SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA

Minor (Even Semester) – 2018

Entry No: | | 1 | 6 | | | | | 0 | 7 | |

B.Tech. || MECHANICAL ENGG || Sem. IV

Thermal Engineering

Subject Code: MEL-2212

Time allowed: 1 Hrs. **Max Marks: 20**

Important Instructions: All questions are compulsory and assume any missing data

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Q1 Under what circumstances water tube boiler used in preference to smoke tube boiler? Discuss the working of Locomotive boiler with the help of neat sketch. **(8)**

Q2. Write short note on:

1. Economiser
2. Air Preheater **(4)**

Q3: Following data relate to a boiler trial for one hour:

Steam generated=6000kg, Coal burnt= 600kg, Boiler pressure = 10 bar, feed water temperature entering the economizer = 25^0C and leaving the economizer = 80^0C, condition of steam leaving the super heater = 250^0C, Steam condition leaving the boiler = 0.95, calorific value of coal 33000 kj/kg; Temperature of steam leaving the super heater = 250^0 C.

1) Find the equivalent evaporation with and without super heater
2) Boiler efficiency
3) Percentage heat utilized in the boiler, economizer and the super heater. **(8)**

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Mechanical Engineering
B. Tech. (Branch) Major Examination (Even) 2017-18

Entry No: | | | | | | | 0 | 0 | 7 |
Date: 07/05/2018

Total Number of Pages: [02]
Total Number of Questions: [07]

Course Title: Thermal Engineering
Course Code: MEL 2212

Time Allowed: 3.0 Hours

Max Marks: [50]

Instructions / NOTE

i. Attempt All Questions.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume any missing data to suit the case / derivation / answer.

	Section - A	
Q1.	(a) What are the advantages of operating a boiler at or above the critical pressure of boiler?	[02]
	(b) Define critical velocity, critical pressure ratio.	[02]
	(c) Why are steam turbine compounded? Explain.	[02]
	(d) Why does a barometric jet condenser not require a water-extraction pump?	[02]
	(e) Write the uses of compressed air.	[02]
	(f) Why is a cooling arrangement provided with all compressor?	[02]
Q2.	(a) Establish the energy balance in a boiler. How can its performance be improved?	[04]
	(b) Describe the various methods of compounding in an impulse turbine.	[04]
	Section - B	
Q3.	In a stage of an impulse turbine provided with a single row wheel, the mean diameter of the blade ring is 65 cm and the speed of rotation is 2300 rpm. The steam issues from the nozzles with a velocity of 210 m/s and the nozzle angle is 18°. The rotor blades are equiangular and due to friction in the blade channels the relative velocity of steam at outlet from the blades is 0.81 times the relative velocity of the steam entering the blades. Take axial thrust on blades as 102 N. Determine Blade angle in degrees, Relative velocity of steam at outlet, m/s, and Flow velocity at outlet, m/s and Power developed, kW.	[06]
Q4.	A converging-diverging nozzle expands steam from 1400 kPa and 300 °C to 600 kPa. The flow rate is 1 kg/s. For expansion, n =1.3. Specific volume of steam at throat is 0.2855 m^3/kg. Find Pressure of steam at throat, in kPa, Steam velocity at throat, in m/s, Throat area in mm^2. If enthalpy and specific volume of steam at exit	[06]

	are 2844 kJ/kg and 0.352 m^3/kg respectively, determine the exit area of the nozzle in mm^2.	
Q5.	Following data refer to a boiler Pressure of steam 9.0 bar Quality of steam 0.97 dry Quantity of steam 5600 kg/h Temperature of feed water 36.0 °C Coal consumption 700 kg/h Calorific value of Coal 31380 kJ/kg Calculate the equivalent evaporation in kg/kg of coal, Calculate the efficiency of boiler. Saving in coal consumption per hour if by putting an economizer the temperature of feed water is raised to 100° C. Other data remain same except the increase of boiler efficiency by 5 %.	[06]
Q6.	The data refers to a surface condenser. Condensate temperature = 30^0 C, Mean temperature of condenser = 35^0 C, Barometer = 76cm of Hg, Condenser vaccum70 cm of Hg, condensate collected = 930 kg/hr, cooling water circulated = 36800 kg/hr, rise in temperature of cooling water = 12.5^0 C. Calculate the dryness fraction of steam entering the condenser and capacity of air pump in m^3/min and mass of air handled in kg/hr.	[06]
Q7.	A two stage, single acting air compressor takes in air at 1 bar and 300 K. The air is discharged at 10 bar. The intermediate pressure is ideal for minimum work and the intercooling is perfect. The compression follows the laws $p.v^{1.3}$ = Constant. The rate of discharge is 0.1 kg/s. Find: 1) Power required to drive the compressor. 2) Saving in the power required compared with single stage working. 3) Isothermal efficiency.4) Heat rejected to intercooler in kj/s. Take R = 0.287 kj/kg K, C_p = 1.0 kj/kg K.	[06]

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
SCHOOL OF MECHANICAL ENGINEERING
B. Tech. (Mechanical Engineering) Minor Examination (Even Semester) 2018-19

Entry No: | | | | | | | | | |

Total Number of Pages: **[01]**

Date: **07th Feb. 2019**

Total Number of Questions: **[04]**

Course Code: **MEL 2212**

Course Title: **Thermal Engineering**

Time Allowed: 1 ½ Hours **Max Marks: [50]**

Instructions / NOTE

i. Attempt All Questions.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume an appropriate data / information, wherever necessary / missing.
iv. Use of Steam Table is permissible in examination.

