Q. Code: 737430

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

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

Third Semester

MR16305 – MARINE STEAM ENGINES

(Marine Engineering)

(Regulation 2016)

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

(Use of Steam tables, Mollier diagram, Heat and mass transfer tables are permitted)

Answer **ALL** questions

PART A - (10 X 2 = 20 Marks)

		CO	RBT
1.	State advantages of Binary vapour power cycle.	**1**	**U**
2.	List the methods of for improving thermal efficiency of Rankine cycle.	**1**	**U**
3.	Define MEP.	**2**	**R**
4.	Mention advantages of compound steam engines.	**2**	**R**
5.	Define “Critical pressure ratio”	**3**	**R**
6.	Quote the effect of friction in the steam nozzle.	**3**	**U**
7.	State the principle of impulse turbine.	**4**	**U**
8.	Mention the requirement of compounding in steam turbine.	**4**	**U**
9.	Differentiate between Conduction and Convection heat transfer.	**5**	**U**
10.	How the heat transfer takes place in Radiation?	**5**	**U**

PART B - (5 X16 = 80 Marks)

11.	(a)	With neat sketches explain Reheat Rankine cycle and derive its efficiency. Also state its advantages and disadvantages.	**(16)**	**1**	**AP**
		(OR)			
	(b)	A steam power plant operates on the simple ideal Rankine cycle. Steam enters the turbine at 40 bar, 600 ^{o}C and is condensed in the condenser at a temperature of 40 ^{o}C. (a) Show the cycle on a T-s diagram. If the mass flow rate is 10 kg/s, Estimate (b) the thermal efficiency of the cycle and (c) the net power output in MW.	**(16)**	**1**	**AP**
12.	(a)	Explain with neat sketches working of receiver type of compound steam engine. Also state its advantages and disadvantages.	**(16)**	**2**	**AP**
		(OR)			
	(b)	The following data relate to a test on a double-acting, single-cylinder steam engine;	**(16)**	**2**	**AP**

Indicated power, 90 kW; engine speed, 140 r.p.m.; cylinder diameter, 30 cm; piston stroke, 45 cm; steam pressure at admission, 1,100 kPa; cut-off at 1/3rd stroke and back pressure, 40 kPa. Neglecting the effect of clearance volume, calculate the diagram factor.

13. (a) A convergent-divergent nozzle for a steam turbine has to deliver steam under a supply condition of 11 bar with 100°C superheat and a back pressure of 0.15 bar. If the outlet area of the nozzle is 9.7 cm^2, determine using steam tables, the mass of steam discharged per hour. If the turbine converts 60% of the total enthalpy drop into useful work, determine the power delivered by the turbine. Neglect the effect of friction in the nozzle. Take Cp of superheated steam as 2.3 kJ/kg K. **(16)** 3 **AP**

(OR)

(b) Derive an expression for mass flow rate through a steam nozzle. Also derive the condition for maximum mass flow rate. **(16)** 3 **AP**

14. (a) With neat sketches explain pressure compounding of steam turbine. **(16)** 4 **AP**

(OR)

(b) The steam leaves the nozzle of a single-stage impulse wheel turbine at 800 m/sec. The nozzle angle is 20°, the blade angles are 30° at inlet and outlet, and friction factor is 0.8. Calculate: (a) the blade velocity, and (b) the steam flow in kg per hour if the power developed by the turbine is 257 kW. **(16)** 4 **AP**

15. (a) A furnace wall is made up of three layers of thickness 300 mm, 150 mm and 100 mm with thermal conductivities of 1.65 W/m°C, k and 9.2 W/m°C respectively. The inside is exposed to gases at 1500°C with convection coefficient of 25 W/m^2 °C and the inside surface is at 1500°C and the outside surface is exposed to air at 25°C with convection coefficient of 12 W/m^2 °C. Estimate, i. The unknown thermal conductivity, ii. The overall heat transfer coefficient, iii. All surface temperatures. **(16)** 4 **AN**

(OR)

(b) (i) State Fourier's law of heat conduction and derive the equation for heat transfer through conduction. **(8)** 5 **AN**

(ii) Differentiate between Free convection and Forced convection with industrial examples. **(8)** 5 **AN**