

Department of Electrical Engineering
Assignment
Date: 22/06/2020
Course Details

Course Title:	Thermodynamics	Module:	02
Instructor:	SIR MUJTABA	Total Marks:	50

Student Details

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Q1.	(a)	State the following along with their mathematical expressions: i. The ideal gas law ii. Dalton's law of partial pressure	Marks 04+06
			CLO 2
	(b)	Explain the Carnot cycle.	
Q2.	(a)	You need to buy a refrigerator for your home. Outline the key factors that you will consider while buying the refrigerator.	Marks 05+08
			CLO 3
	(b)	Explain vapour absorption refrigeration system.	
Q3.		Distinguish between water tube & fire tube boilers.	Marks 06
			CLO 3
Q4.		State the meaning of the word "stroke" & describe the working of a 04 stroke engine.	Marks 12
			CLO 3
Q5.	(a)	Outline the differences between a petrol engine & a diesel engine.	Marks 04+05
	(b)		Several provincial governments in Pakistan have banned the use of 02 stroke engines in auto rickshaws. Identify the causes behind this decision.

(1)
QNO. 1 (i)

(i) Ideal Gas Law:-

Ans: The ideal gas law is also called the general gas equation, this equation states that of a hypothetical ideal gas. It is a good approximation of the behaviour of many gases under many conditions.

Mathematical Expressions:-

$$PV = nRT$$

P = Pressure

T = Temperature

V = Volume

R = ideal gas constant

n = Amount of substance.

Q NO. (1) (b)

(ii) Dalton's Law of Partial Pressure:-

Ans. Statement:-

It states that the mixture of non-reacting gases, the total pressure exerted is equal to to the sum of the partial pressure of the individual gases.

Mathematically Expression:-

The pressure of mixture of non-reactive gases can be defined as:

$$P_{\text{Total}} = \sum_{i=1}^n P_i \quad \text{or}$$

$$P_{\text{Total}} = P_1 + P_2 + P_3 \dots + P_n$$

$$P_i = P_{\text{Total}} \times x_i$$

Q NO. 1 (b)

Ans. Carnot cycle :-

The most efficient heat engine cycle is Carnot cycle.

It consists of two isothermal processes and two adiabatic processes.

The Carnot cycle can be thought of as the most efficient heat engine cycle allowed by physical laws.

When the second law of thermodynamics states that not all the supplied heat in a heat engine can be used to do work, the Carnot efficiency sets the limiting value on the fraction of heat which can be so used.

(11)

In order to approach the Carnot efficiency, the process involved in the heat engine cycle must be reversible and involve no change in entropy.

This means that the Carnot cycle is an idealization, since no real engine processes are reversible and all real physical processes involve some increase in entropy.

Carnot Efficiency:-

$$\frac{T_H - T_C}{T_H} \times 100\%$$

The temperature in the Carnot efficiency must be in Kelvins.

Q NO. 2 (a)

Ans.

There are following
key factors:-

(i) Look for the Energy
Star:-

Energy star is simple choice
of saving the energy.

After heating, cooling and
hot water, the refrigerator
is probably the next
largest energy user in
your home.

(ii) Consider a Refrigerator with
a Top Mounted Freezer:-

Refrigerators are sold in many
configurations including top freezer,
bottom freezer and side-by-side.

(A) Top-freezer have to be the

(6)

A top freezer refrigerator that has earned the Energy Star uses less energy than a 60-WATT light bulb.

(iii)

Purchase An Appropriately Sized Refrigerator:-
Generally, the larger the refrigerator, the greater the energy consumption. The most energy efficient models are typically 16-20 cubic feet. When you replace an old refrigerator with new one, do not keep the old refrigerator for extra cold storage.

(iv) Consider the features that are most important to you.

Which feature do you need in your new fridge?

The initial purchase price and over the lifetime of the product.

For example, though the door ice adds about 84 kWh of energy, or \$10 per year to your utility bill.

(v) Recycle Your Old Refrigerator:-
This is another way to help prevent global warming. Not only it prevents energy-wasting units from ending up in someone else's home, but it avoids the release of harmful materials.

Q NO. 2 (b)

Explain vapour absorption refrigeration system.

Ans: Vapour absorption Refrigeration system:-

The power utilized in vapour compression system is high grade energy, i.e. electric power for running the compressor motor.

In absorption refrigeration system, however, heat is directly utilized as source of energy.

Of course, it may preferable to utilize heat as such as it avoids undergoing through the various energy transformation required in the generation of electrical energy from heat energy.

It may be recalled that in the compression system, the vapour was compressed by undergoing a great change in volume during the compression process.

Accordingly the major part of the power was consumed in the process.