	Section - A		
Q1.	(i) Define the term (a) Boiler efficiency (b) Evaporation ratio (ii) Differentiate between water tube and fire tube boiler. List out various types of water tube boiler	04 2 06 3	CO1
Q2.	List out the various boiler mountings and accessories with neat sketch	10 3	CO1
Q3.	(i) Define the term 'Steam Nozzle'. List out various types of steam nozzle with neat sketch. (ii) Derive an expression to estimate the discharge through steam nozzle in terms of pressure at inlet and outlet.	5 2 5 2	CO1
	Section - B		
Q4.	The following are the data collected for a boiler using furnace oil as the fuel. Find out the boiler efficiency by indirect method. **Ultimate analysis (%)** Carbon=84; Hydrogen=12; Nitrogen=0.5; Oxygen= 1.5; Sulphur = 1.5; Moisture = 0.5;GCV of fuel = 10000 kCal/kg; Fuel firing rate = 2648.125 kg/hr; Surface Temperature of boiler = 80°C;Surface area of boiler = 90m^2; Humidity = 0.025 kg/kg of dry air; Wind speed = 3.8 m/s **Flue gas analysis (%)** Flue gas temperature = 190°C;Ambient temperature = 30°C; CO_2% in flue gas by volume = 10.8 ;O_2% in flue gas by volume = 7.4	20 8	CO2

Course Outcomes

CO1. To understand the basic concept of various thermal engineering components.
CO2. To investigate the effectiveness of energy conversion process in mechanical power generation and steam power plants and its components.

CO	Questions Mapping	Total Marks	Total Number of Students (to be appeared in Exam)
CO1	1,2,3	30	35
CO2	4	20	35

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
SCHOOL OF MECHANICAL ENGINEERING
B. Tech. (Mechanical Engineering) Minor Examination (Even Semester) 2018-19

Entry No: | | | | | | | | | |

Total Number of Pages: **[01]**

Date: **19th March 2019**

Total Number of Questions: **[04]**

Course Code: **MEL 2212**

Course Title: **Thermal Engineering**

Time Allowed: 1 ½ Hours

Max Marks: [20]

Instructions / NOTE

i. Attempt All Questions.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume an appropriate data / information, wherever necessary / missing.
iv. Use of Steam Table is permissible in examination.

	Section - A		
Q1.	Derive an expression for indicated work of a reciprocating air compressor by neglecting clearance volume.	5	CO1
Q2.	(a) List out various use of compressed air. (b) Classify the rotary air compressor	3 2	CO1
Q3.	An ideal single stage single acting reciprocating air compressor has a displacement volume of 14 litre and clearance volume of 0.70 litre. It receives the air at a pressure of 1 bar and delivers at a pressure of 7 bar. The compression is polytropic with an index of 1.35 and re-expansion is isentropic with an index of 1.39. Calculate the net indicated work of a cycle.	5	CO2
	Section - B		
Q4.	Calculate the power required to compress 30 m^3/min atmospheric air at 101.3kPa, 20°C to a pressure ratio of 7 in a LP cylinder. Air is then cooled at constant pressure to 25°C in an intercooler before entering HP cylinder. Where air is again compressed to a pressure ratio of 6. Assume polytropic compression with n=1.35 and R=0.287 kJ/kg K	5	CO2

Course Outcomes

CO1. To understand the basic concept of various thermal engineering components.
CO2. To investigate the effectiveness of energy conversion process in mechanical power generation and steam power plants and its components.

CO	Questions Mapping	Total Marks	Total Number of Students (to be appeared in Exam)
CO1	1,2,3	30	35
CO2	4	20	35

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Mechanical Engineering
B. Tech. (Mechanical Engineering) Major Examination (Even) 2018-19

Entry No: | 1 | 7 | B | M | E | 0 | 0 | 1 | | **Total Number of Pages: [02]**

Date: 11th May 2019 **Total Number of Questions: [05]**

Course Title: Thermal Engineering
Course Code: MEL 2212

Time Allowed: 03 Hour **Max Marks: [50]**

Instructions:

i. Answer all the questions.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume an appropriate data / information, wherever necessary / missing.

