Md saif

A Laboratory Manual

for

Thermal Engineering

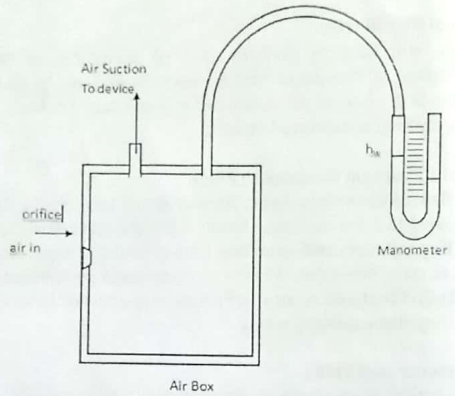
(22337)

Semester-III

(ME/PT/PG)

Maharashtra State
Board of Technical Education, Mumbai
(Autonomous) (ISO:9001:2015) (ISO/IEC 27001:2013)

VII Circuit diagram / Setup



Air box arrangement

VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Reciprocating air compressor test rig	P = 10 bar N = 650 rpm	1 No.
2.			
3.			

IX Precautions to be Followed

1. Stay away from rotating components.
2. Check oil level in compressor before it is started.

X Procedure

1. Start the air compressor
2. Run it till tank pressure becomes 2 bar
3. Open air exit valve so that tank pressure will not rise further.
4. Take manometer reading
5. Calculate air flow rate in m^3/s
6. Repeat the same for pressures of incremental 2 bar pressure steps.

XI Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.	Reciprocating		P = 10 bar	01	
2.	Air compressor		N = 650 RPM	01-04	
3.	test Ring		N = 700 RPM	01	

XII Actual Procedure Followed

Start air compressor run it tank pressure become bar take manometer reading calculate air flow in N/S

XIII Precautions Followed

Stay away from rotating component check oil level in compressor before it is started

XIV Observations and Calculations

S.N.	Pressure in tank	h_1	h_2	$h_w = h_1 - h_2$
1	2 bar	88	78	10 mm
2	4 bar	86	76	10 mm
3	6 bar	86	70	10 mm
4	8 bar	80	70	10 mm

Air is ideal gas. Use equation of state to find density of air.

$P_aV_a = mRT_a$ $Ta = 30^\circ c + 273 = 303^\circ K$

$Q_a = m / V_a = P_a / RT_a = \ldots 1.17 \ldots m^3/kg$ $2.29\ kg/m^2 = \frac{2\times10^5}{2.81\times30} = 2.29\ kg/m^3$

$h_aQ_a = h_wQ_w \left(\frac{10}{100}\right)^2$

A_o = Area of orifice = $\pi r_o^2 = \ldots 10^{-4} \ldots m^2$

$17 = 10.00125)^2$

$= 0.0049\times10^{-3}\ m^2$

$50hg = \frac{h1N \times \theta W}{\ell\theta}$

$= \frac{2.5\times10^{-3}\times1000}{2.29}$

hHa = 10 a Haf

assume air change efficient

$d = 0.01$

According to steady flow energy equation applied across orifice

$(u_1 + P_1v_1 + V_1^2/2 + Z_1g \pm Q) = (u_2 + P_2v_2 + V_2^2/2 + Z_2g \pm W)$

$Q = 0,\ W = 0,\ u_1 - u_2 = 0,\ z_1g - z_2g = 0$

$P_1v_1 + V_1^2/2 = P_2v_2 + V_2^2/2$

Multiplying both sides by $1/g$ & $v = 1/Q$ and rearranging terms

$P_1/Qg - P_2/Qg = V_2^2/2g - V_1^2/2g$

$h_a = V_2^2/2g$ neglecting V_1

$V_2 = \sqrt{2gh_a}$

Discharge of air is
$Q = C_d * A * V_2$

$V^2 = \sqrt{294}$

Discharge here is denoted by
$Va = C * A * \sqrt{2gh_a}$

$A \times 1.04$

$V_a = C_dA_o\sqrt{(2gh_a)} =$ $0.61 \times 0.0042 \times 10^{-3} \times 52 \times 2$ ..... m^3/s

$0.0138 \times 10^{-3}\ m^3/s$

XV Results

S.N.	Pressure in tank	Volume flow rate (V_a), m^3/s
1	2 bar	$9.04 \times 10^{-4}\ m^3/s$
2	4 bar	$9.04 \times 10^{-5}\ m^3/s$
3	6 bar	$9.04 \times 10^{-6}\ m^3/s$
4	8 bar	$9.04 \times 10^{-4}\ m^3/s$

XVI Interpretation of Results

We have calculate of discharge of air sing air bar and air flow rate

XVII Conclusions

Can calculate flow rate in compressor and C.I Engine we air bar arrangment.

XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Write equation of state and state meaning of all terms involved with their units.
2. If pressure of atmosphere changes what will be effect on volume flow rate of air at the inlet of compressor?
3. What are the units of pressure mentioned on pressure gauges? State their conversion factors to convert them in to bar.

(Space for Answer)

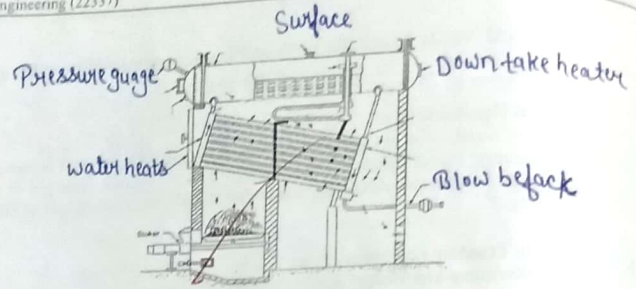
1 Ans Equation of State, or charastic gas equation of given by the relation ($PV = MRT$)

P = Pressure in gas N/m^2
V = volume of gases m^3
m = mass of there is volume
R = Characteristic of connecting
J/kg·K = Temperature of gas in K

2 Ans Theroitically on increase in to processure could increase the density of air reaming that more air would entire the compressure.

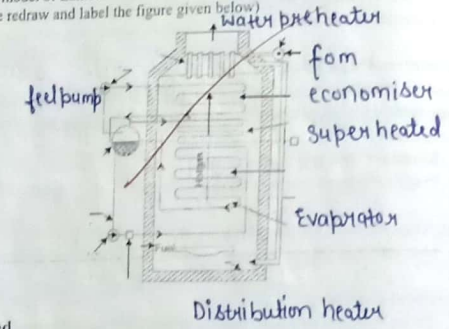
3 Ans Generally the unit of pressure mention on pressure guage on N/m^2 KN/m^2

1 N = 1 Pascal
1 bar = 100 Pascal
1 bar = 100 KN/m



Name of boiler - ...lamont Boiler.....

(Note – Draw the sketch of the model of Lamont boiler available in your laboratory and label the components. In case components are not visible redraw and label the figure given below)



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Models of Boiler	Laboratory Models of fire tube and water tube boilers	1 No.
2.	Cherts	Babcos and wiekon	1
3.	PPT videos		

IX Precautions to be Followed

1. Use safety shoes.
2. Do not try to dismantle model of boiler forcefully.

X Procedure

1. Select boiler model for demonstration.
2. Locate path of water and steam from inlet to outlet.
3. Locate path of air, fuel and gases.
4. Locate these paths with arrowheads on given figures with different colors.
5. Draw sketches of other any two boilers indicating above paths.
6. Write specifications of different boilers.

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.	Models of Boiler		labartary mode of fire	01	
2.	Charts		babce or wiekon	01	
3.	P.P.T videos			01	

XII Actual Procedure Followed

1. Select boiler model for boiler force fully
2. Locate Path of air fuel and gases.
3. locate path of water and steam from in let into collect

XIII Precautions Followed

1. use Saftey Shoes.
2. Do not try to dismantle module of boiler force fully.

XIV Observations and Calculations

For any two boilers trace the path of flue gases and steam and enter in given table.

Boiler	S. No.	Components in sequence through which steam is generated	S. No.	Components in sequence through which gases pass
		Water drum		furance Innate
		water tube		tabes
		uptake heater		Battles
		upper side of boiler		Hedders
		Super head		Chimney
		Steam Stop value		
		Steam drum		

XV Results

we know Expriimental Safty value in parts details

XVI Interpretation of Results (Giving meaning to results)

XVII Conclusions (Actions to be taken based on the interpretations.)

we Expriment know as boiler parts

XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. State applications of water tube boilers.
2. State applications of fire tube boilers.
3. Which boilers are called as high pressure boilers?
4. Suggest some changes in arrangement of different components / path of steam or gases to make it more efficient.
5. List manufacturers of boilers with applications.
6. Write specifications of a typical boiler.
7. What is need of boiler blow down?
8. What is composite boiler?
9. Draw sketches of two more boilers.

