Q. Code: 195257

Reg. No. | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, DEC 2019

Fourth Semester

ME16403 – THERMAL ENGINEERING

(Mechanical Engineering)

(Regulation 2016)

Time: Three Hours **Maximum : 100 Marks**

(Use of approved steam table, Mollier diagram Psychometric Chart permitted in the examination)

Answer **ALL** questions

PART A - (10 X 2 = 20 Marks)

		CO	RBT
1.	State the function of piston pin.	1	R
2.	State the Significance of Mean effective pressure.	1	U
3.	What is meant by Knocking in diesel engine?	1	U
4.	What are the advantages and disadvantages of common rail system?	1	U
5.	Mention the applications of nozzle.	2	U
6.	What is governing of steam turbine and state the various methods of governing?	2	U
7.	Explain the methods of controlling output of the reciprocating compressor.	2	U
8.	State the main types of compressors. Give the applications of each.	2	U
9.	An inventor claims to have developed a refrigeration unit which maintain the refrigerator space at -6^0 C while operating in a room where temperature is 27^0 C has COP =8.5. Find out whether his claim is correct or not.	3	AP
10.	What you meant by a ton of refrigeration?	3	U

PART B - (5 X16 = 80 Marks)

11.	(a)	(i)	Show that efficiency of Otto cycle depends upon its compression ratio.	(4)	1	U
		(ii)	A gas engine working on the Otto cycle has cylinder bore of 200 mm and stroke length of 250 mm. The clearance volume is 1570 cm^3. The pressure and Temperature at the beginning of compression are 1 bar and 27^0 C respectively. The maximum temperature of the cycle is 1400^0 C. Determine the pressure and temperature at the salient points and also the air standard efficiency, the work done and mean effective pressure.	(12)	1	AP

(OR)

	(b)	(i)	In an air standard diesel cycle the compression ratio is 16. At the beginning of isentropic compression, the temperature is 15^0 C and pressure of 0.1 Mpa. Heat is added until the temperature at the end of constant pressure process is 1480^0C. Calculate (i). The cut-off ratio (ii). Heat added per kg of air (iii). Cycle efficiency (iv). m.e.p	**(8)**	**1**	**AP**
		(ii)	An isentropic air turbine is used to supply 0.1 kg/s of air at 0.1 MN/m^2 and at 285 K to a cabin. The pressure at the inlet to the turbine is 0.4 MN/m^2. Determine the temperature at turbine inlet and power developed by the turbine C_p= 1 kJ/kg K	**(8)**	**1**	**AP**
12.	(a)	(i)	Why IC engine should be cooled? Explain thermostatic cooling system.	**(8)**	**1**	**U**
		(ii)	Draw a layout of coil ignition system for four stroke petrol engine and explain its working principle.	**(8)**	**1**	**U**

(OR)

	(b)	(i)	A six cylinder single acting I.C. Engine bore and stroke of 12 cm by 15 cm has a piston speed of 480 meter per minute. It develops 45 kW bp and has mechanical efficiency of 75%. The mean effective pressure is 4.42 bar. The specific fuel consumption is 0.25 kg/kW of bp hour. If the fuel has a heating value of 42000 kJ/kg, determine (a). Whether this is a two stroke or four stroke cycle engine. (b).thermal efficiency based on brake power.	**(8)**	**1**	**AP**
		(ii)	Explain the working principles of MPFI system.	**(8)**	**1**	**U**
13.	(a)	(i)	Steam at a pressure of 10 bar and 0.9 dry discharge through a nozzle having throat area of 350 mm^2. If the back pressure is 1.4 bar find (a) final velocity of steam (b) cross-sectional area of the nozzle for maximum discharge.	**(8)**	**2**	**AP**

		(ii)	Show that the maximum discharge of steam through nozzle takes place when ratio of steam pressure at the throat to the inlet pressure is given by $\frac{p_2}{p_1}=\left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$ Where n is the index of expansion.	**(8)**	**2**	**U**
			(OR)			
	(b)	(i)	What are the methods of governing of steam turbine? Describe any one method of governing a steam turbine.	**(8)**	**2**	**U**
		(ii)	In a stage of impulse reaction turbine operating with 50% degree of reaction the blades are identical in shape. The outlet of the moving blade is 19^0 and the absolute discharge velocity of steam is 100 m/s in the direction at 100^0 to the motion of the blades. If the rate of flow of steam through the turbine is 15000kg/h. Calculate the power developed by the turbine in kW.	**(8)**	**2**	**AP**
14.	(a)		Explain the working principles of an ideal reciprocating compressor and derive the expression for work required/cycle without clearance volume when compression is a) isothermal b) Polytropic c). Adiabatic.	**(16)**	**2**	**AP**
			(OR)			
	(b)	(i)	Determine the size of the cylinder for a double acting compressor of 37.5 kW (ip) in which the air is drawn in at 1 bar and 15^0 C and compressed according to the law $pv^{1.2}$=C to 6 bar r.p.m 100, average piston speed=150 meter per minute. Neglect clearance volume.	**(8)**	**2**	**AP**
		(ii)	A two stage air compressor with complete intercooling delivers air to the mains at a pressure of 30 bar, the suction condition being 1 bar and 27^0 C. If both cylinders have the same stroke, find the efficiency of compression to be a maximum Assume the index of compression to be 1.3	**(8)**	**2**	**AP**
15.	(a)	(i)	Draw the layout of vapor compression refrigeration system and describe the function of its components. Represent the working	**(8)**	**3**	**U**

of its system by a thermodynamics cycle drawn on either a T-S or p-h plane.

(ii) A refrigerator works between -7^0 C and 27^0 C. The vapor is dry at the end of adiabatic compression. There is no under cooling and expansion is by throttle valve. Estimate the COP and power of the compressor to remove 200 kJ/min. The properties of the refrigerant are as under **(8) 3 AP**

Temperature ^{0}C	Enthalpy kJ/kg		Entropy kJ/kg K	
	Liquid	Latent of vaporization	Liquid	Vapor
-7	-30	1298	-0.108	4.75
27	115	1173	427	4.33

(OR)

(b) (i) Distinguish between compression and absorption system. **(4) 3 U**

(ii) An Ammonia refrigerator produces 30 tonnes of ice from and at 0^0 C in a day of 24 hours. The temperature range in the compressor is from -25^0 C to 15^0 C. The vapor is dry saturated at the end of compression and an expansion valve is used. Assume a coefficient of performance of 60% of the theoretical. Calculate the power in kW required to drive the compressor. Laent heat of ice is 334.72 kJ/kg **(12) 3 AP**

Temperature ^{0}C	Enthalpy kJ/kg		Entropy kJ/kg K	
	Liquid	Vapor	Liquid	Vapor
15	100.04	1319.22	0.3473	4.4852
-25	-54.56	1304.99	-2.1338	5.0585