	Section - A		
Q1.	(a) List out the various instruments required for the boiler testing calculating its efficiency by indirect method?	[2]	CO1
	(b) What are the main difference between the dry flue gas loss and wet flue gas loss?	[2]	CO1
	(c) Define the term the boiler efficiency and evaporation ratio.	[4]	CO1
	(d) Write a chemical equation for oxidation of propane.	[2]	CO3
Q2.	(a) Draw the velocity diagram of impulse turbine and name its vector components.	[2]	CO3
	(b) List out the various boiler mountings and accessories	[4]	CO2
	(c) Define the following terms (i) Steam condenser (ii) Reaction Turbine (iii) Cooling Tower (iv) Impulse Turbine.	[4]	CO2
	Section - B		
Q3.	(a) Calculate the boiler efficiency using direct method from the data given below. An oil fired package boiler was tested for 2 hours duration at steady state condition. The fuel and water consumption were 250 litres and 3500litres respectively. The specific gravity of oil is 0.99. The saturated steam generation pressure is 10 kg/cm^2 (g). The boiler feed water temperature is 40°C. Gross calorific value 11000 Kcal/kg. Determine the boiler efficiency and evaporation ratio.	[6]	CO1
	(b) Define the term (I) Condenser efficiency (ii) Blade efficiency (iii) Stage efficiency (iv) Nozzle efficiency	[4]	CO3
Q4.	(a) The rotor of impulse turbine of 260 mm diameter and runs at 20500 rpm. The nozzle angle is 20° and issue a steam jet with a velocity of 910 m/s. The mass flow rate of steam through the turbine nozzle blade of 2 kg/s. Draw the velocity diagram and calculate the (a) tangential forces on blades (b) axial force on blades (c) power developed by the turbine wheel (d) efficiency of the blade (e) inlet angle of blade.	[8]	CO2
	(b) Write an expression for optimum operating condition for (I) Impulse turbine (ii) Reaction turbine	[2]	CO2
Q5.	(a) A parson reaction turbine running at 400 rpm with 50% reaction develops 75kW per kg of the steam; the exit angle of the blade is 20 and the steam velocity at 1.4 times blade velocity. Determine (i) Blade	[6]	CO3

	efficiency (ii) Blade inlet angle (b) List out the various governing methods of steam turbine and explain any one method in detail.	[4]	CO3

Course Outcomes

CO1. To understand the basic fundamental of the different thermal sub-systems
CO2. To analysis the effectiveness of energy conversion process in mechanical power generation and steam power plants and its components
CO3. To analysis the performance of the different thermal system

CO	Questions Mapping	Total Marks	Total Number of Students (to be appeared in Exam)
CO1	1(a), 1(b), 1(c), 3(a)	13	36
CO2	2(b), 2(c), 4	18	36
CO3	1(d),2(a) 3(b),5(a), 5(b)	19	36

SHRI MATA VAISHNO DEVI UNIVERSITY, KATRA
School of Mechanical Engineering
B. Tech.(Mechanical Engg.) Minor 1Examination-2020

Entry No: | | | | | | | | | |

Total Number of Pages:[01]
Total Number of Questions: [04]
Course Code: MEL2212
Max Marks: [20]

Date:
Course Title: Thermal Engineering
Time Allowed: 1.5 Hours

Instructions / NOTE

i. Attempt All Questions.
ii. Support your answer with neat freehand sketches/diagrams, wherever appropriate.
iii. Assume any missing data to suit the case / derivation / answer.

Q1.	a. Under what circumstances water tube boiler used in preference to smoke tube boiler? b. Write in brief essentials of a good boiler. c. State advantages of high pressure boilers in brief. d. On what basis a convergent- divergent nozzle is designed?	[4] CO1and CO2
Q2.	Discuss the working with the help of neat sketch (Any two): 1. Locomotive boiler. 2. Benson Boiler. 3. Striling Boiler.	[8] CO1
Q3.	a. Prove that the velocity at throat is sonic under the conditions of maximum mass flow rate in case of nozzles. b. Write short note on : 1. Economiser 2. Air Preheater 3. Fusible Plug.	[4] CO1 and CO2
Q4.	Following data relate to trail Boiler: Duration of trail = 8 hrs. Steam pressure = 20 bar. Total Coal Burnt = 1300 kg. Temperature of feed water enter and leaving = 35^0 C, and 105^0 C super heater steam temperature = 350^0C, C.V. of coal = 29000 kj/kg. x= 0.98. Calculate the following: 1. Percentage of heat utilized in the boiler. 2. Equivalent evaporation from and at 100^0 C per m^2. 3. Overall efficiency of the boiler.	[04] CO1

Course Outcomes

CO1: Understanding Requirement of steam as a working substance for power generation or for process and space heating etc. Classification of Boilers, mounting and accessories, Boiler performances equivalent evaporation and boiler efficiency.

CO2: Design of steam nozzles.

m_f = 1300kg.
m_s = 29000 x 8 kJ/k