(Space for Answer)

1 Ans A fire tube boiler is a packed boiler in which hot gases from a fire pass through one tube or more tubes removing through ok package container of water the heat of packed container of water the heat of gases is transfer of through the walls of the tubes by thermal conduction heat water and ultmetly reaction steam.

2 Ans A fire tube boiler is packeged boiler in which heat gases from a fire pass through one tube or more tubes running through a packeged container of water the heat of the gases is transfer through the walls of the tubes by thermal conduction heating the water and ultmatly creating

7 Ans Boiler blow down is water intentionally wasted from a boiler to avoid concentration at impurities during contining evaporation of stem the water is blow out of the boiler with some force by steam pressure within the boiler

8 Ans composite boiler are combination of oil fired boiler and exhaust gas economizery when the diesel engine is at full load the fuel the steam diamond, ensides the steam production achieved from the diesel engine exhust gases.

6 Ans Eletric - The boiler is powered by electricity

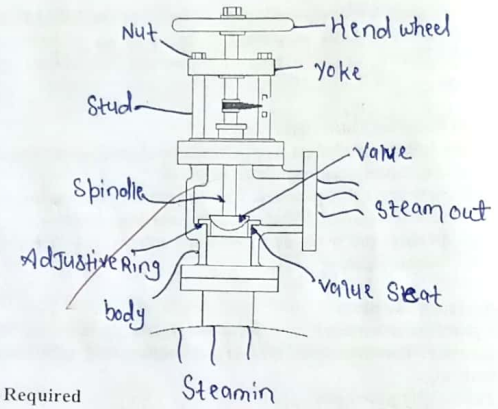
Gas (Natural Doopane) - The boiler powered by gas and propanes are common types

Oil - The boiler is powered by oil

Steam / Hydromic : The boiler is used is fluid by system or not water.

Name of mounting - Steam Stop valve

(Note – Draw the sketch of the actual mounting / model of mounting of boiler available in your laboratory and label the components. In case components are not visible redraw and label the figure given below)



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Commonly used mounting	Mountings that can be assembled and dismantled	1 each
2.	fulsion valve		
3.	Pressure gauge		
4.	water level		

IX Precautions to be Followed

1. Use safety shoes.
2. Maintain tools and equipments.

X Procedure

1. Select boiler mounting(s) available for dismantling location
2. Locate selected mounting on the boiler model
3. Write function of the mounting in given table
4. Dismantle the same using tools.
5. List the parts and state the function of each part in given table
6. Locate different areas need maintenance / replacement
7. Assemble the same again

XI Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.	Commonly		Mounting that can be assembled and disamble	01	
2.					
3.					

XII Actual Procedure Followed

01. locate Selected Naunting the boiler modules

XIII Precautions Followed

i.e use Sefty Shoes (ii) maintain tool equipment

XIV Observations and Calculations

S No	Mounting	Location & Function	Parts of the given mounting	Maintenance issues located
1	Control Nountaing	To Check water level	Boiler Plat cocked	Mud deposited
2				over pipe
3				Pointer deflate
4	Safety	Release Excess Pressure cleaning Avoid	quasing cape	leakage
5			Spring level	Replacement of Exit
6				
7	Nountaing	Regwake water supply Pre heat steam		
8				
9				

Some of the typical maintenance related issues in different mountings can be as follows

- Check condition of internal parts of valve for sign of corrosion, galling and wear.
- Check for pitting, cracking, resiliency, and condition of springs.
- Check spindle for straightness and adjusting ring threads for freedom of movement.
- Check the discharge and drain piping, it should be well clear.
- Check dampers to ensure that linkages are secured and well-greased.
- Check condition and operation of all feed water, blow down, drain, and other valves.

XV Results

XVI Interpretation of Results (Giving meaning to results)

XVII Conclusions (Actions to be taken based on the interpretations.)

XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO

1. What should be discharge capacity of safety valve?
2. What shall be maximum set pressure of safety valve?
3. Write materials of different parts used in Steam Stop Valve
4. Which type of safety valve is used in high pressure and low pressure boilers?

(Space for Answer)

1 Ans The safty value can be sized on the maximum how expirience in the flow Path with the greatest amount of flow the dischwrge capacity of Safty values 'A' would either be the fault load of the largest PRV or alternatively the cambined faut load of both the ADS and PRVA.

2 Ans A value should be to open at the manimum allow be working pressure (MAWP) of the vessel the value is intended to Protect there is same idevome to actual set pressure which iteams that value set at 100 Ping may opin. Slighty above or Slighty below this level.

3 Ans The Flangs of values body batted to the boiler at the highest part of steam space. it consist of value seat space and nut. the main body of valve is made of east iron and value seat made from gun metal when Steam Stop valve is placed directly over the boiler and connected to the Steam pipe line called the Junction value if it is placed near to Palm move then normally called Steam Stop valve

the lower ends of Spindle connected and valve upper and pass through glend and yoke and onnets with the prevet the lealy of steam.

4 Ans Depends on the boiler code in your In Essence all Safety values are some with a Spring locate Plug that lets the blug move off the Seat once the pressure exeddes high temperature valves are made of Stronger tougher meter mial then after relief valves boiler relief valves also have noise attenation alivies to ment next and Safety regulation.

Name of accessory – Economiser

(Note – Draw the sketch of the actual economiser / model of economiser of boiler available in your laboratory and label the components. In case components are not visible redraw and label the figure given below)

VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Suitable size accessories.	Accessories that can be assembled and dismantled.	1 each
2.			

IX Precautions to be Followed

1. Use safety shoes.
2. Do not try to dismantle accessories forcefully.

X Procedure

1. Select boiler accessory (ies) available for dismantling.
2. Dismantle the same using tools.
3. Understand functions of different parts.
4. Locate different areas need maintenance / replacement.
5. Assemble the same again.

XI Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1	Super heater				
2	Economiser				
3					

XII Actual Procedure Followed

Select boiler accessories available for dismating dismentle the same using tools under stand.

XIII Precautions Followed

use safty shoes
Do not try to dismentle accessories forcefully.

XIV Observations and Calculations

S. No	Accessory	Location & Function	Parts of the given accessory	Maintenance issues located
1	Economiser	Measured flumb		
2		to heater		
3				
4		Evoten evoots		
5		heat the steam		
6				

Some of the typical maintenance related issues in economizer can be as follows

- Inspect tubes for bend or deformation
- Inspect heat transfer surface & anti wear tiles for wear or crack.
- Inspect tail elbows, straight tubes for wear out, burn etc.
- Measure elbows, tubes or U bends thickness.
- Inspect row deformation which will affect flue gas corridor.
- The major problem at the economizer section is low temperature corrosion and problems from gas side deposits.
- Sliding and leaky expansion joints at the casing may allow accumulation of soot with severe acid attack.

Some of the typical maintenance related issues in superheater can be as follows

- Check tubes, tube clips, positioning
- Check tubes for oxidation, bend, corrosion, wear, crack etc.
- Measure diameters of tube using Vernier caliper and note them
- Peel of oxidation layer from mid section of a tube.
- Measure thickness of oxidation layer using micrometer and note it.
- Check protection tiles, tube clips and positioning plates for missing or burning or falling

XV Results

XVI Interpretation of Results (Giving meaning to results)

we have exprimert different.

XVII Conclusions (Actions to be taken based on the interpretations.)

XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. State advantages of economizer.
2. State advantages of air pre-heater.
3. State other application areas of economizer.
4. What are non-condensing type economizers?
5. What are different super-heaters commonly used in power plants?
6. What is use of de-superheater in super-heater?

(Space for Answer)

1 Ans Advantage and benefits of Economize It ecovers more heat at flue goes which normal air Per-heater can not do. Due increase in fluel price all power plants are going pressure increasing boiler efficiency So by using Eomizer This pressure can be hinimized.

2 Ans Advantages of air preheating air increase combustion rate and Them in increase Steam generation ratio of boiler due to higher temp of air force temperature increase below grad cool Comb & bunt efficiency.

3 Ans Economizer (uk) are mechanical device Intended to reduce Energy comsomption o to perform use ful function Such as per heating a fluied The Them term Economizer is used further purpose as well boiler power explemtten heating refrigriation ventitating and air conditioning

XIX References / Suggestions for Further Reading

1. https://books.google.co.in/books?id=xJUqDwAAQBAJ&q=superheater&source=gbs_word_cloud_r&cad=5#v=snippet&q=superheater&f=false (google book on boiler maintenance)
2. http://www.brighthubengineering.com/marine-engines-machinery/74949-inspection-carried-out-in-boiler-superheater-and-in-steam-drum/ (super-heater cleaning)
3. https://www.youtube.com/watch?v=y4anGmVTd-M (economizer cleaning)

XX Assessment Scheme

	Performance Indicators	Weightage
	Process Related (10 Marks)	**(40%)**
1	Identifying main parts of accessories	20%
2	Locate different areas of maintenance	20%
	Product Related (15 Marks)	**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. .....
2. .....
3. .....

