BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING) FIRST YEAR FIRST SEMESTER EXAMINATION 2019 (Old)

THERMODYNAMICS II

Time: Three hours Full Marks: 100

Answer any ***FIVE*** questions
Use of steam and other thermodynamic tables is permitted
All parts of the same question must be answered together
Data, consistent with the problem may be assumed if necessary

Q:1 (a) Explain the effect of regeneration in a gas turbine plant. 5
(b) In absorption refrigeration cycles, why is the fluid in the absorber cooled and the fluid in the generator heated? 5
(c) Derive a relationship between relative humidity and specific humidity. 5
(d) State chemical name of the following refrigerants: R11, 22, R134a, R170. 5

Q:2 (a) What is back work ratio? Why is the back-work ratio much higher in the Brayton cycle than in the Rankine cycle? 5
(b) A gas turbine working on an air standard Brayton cycle operates between the temperature limits of 27^0C and 927^0C and pressure limits of 101 kPa and 505 kPa. Calculate (i) thermal efficiency of the cycle, (ii) compressor work in kJ/kg, (iii) work in kJ/kg and (iv) air flow rate for 2.0 kW of net output. 15

Q:3 (a) Define the following terms related to reciprocating engines: stroke, bore, top dead center, and clearance volume. 6
(b) An air-standard Diesel cycle has a compression ratio of 16 and a cutoff ratio of 2. At the beginning of the compression process, air is at 95 kPa and 27°C. Determine (i) the temperature after the heat-addition process, (ii) the thermal efficiency, and (iii) the mean effective pressure. 14

Q:4 (a) What is cogeneration? 5
(b) Consider a 210 MW steam power plant that operates on a simple ideal Rankine cycle. Steam enters the turbine at 10 MPa and 500°C and is cooled in the condenser at a pressure of 10 kPa. Show the cycle on a *T-s* diagram with respect to saturation lines, and determine (i) the quality of the steam at the turbine exit, (ii) the thermal efficiency of the cycle, and (iii) the mass flow rate of the steam. 15

Q:5	(a)	Explain with neat sketches a cascade refrigeration cycle.	6
	(b)	A refrigerator uses refrigerant-134a as the working fluid and operates on an ideal vapor-compression refrigeration cycle between 0.12 and 0.6 MPa. The mass flow rate of the refrigerant is 0.05 kg/s. Show the cycle on a *T-s* diagram with respect to saturation lines. Determine (i) the rate of heat removal from the refrigerated space and the power input to the compressor, (ii) the rate of heat rejection to the environment, and (iii) the coefficient of performance.	14
Q:6	(a)	Explain adiabatic saturation temperature.	6
	(b)	The atmospheric air at 25^0C DBT and 12^0C WBT is flowing at a rate of $100m^3$/min through a duct. The dry saturated steam at 100^0C is injected into the air stream at a rate of 72kg/h. Calculate the specific humidity, DBT, WBT, relative humidity and enthalpy of air leaving the duct.	14
Q:7		Write short notes on (***any four***): (a) Combined power cycle (b) Gas refrigeration system (c) Heating and humidification process (d) Adiabatic flame temperature (e) Refrigerant (f) Dew point temperature.	20