

**B. TECH. SEM - III (MECHANICAL ENGG.) (2014 COURSE)**

**(CBCS) : SUMMER - 2018**

**SUBJECT: ENGINEERING THERMODYNAMICS**

Day: **Thursday**  
Date: **24/05/2018**

**S-2018-2257**

Time: **02.30 PM TO 05.30 PM**  
Max Marks: **60**

**N.B:**

- 1) All questions are **COMPULSORY**.
- 2) Figures to the right indicate **FULL** marks.
- 3) Use of non-programmable **CALCULATOR** is allowed.
- 4) Use of steam table is allowed.
- 5) Assume suitable data if necessary.

**Q.1 a)** Prove that violation of the clausius statement leads to violation of the kelvin – Planck statement. **(05)**

**b)** A cyclic heat engine operates between a source temperature of  $800^{\circ}\text{C}$  and a sink temperature of  $40^{\circ}\text{C}$ . What is the least rate of heat rejection per kw net output of the engine? **(05)**

**OR**

**Q.2 a)** Define entropy and prove that entropy is a property. **(05)**

**b)** A domestic food freezer maintains a temperature of  $20^{\circ}\text{C}$ . The ambient temperature is  $32^{\circ}\text{C}$ . The heat leaks into the freezer at  $1.75\text{KJ/s}$ . What is the minimum power necessary to pump this heat out? **(05)**

**Q.3 a)** What is the steam boiler? How they are classified? **(05)**

**b)** A boiler evaporates  $3.8\text{ kg}$  of water per  $\text{kg}$  of coal into dry saturated steam at  $10\text{ bar}$ . The temperature of feed water is  $34^{\circ}\text{C}$ . Find the equivalent evaporation "from and at  $100^{\circ}\text{C}$ ." as well as the factor of evaporation. **(05)**

**OR**

**Q.4 a)** What is a boiler draught and how it is produced by a chimney. **(05)**

**b)** Explain the working of a water level indicator with a neat diagram. **(05)**

**Q.5 a)** Explain how the wet steam, dry saturated steam and superheated steam is produced. **(05)**

**b)** Calculate the internal energy of  $1\text{kg}$  of steam at a pressure of  $10\text{ bar}$  when the steam is i)  $0.9$  dry and ii) dry saturated, the volume of water may be neglected. **(05)**

**OR**

**Q.6 a)** Explain construction and working of separating colorimeter with neat sketch. **(05)**

**b)** A steam power plant has boiler and condenser pressures of  $60\text{ bar}$  and  $0.1\text{ bar}$ , respectively. Steam coming out of the boiler is dry and saturated. The plant operators on the Rankine cycle calculate thermal efficiency. **(05)**

**Q.7 a)** Write the construction of a single acting single stage reciprocating air compressor with neat sketch. **(05)**

**b)** Derive an expression for indicated work of a reciprocating air compressor by considering its clearance. **(05)**

**OR**

**Q.8 a)** A single stage single acting reciprocating air compressor receives air at  $1.013\text{ bar}$ ,  $27^{\circ}\text{C}$  and delivers it at  $8.5\text{ bar}$ . The compressor has bore  $260\text{ mm}$  and stroke  $310\text{ mm}$  and it runs at  $210\text{ rpm}$ . The mass-flow rate of air is  $210\text{ kg/h}$ . Calculate the volumetric efficiency of the compressor. **(07)**

**b)** Classify the air compressors. **(03)**

**P.T.O**

- Q.9** a) Explain construction and working of a roots blower with neat sketch. (05)  
b) A root blower compresses  $1\text{m}^3$  of air per second from a pressure of 1.01325 bar to 1.8 bar. Find the power required to run the compressor and its efficiency. (05)

**OR**

- Q.10** a) Explain surging, choking, stalling characteristics in detail. (05)  
b) Compare reciprocating compressor with a rotary compressor. (05)

- Q.11** a) A fuel gas has the following percentage composition by mass  $\text{CO}_2$ - 13.3%,  $\text{CO}$ - 0.9%,  $\text{O}_2$ - 8.35% and  $\text{N}_2$ - 77.4% convert this into volumetric analysis. (06)

- b) Enumerate the advantages of liquid and gaseous fuels over solid fuels. (04)

**OR**

- Q.12** a) Explain high grade and low grade energy in detail. (04)

- b) Write the steps involved in conversion of volumetric analysis to gravimetric analysis. (06)

\* \* \*