Marks Obtained			Dated signature of Teacher
Process Related(10)	Product Related(15)	Total (25)	
8	12	20	

XIX **References / Suggestions for Further Reading**

1. https://www.youtube.com/watch?v=XTkPElH_h3k
2. https://www.youtube.com/watch?v=nyLPOAEYTOs
3. https://www.youtube.com/watch?v=nvAzıprQSOM
4. https://www.youtube.com/watch?v=in45SAFIUKw

XX **Assessment Scheme**

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Simulating various parameters within appropriate ranges satisfactorily	20%
2	Tabulate results independently	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. .....
2. .....
3. .....

Marks Obtained			Dated signature of Teacher
Process Related(10)	Product Related(15)	Total (25)	

Practical No. 6: Determination of dryness fraction of steam

I. **Practical Significance**

In industries who use steam for various purposes need to find out dryness fraction for determining condition of steam. Particles of water in steam can have greater impact on various devices. In steam turbines the presence of water particle can result in erosion as well as corrosion of blades of turbine. Wet steam is economical in certain cases.

II. **Relevant Program Outcomes (POs)**

PO2 - **Discipline knowledge:** Apply Mechanical engineering knowledge to solve broad-based mechanical engineering related problems.
PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical engineering problems.
PO6 - **Environment and sustainability:** Apply Mechanical engineering solutions also for sustainable development practices in societal and environmental contexts.

III. **Competency and Skills**

This practical is expected to develop the following skills for the industry identified competency **'Use principles of thermal engineering to maintain thermal related equipment.'**.

- Follow safety practices.
- Practice energy conservation.

IV. **Relevant Course Outcome(s)**

- Use relevant steam boilers.

V. **Practical Outcome**

- Determination of dryness fraction of a given sample of steam by using separating calorimeter.

VI. **Minimum Theoretical Background**

The steam containing water particles is called as wet steam. Steam calorimeters are devices used to find dryness fraction of the steam. In separating calorimeters water particle are separated mechanically. The steam is allowed to strike on hard surface due to which water particles falls down. The steam is separately collected in another chamber. The weight s of water particles and steam are measured.

VII. **Setup (Models) -**
(Label the sketch)

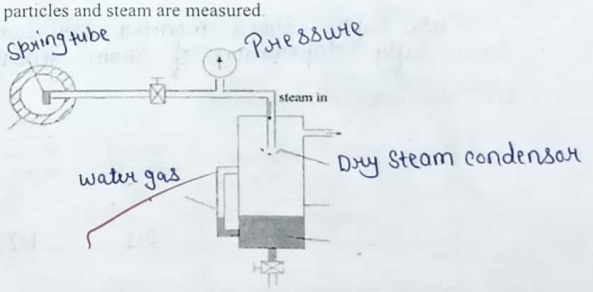


Figure – Seperating Calorimeter

VIII. Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Experimental setup to find dryness fraction of steam.	Steam generator with separating calorimeter. Steam generator equipped with pressure and temperature gauges	1 No.
2	Super heat		
3	Economicer		

IX. Precautions to be Followed

1. Use safety shoes.
2. Monitor pressure gauge for safe operation of steam generator.

X. Procedure

1. Start the steam generator.
2. Note the pressure and temperature of steam generator.
3. Open the steam valve for few seconds and send the sample to calorimeter.
4. Measure mass of condensate collected.
5. Measure mass of dry steam separately.

XI. Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.	Set up drunet		Steam eye reader	01	
2.			meter Step	01	
3.			Generator	01	

XII. Actual Procedure Followed

Start the Steam generator measure mass of condensate Separately

XIII. Precautions Followed

use Safty Shoes monitor pressure gauge for Safty operation of Steam generator.

XIV. Observations and Calculations

S. No.	Pressure bar	Mass of water (M_w) kg	Mass of dry steam (M_s) kg	Dryness fraction
1	8	0.1	1.25	0.925
2				

Dryness fraction is calculated by formula (Calculate at different pressures)

$$x = M_s / (M_s + M_w)$$

$$= 1.25 / (1.25 + 0.1) = 0.925$$

XV. Results

The dryness fraction Sample taken from nois Steam in 0.925

XVI. Interpretation of Results (Giving meaning to results)

Dryness fraction of Given Sample of Steam is $x = 0.925$

XVII. Conclusions (Actions to be taken based on the interpretations.)

we know that expriment calculate other parts Sevsing

XVIII. Practical Related Questions

Note. Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. State limitation of separating calorimeter.
2. Explain principle of separating and throttling calorimeter.
3. State formula to determine enthalpy of steam when it contain water particles.
4. List applications where wet steam is used.
5. Calculate dryness fraction for different pressures.

(Space for Answer)

1 Ans calorimeter advices for measuring changes in thermal energy A calorimeter is a devices used for calorimeter this Science of measuring the heat of chemical reaction or physical change an well as heat capacity the word calorimeter is drived from the lating word calori measuring heat different Scanning calorimeter So Thermal calorimeter and accelarted ratio calorimeter and one he among the most common types

2 Ans Two of the most commonly used types in chemistry are Separating calorimeter is used to determine the water of wet and low pressure water vapour by Separating the water from the wet vapour by Separating the Through calorimeter uses the principal of constant Expansion of the Enthalpy to measure the water Extant in the vapour.

3 Ans The Steam power plants work on the Renskive cycle In Ranking cycle Superheat Steam is generated and then taken to Steam is turbine the Steam drives the turbine which turn generated the electricity these used Steam is again converted into water using a condenser.

4 Ans. Heating application for positive pressure Steam be found in food processing factories refineries, and chemical plants to name a few. Saturated Steam is used as the heating Source for process fluid heat Exchangers Reboilers reactors, combustion air preheaters and other types of heat transfer equipment.

XIX. References / Suggestions for Further Reading

1. https://forums.ni.com/t5/Projects-Products/Design-and-Development-of-Virtual-Experimental-Set-up-To/ta-p/3525961
2. https://ecoursesonline.icar.gov.in/mod/page/view.php?id=2420

XX. Assessment Scheme

	Performance Indicators	Weightage
	Process Related (10 Marks)	**(40%)**
1	Operating experimental setup satisfactorily	20%
2	Calculating dryness fraction independently	20%
	Product Related (15 Marks)	**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. .....
2. .....
3. .....

Marks Obtained			Dated signature of Teacher
Process Related(10)	Product Related(15)	Total (25)	
8	13	21	

XI Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.	Mollier chart				
2.					
3.					

XII Actual Procedure Followed

Step The Steam generatar Measure Mass Can State of collected

XIII Precautions Followed

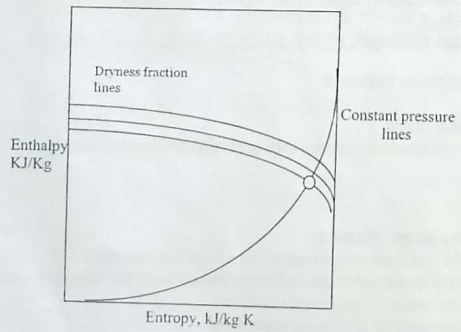
use Safety Shoes Monitar pressure gauge for Safe operation of Steam generatar

XIV Observations and Calculations

S. No	Pressure bar	Dryness fraction	Enthalpy (h) kJ/kg	Entropy (s) kJ/kg K
1	1.5	0.5	29.75	6.6
2	1.6	0.93	25.25	6.7

Dryness fraction is calculated by formula

$$X = M_s / (M_s + M_w)$$



After locating point on Mollier chart enthalpy of steam was found to be h = ... kJ/kg

XV Results

XVI Interpretation of Results (Giving meaning to results)

We have Expriment Calculate m = 0.5 , 0.93 etc

XVII Conclusions (Actions to be taken based on the interpretations.)

XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Draw a Mollier chart showing different properties on the same
2. Represent various steam processes on Mollier chart.
3. State advantages and limitations of Mollier chart.
4. State the reason of using saturated steam in most applications?
5. Compare enthalpy in 03 different cases by using steam table and Mollier chart for same data for steam.

