Ref. No. : Ex/ME(M2)/PE/B/T/325E/2023

B.E. MECHANICAL ENGINEERING THIRD YEAR SECOND SEMESTER – 2023

ENERGY CONSERVATION AND MANAGEMENT

Time: 03 hours **Full Marks: 100**

Answer any five questions
Answers to all parts of a question must be together
Very brief and to-the-point answers will be given better credit
Use of steam tables and charts is allowed

1. a) What are primary and secondary energies? Give two examples of each. What is the most useful secondary energy and why? 2+2+2
   b) How climate change is connected with the energy conservation? Are 'energy conservation' and 'energy efficiency' identical? Explain. 2+2
   c) What is the central nodal agency for promoting energy conservation in India? What is the sole defined objective of that agency? 1+1
   d) What is electric grid? How it contributes to energy conservation? 2+2
   e) What is ABT? What are connected load and actual load? 2+2

2. a) What is sustainable development? Does energy conservation contribute to sustainable development? Explain in brief. 2+2
   b) With a neat sketch show the criteria of sustainability. Identify partial sustainability criteria too in the same sketch. 2+3
   c) What is DSM? Why is it even better than improving energy efficiency? 2+2
   d) Why Indian power tariff is not favorable for energy conservation? 2
   d) State five major activities of energy conservation of the BEE? 5

3. a) Show that two heat engines connected in series will have a combined efficiency greater than efficiency of each heat engine. 4
   b) 'Regeneration increases the efficiency of a steam power plant but it decreases the efficiency of a CCGT' – why? 2
   c) Why supplementary firing is possible in CCGT? What are the advantages and limitations of it? 1+3
   b) There are two heat engines with efficiencies $\eta_1 = 0.4$ and $\eta_2 = 0.3$ respectively. First we arrange them in series and then we place them in parallel. In both cases the same total amount of heat Q_1 is added to these heat engines. Find the ratio in which Q_1 is to be divided between the heat engines in parallel to achieve a greater overall efficiency than those two in series. Check the feasibility of this claim also. 10

4. a) The efficiency of available plants for electricity generation and heating boilers are 40% and 90% respectively. What should be the maximum fuel energy consumption rate (in kW) of a micro-cogeneration for 30 kW power and 50 kW utility heat delivery above which cogeneration may not be an acceptable option? 4

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b) Draw a neat sketch of a back pressure cogeneration system. Why is it called 'back pressure' system? What type of heat and power load justifies a back pressure system and why? 2+2+2
c) Show a system schematic for which amount of heat supply can be even more than heat input to it through fuel. Does it violate the basic energy conservation principle? Explain. 3+2
d) What is FESR? Explain. What is the unit of it? 4+1

5. a) With a neat sketch, show the principle of operation of a pebble bed heat exchanger. Why is it an efficient device for gas to gas waste heat recovery? What are its limitations? 6+2+2
b) Define payback period (PBP) and return on investment (RoI). Write the equations of those two explaining all terms. What are the desired values of these two and why for waste heat recovery equipment installation? 2+4+4

6. Write short notes on: a) significance of excess air control in boilers for energy conservation, b) power to gas and gas to power for energy conservation, c) PAT scheme , d) energy manager 4X5