loss due to 0radiation, convection and other unaccounted loss is 1.0%.

**Q.5** **(a)** Explain function of BEE. **03**

**(b)** Give recommendation for efficient design of furnace. **04**

**(c)** Explain Bachat Lamp Yojana, its aim and benefits. **07**

**OR**

**Q.5** **(a)** List out the various source of waste heat recovery. **03**

**(b)** Summarize the practices to be followed for proper steam trap installation. **04**

**(c)** Explain in brief about Clean Development Mechanism. **07**

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Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2022**

**Subject Code:3161919 Date:10/06/2022**

**Subject Name:Energy Conservation and Management**

**Time:10:30 AM TO 01:00 PM Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | Discuss pre -audit phase activities. | **03** |
| | **(b)** | Briefly explain various schemes relating to Bureau of Energy Efficiency (BEE) for designated consumers, State designated agencies. | **04** |
| | **(c)** | Define energy security. Enlist different strategies to achieve it and discuss role of energy conservation to achieve energy security. | **07** |
| **Q.2** | **(a)** | Compare Net Present Value and Internal Rate of Return | **03** |
| | **(b)** | What is energy security? Explain how it can be achieved? | **04** |
| | **(c)** | Explain Simple pay back method with its advantage & limitation | **07** |
| | | **OR** | |
| | **(c)** | Write note on 'Indian Energy scenario'. | **07** |
| **Q.3** | **(a)** | Explain Sensitivity Analysis. | **03** |
| | **(b)** | Discuss the role of Energy Service Companies for financial management. | **04** |
| | **(c)** | Explain briefly the various elements of a monitoring and targeting system. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Explain need for energy audit | **03** |
| | **(b)** | Distinguish between energy conservation and energy Management. | **04** |
| | **(c)** | Classify the energy audit & Explain the three phases of detailed energy audit. | **07** |
| **Q.4** | **(a)** | Define the following terms: Dew Point temperature, HCV, Latent heat of fusion | **03** |
| | **(b)** | Explain techniques of energy conservation in refrigerated cold storage plants. | **04** |
| | **(c)** | List application, advantages of Thermic fluid heaters and super critical boilers from energy conservation point of view. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Mention the various source of waste heat recovery | **03** |
| | **(b)** | List advantages and applications of cogeneration. | **04** |
| | **(c)** | Write brief note on ECBC code for Building construction. | **07** |
| **Q.5** | **(a)** | Give tips for energy saving for future. | **03** |
| | **(b)** | Explain energy conservation Act 2001 and its features, notifications under the Act. | **04** |

| | | | |
|---|---|---|---|
| | **(c)** | Explain the importance of CUSUM chart and its procedure to analyze the case with help of diagrams. | **07** |

**OR**

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | List the various key instruments for carrying out energy audit | **03** |
| | **(b)** | How to make lighting system of your college campus more efficient? | **04** |
| | **(c)** | Explain the terms in detail: Sustainable development, Kyoto Protocol. | **07** |

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