(Space for Answer)

3 Ans. Advantages Mollier Chart :- Mollier diagram Enthalpy and Exphapy gas alogical Extension If = T-S we temp - Entropy The advantage of t-S diagram but introduction anytipically mollier diagram but and for Thermodynamic for is Thermodyanamic fluid as Such as Steam Shown

2 Ans. Enthalpy : Enthalpy diagram for water and Steam The diagram below can be used to determine Enthalpy various diagram in water Steam Thermodyanamic diagram is usful when angle Zinc The performance of adjhute Steady flow Process

Temp.	P	P	liquid	vapour	hf	R	hs	t
-40	2·907	5·830	0·2305	28·25	19·29	19·4		
-38	3·064	6·196	0·23205	27·20	18·26	192·4		
-36	32·29	6·541	00·23205	25·74	182·23	192·0		
-34	3·423	6·970	0·2850	24·74	183·19	191·6		
-32	3·627	7·386	0·2380	23·	194·21	191·21		
-30	3·841	7·386	6·2449	21·91	185·14	190·26		

XIX References / Suggestions for Further Reading

1. https://www.youtube.com/watch?v=ZKVs0FvfgP4
2. https://ecoursesonline.icar.gov.in/mod/page/view.php?id=2410

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Locating steam condition on Mollier chart.	30%
2	Finding values of enthalpy and entropy.	10%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. .....
2. .....
3. .....

Marks Obtained			Dated signature of Teacher
Process Related(10)	Product Related(15)	Total (25)	

Practical No. 8: Assembly and dismantling steam turbines (Using dissectible / working model)

I Practical Significance

Steam turbines are important device in thermal engineering. Steam turbines are employed as the prime movers together with the electric generators in thermal and nuclear power plants to produce electricity. They are also used to propel large ships, ocean liners, submarines and to drive power absorbing machines like large compressors, blowers, fans and pumps.

II Relevant Program Outcomes (POs)

PO2 - **Discipline knowledge:** Apply Mechanical engineering knowledge to solve broad-based mechanical engineering related problems.
PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical engineering problems.
PO6 - **Environment and sustainability:** Apply Mechanical engineering solutions also for sustainable development practices in societal and environmental contexts.
PO 8. **Individual and team work:** Function effectively as a leader and team member in diverse/ multidisciplinary teams.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use principles of thermal engineering to maintain thermal related equipment.'**.

- Demonstrate working as a leader/a team member.
- Maintain tools and equipments

IV Relevant Course Outcome(s)

- Use relevant steam nozzles and turbines.

V Practical Outcome

- Assembly and dismantling of impulse and reaction turbines.

VI Minimum Theoretical Background

Impulse turbine has nozzles and moving blades. The nozzles are convergent-divergent type while moving blades are symmetrical in shape. Reaction turbines employs aerofoil shaped blades. The shapes of fixed as well as moving blades are same.

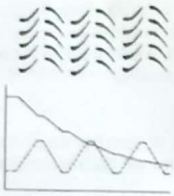
VII Setup (Models) -

Name of Turbine - Impulse turbine

(Note – Name the components)

Name of turbine - Reaction Turbine

(Note – Name the components)



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Impulse Turbine	Impulse turbine of suitable size which can be dismantled and assembled.	1 No.
2	Reaction Turbine	Reaction turbine of suitable size which can be dismantled and assembled.	1 No.
3			

IX Precautions to be Followed

- Use safety shoes.
- Use tools carefully.

X Procedure

1. Select turbine model for demonstration.
2. Dismantle the same using suitable tools.
3. Locate different components of the given turbine.
4. Locate different damage / failure areas in given turbine.
5. Assemble the same again.

XI Resources Used

S.No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1	Impulse turbine			01 -	
2	Reaction turbine			01 -	
3					

XII Actual Procedure Followed

01 Select turbine may cycle for demonstration

02 planimeter fine same using suitable.

XIII Precautions Followed

01 use safety shoes

use tools director

XIV Observations and Calculations

Type of turbine selected – Impulse

S. No.	Components in sequence dismantled	Type	Material	Tool used	Possible failure / damage
1	Turbine blades	Impulse / reaction	CR-NL N-Steep		Erosion/ corrosion
2	Turbine Rotor	Impulse	NL-base		Figure / corrosion
3	Diaphragm				
4	Turbine casing	Impulse	cast/Alloy		Corrosion
5	Bearings	Impulse	Cu-Brass		creep
6	Turbine seals	Impulse	Carbon		Fatigue
7			ring brass		Earth

Type of turbine selected – Reaction

S. No.	Components in sequence dismantled	Type	Material	Tool used	Possible failure / damage
1	Turbine blades	Impulse / reaction	Ni-bassed alloy		Erosion/ corrosion
2	Turbine Rotor	Reaction	— " —		Corrosion
3	Turbine casing	Reaction	Cmnosed		creep
4	Bearings	Reaction	Brave		fatigue
5	Turbine seals	Reaction	carbon		Erosion
6			ring bas		

XV Results

XVI Interpretation of Results (Giving meaning to results)

XVII Conclusions (Actions to be taken based on the interpretations.)

XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Collect specifications of steam turbines used for different applications (Refer Siemens website)
2. State ten differences between impulse and reaction turbines.
3. Collect data of steam turbines used in non-conventional power sector.
4. Explain backpressure turbines.
5. Collect information on steam turbine blade failure.

(Space for Answer)

2 Ans

Impules turbine	Reaction turbine
1. Steam flow the nozzles Strikes the moving blades	Steam flow the fixed blades Sthen over moving blands
ii Expension of Steam takes place in nozzle only	Expansion of Steam occures Party in fixed moving blades.
iii Steam Strikes the blades with kinetic Energy	Steam move over moving blades with pressure K.E
iv Steam pressure-remain constant during its follow through the symmetrical	Steam pressure is reduse during its follow through the noulbad
v Blads are Symmetrical	Blade are not Symmetrical

vi. efficiency is low	efficiency is high
vii High Speed	low Speed
viii. manufacturing of blendes simple	Difficult.

XIX References / Suggestions for Further Reading

1. https://www.eolss.net/sample-chapters/C08/E3-10-03-02.pdf
2. https://www.geoilandgas.com/sites/geog.dev.local/files/1261.pdf
3. https://www.gepower.com/steam/steam-turbines
4. http://www.steamforum.com/pictures/wgp4205%20Turbine.pdf
5. http://www.mechanicalengineeringsite.com/steam-turbine-basic-parts/

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		(40%)
1	Identifying main components of turbines	20%
2	Dismantling & assembling turbines	20%
Product Related (15 Marks)		(60%)
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	100 %

Names of Student Team Members

1. .....
2. .....
3. .....

Marks Obtained			Dated signature of Teacher
Process Related(10)	Product Related(15)	Total (25)	

Practical No. 9: Assembly and dismantling of cooling towers (Using dissectible model).

I Practical Significance

Cooling towers have carried area of applications. Various applications like thermal power plants, sugar factories, air-conditioning plants etc. use cooling towers. Newer materials in construction of cooling towers are being introduced now-a-days. Efficient operation of cooling tower improves efficiency of entire plant.

II Relevant Program Outcomes (POs)

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Mechanical engineering problems.
PO2 - **Discipline knowledge:** Apply Mechanical engineering knowledge to solve broad-based mechanical engineering related problems.
PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical engineering problems.
PO8 - **Individual and team work:** Function effectively as a leader and team member in diverse / multidisciplinary teams.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use principles of thermal engineering to maintain thermal related equipment.'**:

- Identify different types of cooling towers.
- Locate different parts of cooling towers.

IV Relevant Course Outcome(s)

- Use relevant steam condensers.

V Practical Outcome

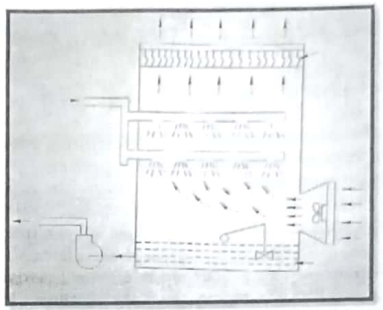
- Assembly and dismantling of cooling tower (Model)

VI Minimum Theoretical Background

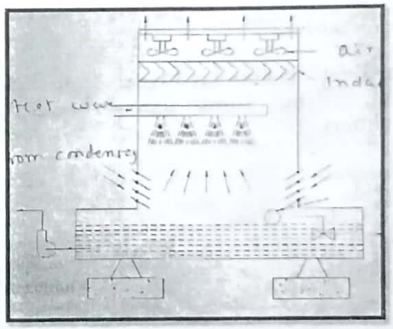
For condensing steam in different applications continuous supply of cold water is required. If this water source is not available nearby in abundant manner, re-circulation of water is necessary. This is possible using cooling towers. In cooling towers condenser cooling water is cooled again. Principle of evaporative cooling is used in during this process. Atmospheric air is used for cooling the condensate cooling water. Depending on way of cooling they are classified as natural draft and forced draft cooling towers.

VII Setup (Models) -

Name of cooling tower - forced draft circulation cooling chapter
(Note – Label different components)



Name of cooling tower - Natural circulation cooling tower
(Note – Label different components)



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
	Models of cooling towers	Suitable size those can be dismantled and assembled in laboratory.	1 each

IX Precautions to be Followed

- Use safety shoes.
- Follow standard procedures for dismantling.

X Procedure

1. Select cooling tower available for dismantling.
2. Dismantle the same using tools.
3. List the parts and state the function of each part in given table.
4. Locate different areas need maintenance / replacement.
5. Assemble the same again.

