TE Mechanical (R-2019) May 2022

University of Mumbai

Examinations Summer 2022

21/5/2022

Subject: Turbomachinery, Course Code: MEC-602 Sem:VI

Time: 2-hour 30 minutes Max. Marks: 80

Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	High pressure boiler is the one in which pressure of steam generated is
Option A:	greater than 70 bar
Option B:	greater than 20 bar
Option C:	greater than 80 bar
Option D:	greater than 40 but less than 80 bar
2.	The ratio of heat actually used in producing the steam to the heat liberated in the furnace is called.....
Option A:	Steam efficiency
Option B:	Boiler efficiency
Option C:	Evaporation capacity of a boiler
Option D:	None of the above
3.	In a centrifugal pump the liquid enters the pump .....
Option A:	At the top
Option B:	At the bottom
Option C:	At the center
Option D:	From sides
4.	Indicator diagram of a reciprocating pump is a graph between....
Option A:	Floor vs swept volume
Option B:	Pressure in cylinder vs stroke length
Option C:	Flow vs speed
Option D:	Pressure vs speed
5.	In an impulse steam turbine ____
Option A:	The steam is expanded in nozzles only and there is a pressure drop and heat drop
Option B:	The steam is expanded both in fixed and moving blades continuously
Option C:	The steam is expanded in moving blades only
Option D:	The pressure and temperature of steam remains constant
6.	In a reaction steam turbine _____.
Option A:	The steam is allowed to expand in the nozzle, where it gives a high velocity before it enters the moving blades
Option B:	The expansion of steam takes place partly in the fixed blades and partly in the moving blades
Option C:	The steam is expanded from a high pressure to a condenser pressure in one or more nozzles
Option D:	The pressure and temperature of steam remains constant
7.	Reciprocating Compression efficiency is compared against
Option A:	Adiabatic compression
Option B:	Both isothermal and adiabatic compression
Option C:	Isentropic compression

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Option D:	Isothermal compression
8.	Volumetric efficiency of a reciprocating compressor
Option A:	Increases with increase in clearance volume
Option B:	Decreases with increase in clearance volume
Option C:	Is not dependent upon clearance volume
Option D:	Can't predict
9.	Pelton turbine is _____
Option A:	Tangential flow
Option B:	Radial flow
Option C:	Mixed flow
Option D:	Axial flow
10.	In a two-stage gas turbine plant, with intercooling and reheating _____.
Option A:	Both work ratio and thermal efficiency improve
Option B:	Work ratio improves but thermal efficiency decreases
Option C:	Thermal efficiency improves but work ratio decreases
Option D:	Both work ratio and thermal efficiency decreases

Q 2	**Solve any Two Questions out of Three** **10 marks each**
A	Draw a neat sketch of various components of the centrifugal compressor and sho thevariation of pressure and velocity of air being compressed.
B	The air in a gas turbine plant is taken in at low pressure at 293 K and 1.05 bar and aftercompressionitispassedthroughintercooler, whereitstemperatureisreducedto300K. The cooled air is further compressed in high pressure compressor and then passed in thecombustion chamber, where its temperature is increased to 750^{0}C by burning the fuel. The combustion products expand in high pressure turbine which runs the compressor andfurther expansion is continued in low pressure turbine which runs the alternator. The gascoming out from low pressure turbine are used for heating the incoming air from highpressurecompressorandthen expanded toatmosphere. Pressure ratio of each compressor = 2, η_{iso} (each compressor stage) = 82%, η_{iso} (eachturbinestage) =82%, effectivenessofheatexchanger=0.72, airflowrate=16kg/s,C.V.offuel=42,000kJ/kg,C_v(air)=1.0kJ/kgK,C_p(gas)=1.15kJ/kgK,γ_{air}=1.4, γ_{gas}=1.33. Neglecting massof fuel, Calculate: (i) Power output, (ii) Thermal efficiency, (iii)Specificfuelconsumption.
C	The impeller of centrifugal pump is of 320 mm diameter and 55 mm with at the periphery and has blades whose tip angle inclinedbackward 60° from the radius. The pump delivers 18 m^3/min of water and impeller rotates at 1000 rpm. Assuming that the pump is designed to admit radially. Calculate 1. speed and direction of water as it leaves the impeller 2. torque exerted by the impeller on water 3. shaft power required 4. lift of the pump

Q 3	**Solve any Two Questions out of Three** **10 marks each**
A	Makealist of anyfive boiler mountings andwritetheir function and location in boiler cell, with sketch diagram.
B	Followingobservation weremadeduringatest onsteam boiler. Boilerpressure=10bar, calorificvalueoffuelused=33000kJ/kg,feedwatertemperatureenteringtheeconomizer=25^{0}C,andl

	eavingtheeconomizer=80^{0}C,conditionofsteamleavingthesuperheater=250^{0}C,steamconditionleavingtheboiler = 0.95, amount of water evaporated = 6000 kg/hr, amount of fuel burnt = 600 kg/hr.Find the equivalent evaporation with and without superheater, boiler efficiency, and thepercentageofheatutilized intheboiler, economizerandthe superheater.
	Steam with a velocity of 400 m/s relative to the moving blades enters an impulse turbine at anangleof30°.Thebladevelocityis20m/s.Theworkdevelopedinthebladesisestimated to be 165.54 kW/kg. Assuming the blades to be symmetrical inshape,determinethebladeefficiencyand bladevelocitycoefficient.
Q4	**Solve any Two Questions out of Three** **10 marks each**
A	A boiler produces 200 kg of steam per hour at 10 bar and 0.95 dry. Feed water is heated by an economizer to a temperature of 110^{0}C. 225 kg of coal of calorific value of 30100 kJ/kg is fired per hour. If 10 % of coal remain unburnt, find the thermal efficiency of boiler and boiler and grate combined.
B	The three jet Pelton turbine is required to generate 10,000 kW under a net head of 400 m.Thebladeangleatoutletis15^{0}andthereductionintherelativevelocitywhilepassing over the blade is 5%. If the overall efficiency of the wheel is 80%, C_v = 0.98 and speed ratio = 0.46, then find: (i) The diameter of the jet (ii) Total flow in m^3/s (iii) The force exerted by a jet on the buckets.
C	Derivetheexpressionfor optimum pressureratioformaximumspecificoutputinactualsimplegasturbine cycle.