XI Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

Select cording tower avilable for dismantling Dismantle the same using tools assemble the same again

XIII Precautions Followed

use Safety Shoes
follow Standards produces for dismantings

XIV Observations and Calculations

S. No.	Name of part	Function of part	Material	Maintenance required
1	Eliminator	to control drift	PVC	Reeplacement
2	Fan	to force air	Al. FRP. GS	ouw having
3	Motor	to drive fan	Steel	Replace
4	Fill Material	on next Page	M106, wood	inspection
5	Casing		FRP	Claming
6	Cold water basin	Store water	R.C.C	proper
7	Louvers	Prevent Sun	Ahesetos	inspection
8		linght Enter	Sheets	Relanpement

cooling tower Equal usingafan

FRP-Fiber required Plastic. CRS. Galven used Steel.

XV Results

XVI Interpretation of Results (Giving meaning to results)

We know Expriment assembly and dissambly parts

XVII Conclusions (Actions to be taken based on the interpretations.)

XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. State principle of evaporative cooling.
2. Compare natural draft and forced draft cooling towers.
3. Compile information on currently used materials used for cooling towers.
4. Write cooling towers specifications.

(Space for Answer)

function off all Material is to provided envornement for efficient heat transfer

1 Principal of Evarative calling: The principal underling Evarative cooling is that water must have heat applied to it change from oil fluid to vapour when Evaporative accures this heat is taken from the water that remain im the liquid State resulting a cooler liquid.

A cooling tower is heat rejection device which discharge wastm air from cooling tower to the atmosphere throygh the cooling of water.

4 Ans Cooling Tower Specification is 1am water
= 36.40 CWBT · 288°C
water out let 32.2°C

XIX References / Suggestions for Further Reading

1. http://www.idconline.com/technical_references/pdfs/chemical_engineering/Cooling_Tower_Components.pdf
2. http://www.allkoteliningincaz.com/cooling-tower-components-cooling-tower-parts-functions/
3. http://www.enexio.com/water-technologies/products/cooling-tower-components/
4. http://www.nptel.ac.in/courses/103106101/Module%20-%208/Lecture%20-%202.pdf

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Identifying main parts of cooling towers.	20%
2	Locate different areas of maintenance.	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. .....
2. .....
3. .....

Marks Obtained			Dated signature of Teacher
Process Related(10)	Product Related(15)	Total (25)	

Practical No. 10: Assembly and dismantling of surface condenser.

I Practical Significance

Surface condensers are preferred in large capacity power plants. Surface condenses are suitable for large range of applications due to their inherent advantages. In surface condensers poor quality cooling water can be used along with higher vacuum can be maintained. However they occupy more space and their initial & maintenance costs are more.

II Relevant Program Outcomes (POs)

PO2 - **Discipline knowledge:** Apply Mechanical engineering knowledge to solve broad-based mechanical engineering related problems.
PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical engineering problems.
PO8 - **Individual and team work:** Function effectively as a leader and team member in diverse / multidisciplinary teams.
PO9 - **Communication:** Communicate effectively in oral and written form.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use principles of thermal engineering to maintain thermal related equipment.'**:

- Identify different types of surface condenser.
- Dismantle and assemble given surface condenser.

IV Relevant Course Outcome(s)

- Use relevant steam condensers.

V Practical Outcome

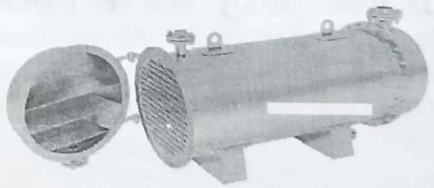
- Dismantle given model of surface condenser, draw sketches of various parts and assemble it.

VI Minimum Theoretical Background

In surface condenser, one fluid flows through tubes, where as another fluid flows over shell side. There is indirect contact of hot and cold fluid. Depending upon number of times tube length is travelled by fluid they are classified as single pass / double pass /multi pass. They can also be classified as center flow and down flow depending upon location of air pump.

VII Setup (Models) -

(Note – Label different components)



VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
	Surface condenser	Suitable size	1 each

IX Precautions to be Followed

- Use safety shoes.
- Arrange parts neatly to help quick assembly.

X Procedure

1. Select condenser available for dismantling.
2. Dismantle the same using tools.
3. Locate different parts and write their functions
4. Locate different areas need maintenance / replacement.
5. Assemble the same again.

XI Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
	Surface condensor				

XII Actual Procedure Followed

i Select condensor avaliable to dismating.
ii. Dismantle the same using tools.
iii Assemble the same again.

XIII Precautions Followed

i use safty shoes.
ii Arrange part healthy to help quick Assembly

XIV Observations and Calculations

S. No	Components	Function	Material	Tools used	Maintenance issues identified
1	Shell	HE tubes	Steel		
2	Shell expansion joint	to reduce stress	carbon steel	Screw driver	
3	Tube support plates	To support tube	C.I Steel	Pillers	
4	Tube sheets	Posis tube	Steel		
5	Tubes	To store	Steel	Spanners	
6	Waterbox	water	Steel C.I		
7	Pass partitions	To solve	Steel		

XV Results

Divided water path into required no of to cube nasted

XVI Interpretation of Results (Giving meaning to results)

XVII Conclusions (Actions to be taken based on the interpretations.)

XVIII Practical Related Questions

Note. Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Draw a typical condensing plant
2. State Dalton's law of partial pressure.
3. State purpose of air pump in surface condenser
4. State difference between surface and jet condenser.
5. Draw a schematic diagram of typical surface condenser showing all components.
6. How tube leakage in condensers can be detected.

(Space for Answer)

2 Ans. Dalton's law also called dalton law of partial pressure States that in mixture of non reacting gaesses the total pressure exerted is equal talk Sum of the partical pressure.

5. These condenses are heat changer which convert steam, from its gases to its liquid States pressure below atmosphere pressure can also cooled condenser.
condenser tube failues continous to be most common source of plants boiler and steam container they are also up ridicatable.

XIX **References / Suggestions for Further Reading**

- https://www.youtube.com/watch?v=y5015p2QSx8
- https://www.youtube.com/watch?v=lSR5dhRFA9E
- https://www.youtube.com/watch?v=KxLxh-4Wgu4

XX **Assessment Scheme**

	Performance Indicators	Weightage
	Process Related (10 Marks)	**(40%)**
1	Identifying main parts surface condensers	20%
2	Locate different areas of maintenance.	20%
	Product Related (15 Marks)	**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. .....
2. .....
3. .....

Marks Obtained			Dated signature of Teacher
Process Related(10)	Product Related(15)	Total (25)	

Practical No. 11: Determination of thermal conductivity of metallic rod

I **Practical Significance**

Conduction is dominant phenomenon of heat transfer in various applications. Value of thermal conductivity of different materials helps us to separate conductors from insulators. After doing this experiment students can determine experimentally thermal conductivity of any solid metallic rod.

II **Relevant Program Outcomes (POs)**

PO1 - **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Mechanical engineering problems.
PO2 - **Discipline knowledge:** Apply Mechanical engineering knowledge to solve broad-based mechanical engineering related problems.
PO8 - **Individual and team work:** Function effectively as a leader and team member in diverse / multidisciplinary teams.
PO9 - **Communication:** Communicate effectively in oral and written form.

III **Competency and Skills**

This practical is expected to develop the following skills for the industry identified competency **'Use principles of thermal engineering to maintain thermal related equipment.'**:

- Follow safety practices.
- Practice energy conservation.

IV **Relevant Course Outcome(s)**

- Use suitable modes of heat transfer.

V **Practical Outcome**

- Conduct a trial on conduction setup for a metallic rod and calculate thermal conductivity.

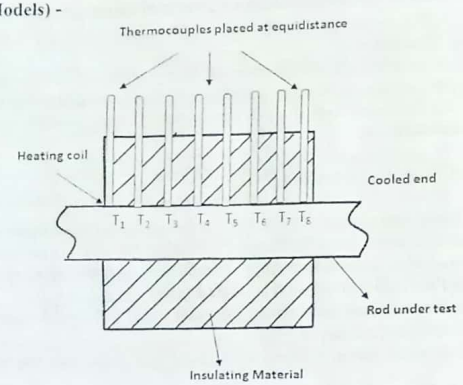
VI **Minimum Theoretical Background**

Fourier's law of conduction states that rate of heat transfer through a material is proportional to negative temperature gradient and to the area, at right angle to the gradient through which heat is flowing. Mathematically

$$Q \propto -(dT / dx)$$
$$Q \propto A$$

Steady state is condition when properties at a location do not change with respect to time.

VII Setup (Models) -



Experimental setup

VIII Resources Required

S.No	Name of Resource	Suggested Broad Specification	Quantity
1	Experimental set up for determination of thermal conductivity of a metallic rod.	Metallic rod of suitable length, Adequately insulated with heating arrangements at one end. Voltage regulator. Six thermocouples on metallic rod. Two thermocouples for water temperature. Arrangement for cooling other end of rod.	1 No.
2	Stop watch	----	1 No.
3	Measuring jar	1 litre	1 No.

IX Precautions to be Followed

- Do not touch heater end by bare hand.
- Use recommended voltage and amperage for heating rod.

X Procedure

1. Switch on Mains
2. Start cooling water supply and measure it. Note it.
3. Switch on the heater.
4. Adjust voltage regulator to get constant voltage and amperage. Note it.
5. Wait till steady state is reached.
6. Measure and note temperatures of thermocouples on given metallic rod. (T_1 to T_6)
7. Measure inlet & outlet temperatures of water. Note them. (T_7 & T_8)

XI Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
	Experimental				
	Stop watch				
	measuring Jar				

XII Actual Procedure Followed

Switch on machine mains State cooling water supply and measure it no. it switch on the heater.

XIII Precautions Followed

Do not touch heater end by have heat use recommended voltage and amperge for heating

XIV Observations and Calculations

m_w = Cooling water flow rate - 0.0074 Kg/s
r = radius of given metallic rod = m 0.0125
Distance between two thermocouples = m

S. No.	V	I	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
01	90	0.7	58.3	56.5	55.1	53.5	52.5	50.8	25.8	28.8
02	199	0.21	162.5	180.34	135.51	20.2	20.24	104.2	8.25	25.5

(Note - Multiple reading are required to reach steady state. Use final reading for the calculations once steady state is achieved).

Calculation –

$Q = -k A (dT/dx) = \frac{29.7}{(0.000491)(305)} = 198.32 \text{ w/m}^2$

Also neglecting any heat loss through insulating material we can write

Q = V * I = 63 Watts (where V is voltage & I is current set)

A = cross sectional area of rod = $\pi * r^2$ $\pi (0.0125)^2 = 4.9 \times 10^{-4}$

dT/dx = Temperature gradient can be calculated by plotting a graph of temperature Vs distance at which thermocouples are positioned and then finding slope of curve obtained.

K = 1.28571.42 W/m K

XV Results

XVI Interpretation of Results (Giving meaning to results)

XVII Conclusions (Actions to be taken based on the interpretations.)

we Expriment in calculating and there is 'A' 'K' etc

XVIII Practical Related Questions

Note Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Define thermal conductivity. State it's unit.
2. List thermal conductivity of commonly used engineering materials.
3. Discuss effects of chemical composition, state on thermal conductivity.
4. Discuss effect of temperature on thermal conductivity of metals and gases.
5. Discuss effect of pressure on thermal conductivity of liquids and gases.
6. If you want to calculate heat lost to insulating powder how will you calculate?

(Space for Answer)

1 Ans Thermal conductivity - A measured of the ability of a material to transfer heat given two surface on either side of the material with temperature different between then the thermal conductivity is the heat energy terms force permit time and per unit surface area divide by the temperature difference

3 Ans Thermal conductivity depends on the chemical composition of the substance composition the liquid is more than gases and metals have highest.

2 Ans i Aluminium Alloy 360 - 9.8 w/mK

ii copper, Electrolytic (BIP) - 3.9 w/mK

iii Yellow brass (high brass) - 22.3

XIX References / Suggestions for Further Reading

- http://nptel.ac.in/courses/103103032/module1/lec2/3.html
- https://www.youtube.com/watch?v=zFkJy_VocCk

XX Assessment Scheme

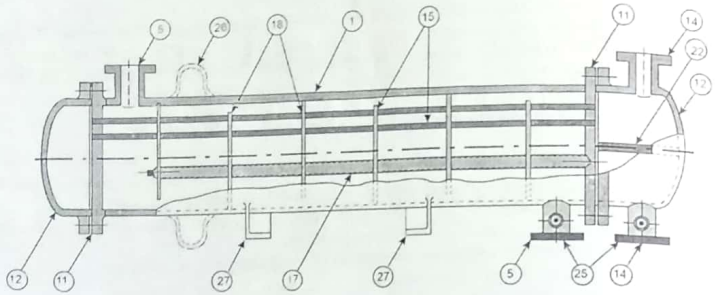
Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Performing the experiment satisfactorily	20%
2	Calculations done independently	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. .....
2. .....
3. .....

Marks Obtained			Dated signature of Teacher
Process Related(10)	Product Related(15)	Total (25)	

VII Setup (Models) -



Shell & tube heat exchanger

VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
	Different heat exchangers available in laboratory.	Suitable size with temperature sensors for measuring hot and cold fluid temperatures.	2 No.

IX Precautions to be Followed

- Do not try & operate other systems of test rig.
- Protect your body parts from moving parts like coupling, belt etc.

X Procedure

1. Start the identified test rig (say IC engine test rig).
2. Locate heat exchangers in this test rig.
3. Run it for few minutes till it stabilizes.
4. Measure temperature of hot and cold fluids at inlets and outlets.
5. Adjust voltage regulator to get constant voltage and amperage. Note it.
6. Repeat it for atleast one another test rig (say refrigeration test rig.)

(Space for Answer)

We observed used

i water calorimeter of IC engine their fuel to operation in the farce of IC engine testing.

2 Ans The chief objective of this study is the proposal design and CFD simulation of a new compacted copper wire woven tin heat exchanger and Silica get adsorbent bed used as part of an adsorption refrigeration system.
This type of heat exchanger design has a large surface area because.

3. Ans Stability training refers to performing exercise while on an unstable surface with the goal of activating stabizoes and trunk muscles that may get negeleted with other forms of training.

XI Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

Start the identify test rig (say IC) like Coughineg Test heat exchanger in the test rig.

XIII Precautions Followed

Don't try and operate other system of leasting

Protent your body parts from moving parts like coupling belt etc.

XIV Observations and Calculations

Name of test rig	Name of heat exchanger	Type of heat exchanger	Hot fluid in temperature Th_i	Hot fluid out temperature Th_o	Cold fluid in temperature Tc_i	Cold fluid out temperature Tc_o
		Parallel or counter flow	88	60	10	32

Calculation –

For parallel flow heat exchanger

$\theta_i = th_i - tc_i =$ 88-10 = 78

$\theta_o = th_o - tc_o =$ 60-32 = 28

For counter flow heat exchanger

$\theta_i = th_i - tc_o =$ 88-10 = 78

$\theta_o = th_o - tc_i =$ 60-10 = 50

In both cases LMTD is calculated as

$LMTD = (\theta_i - \theta_o) / (\ln (\theta_i / \theta_o)$ = ... For parallel flow

$LMTD = (\theta_i - \theta_o) / (\ln (\theta_i / \theta_o)$ = 52.946 For counter flow

XV Results

LMTS for counter flow type heat exchanger in 52.94

XVI Interpretation of Results (Giving meaning to results)

LMTD for Parallel and counter flow that Exchange and appear.

XVII Conclusions (Actions to be taken based on the interpretations.)

logmean temp different is engin valeut temp different which rate of heat transfer.

XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Define heat capacity of hot and cold fluids.
2. State meaning of all terms involved in $Q = U A \theta_m$
3. Elaborate concept of overall heat transfer coefficient.
4. State assumptions used in deriving formula for calculating LMTD.
5. Comment on *fouling* in heat exchangers.
6. Under which conditions you will select parallel flow and counter flow heat exchangers?
7. Can LMTD be applied in multi pass heat exchangers? If not what changes are required in LMTD?

(Space for Answer)

1 Ans So when we mix heat water with cold water there will be at far as thermal energy from heat to cold as a flow of heat from to heat to cold you can think at specific heat as thermal identification heat as after mal inertia. To seph blank first matel the specific heat substance

2 Ans State function as function of state is function defined for a system relating several state variable as state run its that depends only on the current equilibrium state of the system for example a gases liquid a solid crystal as empulsion state function do not depended on the path by which us the system arried at its present state function the Equalibrium

4 Ans LMTD formula

$$\frac{(\Delta T_1 - \Delta T_2)}{\ln(\Delta T_1 / \Delta T_2)}$$

XIX References / Suggestions for Further Reading

- http://www.mesubjects.net/heat-exchangers-3-derivation-of-lmtd/
- https://www.youtube.com/watch?v=bMDOPIfCG0I
- https://www.youtube.com/watch?v=JqpYQG28TVc

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		(40%)
1	Performing the experiment	20%
2	Calculations	20%
Product Related (15 Marks)		(60%)
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	100 %

Names of Student Team Members

1. .....
2. .....
3. .....

Marks Obtained			Dated signature of Teacher
Process Related(10)	Product Related(10)	Total (20)	

Practical No. 13: Use of energy balance equation across heat exchanger.

I Practical Significance

Use of energy balance equation can be made to find unknown parameters in heat exchangers provided other parameters of hot and cold fluids are known. During this heat loss to surrounding is neglected. This experiment will be useful in design of heat exchangers.

II Relevant Program Outcomes (POs)

PO2 - **Discipline knowledge:** Apply Mechanical engineering knowledge to solve broad-based mechanical engineering related problems.
PO3 - **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Mechanical engineering problems.
PO8 - **Individual and team work:** Function effectively as a leader and team member in diverse / multidisciplinary teams.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use principles of thermal engineering to maintain thermal related equipment.'**

- Measure different parameters on heat exchanger.
- Calculate mass flow rate of a fluid.

IV Relevant Course Outcome(s)

- Use relevant steam boilers.

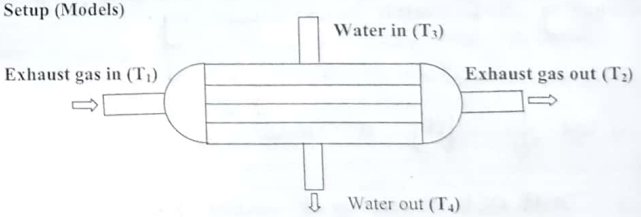
V Practical Outcome

- Conduct trial to determine mass flow rate of one fluid using energy balance equation in heat exchanger.

VI Minimum Theoretical Background

In heat exchanger energy is exchanged between hot and cold fluids. The heat to be exchanged is called as heat duty. As mass flow rate of fluid increases heat exchange also increases.

VII Setup (Models)



Heat Exchanger set up

VIII Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
	Calorimeter of IC Engine test rig or suitable heat exchanger test rig	Suitable size	1 each
	Stopwatch & measuring jar	Suitable size	1 each

IX Precautions to be Followed

- Use safety shoes.
- Do not touch hot water lines.

X Procedure

1. Start Engine and run it at some constant load. Engine shall have calorimeter in the path of exhaust gases.
2. At same time open water flow to calorimeter.
3. After few minutes, measure temperatures of hot (gases) and cold fluid (water).
4. Measure flow rate of water using stop watch and measuring jar.
5. Perform calculations.

XI Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		

XII Actual Procedure Followed

After few minutes measure temp of too gauges and cauld fluid water measure flow watt of water using stop watch and measuring.

XIII Precautions Followed

use of Safety u Shoes.

Dont not touch heat water lines

XIV Observations and Calculations

S. No	T_1 (Gas in)	T_2 (Gas out)	T_3 (Water in)	T_4 (water out)	m_w (Mass flow rate of water
1	60	53	29	39	0.091
2	55	50	27	26	0.036
3	60	56	27	32	0.0166

Considering no heat loss from gases to surrounding write energy equation

$m_g * Cp_g * (T_1 - T_2) = m_w * Cp_w * (T_4 - T_3)$ = 0.043 kg/k

m_g = Mass flow rate of gases to be calculated = ... kg/s

Cp_g = Specific heat for gases = ... kJ/kg K 4.19 KJ/kg·K

M_w = Mass flow rate of water = 0.03 kg/s

Cp_g = Specific heat for water = 4.18 ... kJ/kg K

m_g = 0.042 kg/s

XV Results

Mass flow rate of water cold mass flow of ratio field water.

XVI Interpretation of Results (Giving meaning to results)

Mass flow rate hole water cold

XVII Conclusions (Actions to be taken based on the interpretations.)

Heat Exchanger classification of Energy mg xe
Pq x $(T_1 - T_2)$ mw x (Pw x $(T_4 - T_3)$

XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. List fouling coefficients of different fluids.
2. State guidelines for selecting fluids for tube side and shell side on priority side.
3. List dimensions of heat exchanger you have used for the experiment like tube OD, tube thickness, tube length, tube passes, shell diameter.
4. Define LMTD for parallel flow and counter flow heat exchangers.
5. Explain overall heat transfer coefficient.

(Space for Answer)

1 Ans follow represent theoritical represent to heat flow due to fluid up a transfer

a. Transformer – 0.001
b. Engine – 0.001
c. Acid gas – 0.003
d. Ch

3 Ans for Parallel flow Heat Exchanger.

$Q = + c_1$
$a = th = t$
$LMTD = (\cos - Q)$

$[MTb] = [Q_1 - Q_0]\ [h/100]$

5 Ans ΔT: Different inter parture between be Solid Surface are and Surrounding area k it use in calculating the heat transformer.

XIX References / Suggestions for Further Reading

- http://nptel.ac.in/courses/103103027/pdf/mod1.pdf
- http://www.barriquand.com/en/news/how-to-design-heat-exchanger
- http://www.brighthubengineering.com/hvac/59900-fundamentals-of-heat-exchanger-theory-and-design/

XX Assessment Scheme

Performance Indicators		Weightage
Process Related (10 Marks)		**(40%)**
1	Performing experiment satisfactorily	20%
2	Calculations involved in energy balance	20%
Product Related (15 Marks)		**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. .....
2. .....
3. .....

Marks Obtained			Dated signature of Teacher
Process Related(10)	Product Related(15)	Total (25)	

XI Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
	Step up fanelator		——" ——	1 N	

XII Actual Procedure Followed

- Start the blower
- Ensure turbulent flow
- Adjust heater input

XIII Precautions Followed

Do not touch heater end by bare hand

use recommended voltage and amperage for heating rod.

XIV Observations and Calculations

D_1 = Inside diameter of test section = 0.033 m
L = Test section length = 0.0125m
r_0 = radius of orifice = 0.011 m
A = Test section surface area = $\pi * D_1 * L$ = 0.0129 m^2

Ts = Average temperature of surface of test section = $(T_2 + T_3 + T_4 + T_5 + T_6) / 5$
= ..... K

Ta = $(T_1 + T_7)/ 2$
= ..... K

dT = (Ts – Ta) = ... K

Manometer reading = $h_w = h_1 – h_2$ = 18–18 = 0 m

S. No.	V voltage	I current	T_1	T_2	T_3	T_4	T_5	T_6	T_7	h_1	h_2
01	90V	0.72	28°c	27°c	60°c	60°c	61		37°c	37°c	18
02	110V	0.85	30°c	72°c	76°c	76°c	77		42°c	37°c	18

(Note - Multiple reading are required to reach steady state. Use final reading for the calculations once steady state is achieved).

Calculation –
To find convective heat transfer coefficient.....
$Q = h A (dT)$

$h = Q / A (dT)$

= ..... W/m^2K

To find Q.....

$Q = m_a * C_{pa} * (T_7 – T_1)$ = ... W

Take for air C_{pa} = 1.005 kJ/kg K

To find m_a.....

$h_a Q_a = h_w Q_w$

h_a = ... m

A_o = Area of orifice = πr_o^2 = ... m^2

$V_a = C_d A_o \sqrt{(2gh_a)}$ = ... m^3/s

$m_a = Q_a * V_a$ = ... kg/s

XV Results

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XVI Interpretation of Results (Giving meaning to results)

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.....
.....

XVII Conclusions (Actions to be taken based on the interpretations.)

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.....
.....

XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Define convective heat transfer coefficient. State it's unit.
2. List values of convective heat transfer coefficient for typical fluid flow applications.
3. Define Reynolds number, prandtl number.
4. State values of Reynolds number for different flow conditions of air.

5. Differentiate free convection and forced convection.
6. List applications for free and forced convection.
7. If flow rate of air increases what will be effect on heat transfer coefficient?

(Space for Answer)

1 Ans Temperature of the surrounding fluid is temperature of solid surface is it is used in calculating the heat transfer typically by convection or phase transtions between a fluid and a solid the Heat transfer cofficient has S.I unit in ($w/m^2 \cdot k$)

3 Ans Prandtl Number : Prandtl group is dimensionles number maned after the germen physiest loading Prandtl

Reynoleds : As the ratio of moment diffisitivity to thermal diffusitivity that is the prandtl number.

6 Ans Convection : it is classification as natural carefully and force convensition depending on how the fluid motion in initiated where in forced convection the fluid is force to flow ove a surface or in a tube by external means such as pump or fan.

The plume from this candle flange from laminal a to tublet the reynoleds number can be used predicet when this transition will take place Reynolds number is an important diamensionaless quantity fluid hechaning used to help pradic falter is different

XIX References / Suggestions for Further Reading

- https://www.engineeringtoolbox.com/convective-heat-transfer-d_430.html
- http://nptel.ac.in/courses/103103032/10

XX Assessment Scheme

	Performance Indicators	Weightage
	Process Related (10 Marks)	**(40%)**
1	Performing the experiment satisfactorily	20%
2	Calculations done independently	20%
	Product Related (15 Marks)	**(60%)**
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	**100 %**

Names of Student Team Members

1. .....
2. .....
3. .....

Marks Obtained			Dated signature of Teacher
Process Related(10)	Product Related(15)	Total (25)	

XI Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
	Stefan-Boltzmann	EMS	Supper Soniery	01	

XII Actual Procedure Followed

The water in tank is Heated by immersion heater up to temperature of about 90°c. The heat water is pure in the water Tank.

XIII Precautions Followed

use Shaft Shoes.
Do not touched heater surface with bare hand.

XIV Observations and Calculations

Calculate average temperature of hemisphere using four thermocouples located on it.

Themocouple	T_1 (K)	T_2 (K)	T_3 (K)	T_4 (K)
Temperature °C	53.3	54.9	53.3	53.0

Average temperature of hemisphere = $T = (T_1 + T_2 + T_3 + T_4)/4$ = 66.95

1. Temperature to which water is heated = 63. °C
2. Mass of disc (m_D) = ... kg 6.5×10^{-3} kg
3. Radius of disc = 12.5 mm
4. Specific heat of disc material (Cp_D) = 0.4186 KJ/kg °C (for copper) = 0381 kJ/kg°K

Time, sec	0	5	10	15	20	25	30
Temperature, °C	31.1	31.5	31.7	31.8	31.9	32.0	32.1

Plot a graph of temperature of disc taking on y axis and time on x axis. 32.2 32.3

Find slope of graph at $(dT/dt)_{t=0}$ = ... K/sec $\frac{25 \times 66.95}{25}$ = 1673.75 k/s

Now heat radiated by hemisphere is equal to heat absorbed by copper disc.

$\sigma * A_D * (T^4 - T_D^4) = m * Cp_D * (dT/dt)_{t=0}$

T_D = Temperature of disc at the instant when it is inserted.

A_D = Area of disc = ... $\pi(12.5)^2$ = 490.87 ..... m^2

$\sigma = (m_D * Cp_D * (dT/dt)_{t=0}) / (A_D * (T^4 - T_D^4))$ = $\frac{(6.5 \times 10^{-3} \times 0.4186 \times 1673.75)}{490.87 \times (6635)^2 \cdot (73.7)^2}$

σ = ... W/m^2K^4 = 3.31×10^{-9}

XV Results

XVI Interpretation of Results (Giving meaning to results)

XVII Conclusions (Actions to be taken based on the interpretations.)

we know expriment calculate AD, G etc.

XVIII Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Define radiation heat transfer.
2. Give practical examples where radiation heat transfer is dominant.
3. Define black body and emissivity.
4. State the applications where Stefan Boltzmann constant can be used.

(Space for Answer)

Q1 Ans. Radiation is a metal of heat transfer for heat close not rely upon any constant between the heat Source and the heated objector the Ease with conduction and convection. Heat can be transfarmitted through emply Space can by thermal radition of tin called in forced radiation.

This is a type Electramagnetic radiation.

Q3 Ans. All objects at temperature above absulub zero unit thermal radiation or. Emissivity is define as the ratio of Energy radiation from a blank body easy perfect emitter

XIX References / Suggestions for Further Reading

- https://www.youtube.com/watch?v=MUAc_pAMNig
- http://nptel.ac.in/courses/112108149/pdf/M9/Student_Slides_M9.pdf

XX Assessment Scheme

	Performance Indicators	Weightage
	Process Related (10 Marks)	(40%)
1	Measuring required parameters.	20%
2	Calculating Stefan Boltzmann constant	20%
	Product Related (15 Marks)	(60%)
3	Interpretation of result	20%
4	Conclusions	20%
5	Practical related questions	20%
	Total (25 Marks)	100 %

Names of Student Team Members

1. .....
2. .....
3. .....

Marks Obtained			Dated signature of Teacher
Process Related(10)	Product Related(15)	Total (25)	

List Of Laboratory Manuals Developed by MSBTE

First Semester:

1	Fundamentals of ICT	22001
2	English	22101
3	English Work Book	22101
4	Basic Science (Chemistry)	22102
5	Basic Science (Physics)	22102

Second Semester:

1	Bussiness Communication Using Computers	22009
2	Computer Peripherals & Hardware Maintenace	22013
3	Web Page Design with HTML	22014
4	Applied Science (Chemistry)	22202
5	Applied Science (Physics)	22202
6	Applied Machines	22203
7	Basic Surveying	22205
8	Applied Science (Chemistry)	22211
9	Applied Science (Physics)	22211
10	Fundamental of Electrical Engineering	22212
11	Elements of Electronics	22213
12	Elements of Electrical Engineering	22215
13	Basic Electronics	22216
14	'C' programming Language	22218
15	Basic Electronics	22225
16	Programming in "C"	22226
17	Fundamentals of Chemical Engineering	22231

Third Semester:

1	Applied Multimedia Techniques	22024
2	Advanced Serveying	22301
3	Highway Engineering	22302
4	Mechanics of Structures	22303
5	Building Construction	22304
6	Concrete Technology	22305
7	Strength Of Materials	22306
8	Automobile Engines	22308
9	Automobile Transmission System	22309
10	Mechanical Operations	22313
11	Technology Of Inorganic Chemicals	22314
12	Object Oriented Programming Using C++	22316
13	Data Structure Using 'C'	22317
14	Computer Graphics	22318
15	Database Management System	22319
16	Digital Techniques	22320
17	Principles Of Database	22321
18	Digital Techniques & Microprocessor	22323
19	Electrical Circuits	22324
20	Electrical & Electronic Measurment	22325
21	Fundamental Of Power Electronics	22326
22	Electrical Materials & Wiring Practice	22328
23	Applied Electronics	22329
24	Electrical Circuits & Networks	22330
25	Electronic Measurments & Instrumentation	22333
26	Principles Of Electronics Communication	22334
27	Thermal Engineering	22337
28	Engineering Matrology	22342
29	Mechanical Engineering Materials	22343
30	Theory Of Machines	22344

Fourth Semester:

1	Hydraulics	22401
2	Geo Technical Engineering	22404
3	Chemical Process Instrumentation & Control	22407
4	Fluid Flow Operation	22409
5	Technology Of Organic Chemicals	22410
6	Java Programming	22412
7	GUI Application Development Using VB.net	22034
8	Microprocessor	22415
9	Database Managment	22416
10	Electric Motors And Transformers	22418
11	Industrial Measurements	22420
12	Digital Electronics And Microcontroller Applications	22421
13	Linear Integrated Circuits	22423
14	Microcontroller & Applications	22426
15	Basic Power Electronics	22427
16	Digital Communication Systems	22428
17	Mechanical Engineering Measurments	22443
18	Fluid Machanics and Machinery	22445
19	Fundamentals Of Mechatronics	22048

Fifth Semester:

1	Design of Steel and RCC Structures	22502
2	Public Health Engineering	22504
3	Heat Transfer Operation	22510
4	Environmental Technology	22511
5	Operating Systems	22516
6	Advanced Java Programming	22517
7	Software Testing	22518
8	Control Systems and PLC's	22531
9	Embedded Systems	22532
10	Mobile and Wireless Communication	22533
11	Industrial Machines	22523
12	Switchgear and Protection	22524
13	Energy Conservation and Audit	22525
14	Power Engineering and Refrigeration	22562
15	Solid Modeling and Additive Manufacturing	22053
16	Guidelines & Assessment Manual for Micro Projects & Industrial Training	22057

Sixth Semester:

1	Solid Modeling	17063
2	Highway Engineering	17602
3	Contracts & Accounts	17603
4	Design of R.C.C. Structures	17604
5	Industrial Fluid Power	17608
6	Design of Machine Elements	17610
7	Automotive Electrical and Electronic Systems	17617
8	Vehicle Systems Maintenance	17618
9	Software Testing	17624
10	Advanced Java Programming	17625
11	Mobile Computing	17632
12	System Programing	17634
13	Testing & Maintenance of Electrical Equipments	17637
14	Power Electronics	17638
15	Illumination Engineering	17639
16	Power System Operation & Control	17643
17	Environmental Technology	17646
18	Mass Transfer Operation	17648
19	Advanced Communication System	17656
20	Mobile Communication	17657
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22	Process Control System	17663
23	Industrial Automation	17664
24	Industrial Drives	17667
25	Video Engineering	17668
26	Optical Fiber & Mobile Communication	17669
27	Therapeutic Equipment	17671
28	Intensive Care Equipment	17672
29	Medical Imaging Equipment	17673

Pharmacy Lab Manual

First Year:

1	Pharmaceutics - I	0805
2	Pharmaceutical Chemistry - I	0806
3	Pharmacognosy	0807
4	Biochemistry and Clinical Pathology	0808
5	Human Anatomy and Physiology	0809

Second Year:

1	Pharmaceutics - II	0811
2	Pharmaceutical Chemistry - II	0812
3	Pharmacology & Toxicology	0813
4	Hospital and Clinical Pharmacy	0816