If means were available for raising this pressure of the refrigerant without appreciably altering its volume, the work requirements will be enormously reduced (by about 95% or so).

This may possibly be done by dissolving the refrigerant in some absorbent and supplying the heat to the solution for compression purposes.

The absorption cycle achieves this objective by placing the refrigerant in solution before the so called compression process and by removing from the solution immediately after the process. The absorption of the vapour is governed by Raoult's Law.

The basic difference between vapour compression and vapour absorption cycles will thus be to replace the compressor of the vapour compression cycle by a set of equipment which fulfills the objective discussed above.

The other important element i.e. condenser, expansion device

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and evaporator will exist
in both system.

(12)
Q NO. 3

Distinguish between water tube boiler and fire tube boilers.

Ans.

Fire Tube Boiler	Water Tube Boiler
(i) In fire tube boilers hot flue gases pass through tubes and water surrounds them.	(i) In water tube boilers water passes through tubes and hot flue gases surround them.
(ii) These are operated at low pressure upto 20 bar.	(ii) The working pressure is high upto 250 bar.
(iii) Load fluctuations cannot be handled.	(iii) Load fluctuation can be easily handled.
(iv) It requires more floor area for a given output.	(iv) It requires less floor area for a given output.

Fire Tube Boiler

(v) These are bulky and difficult to transport.

Overall efficiency is upto 75%.

Water does not circulate in a definite direction.

The drum size is large and damage caused by bursting is large.

Water tube Boiler

(v) They are light in weight, hence transportation is not a problem.

Overall efficiency with an economizer is upto 90%.

Direction of water circulation is well defined.

If any water tube is damaged, it can be easily replaced or repaired.

Q NO. 4

What is stroke and also describe the working of four-stroke engine?

Ans:

Stroke:-

The term 'stroke' has following related meanings.

- (i) A phase of 'cycle' engine (e.g. compression stroke, exhaust stroke), during which the piston travels from top to bottom or vice versa.
- (ii) The type of power cycle used by a piston engine (e.g. two-stroke engine, four stroke engine.)
- (iii) "stroke length", the distance travelled by the piston in each cycle. The stroke length - along with bore diameter, determines the engine's displacement.

Working of four Stroke Engine.

A four stroke engine is an internal combustion engine in which the piston completes four separate strokes while turning the crankshaft.

Four stroke engine working as.

(i) Intake :-

Intake is known as induction or suction. This stroke of the piston begins at top dead centre (T.D.C) and ends at bottom dead centre (B.D.C). In this stroke the intake valve must be in the open position while the piston pulls an air-fuel mixture into the cylinder by producing vacuum pressure into the cylinder through its downward motion.

(2) Compression:-

This stroke begins at B.D.C or just at the end of the suction stroke, and end at T.D.C. In this stroke the piston compresses the air-fuel mixture in preparation for ignition during the power stroke.

Both the intake and exhaust valves are closed during this stage.

(3) Combustion:-

It is known as power or ignition. This is the start of the second revolution of the four stroke cycle. At this point the crankshaft has completed a full 360 degree revolution.

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While the piston is at T.D.C., the compressed air-fuel mixture is ignited by a spark plug.

This stroke produces mechanical work from the engine to turn the crankshaft.

(4) Exhaust:-

This is known as outlet.

During exhaust stroke, the piston, once again returns from B.D.C. to T.D.C.

while the exhaust valve is open. This action expels the spent air-fuel mixture through the exhaust valve.

Q NO. 5 (a)

Difference between Petrol Engine and Diesel Engine.

Diesel Engine

- (i) They work on diesel cycle.
- (ii) The fuel is mixed with air inside the cylinder.
- (iii) It has high compression ratio.
- (iv) It has high power production.
- (v) These engines work with fuels that have low volatilities.

Petrol Engine.

- (i) They work on otto cycle.
- (ii) Air and fuel is mixed in carburettor.
- (iii) It has relatively low compression ratio.
- (iv) Relatively low amounts of power are produced in a petrol engine.
- (v) Highly volatile fuels are used in these internal combustion engines.

Diesel Engine

- (vi) Generally used in heavy vehicles such as trucks and buses.
- (vii) It has low fuel consumption.

Petrol Engine

- (vi) Used in light vehicles such as motorcycles and cars.
- (vii) It has high fuel consumption.

QNO. 5 (b)

Ans.

The Punjab Transport department is all set to launch a phase-out campaign against two-stroke Rickshaws.

Four-stroke CNG Rickshaws manufacturers of the country demanded the government to provide incentive to materialize the plan of phasing out 2-stroke and introduction of around 5,00,000 4-stroke rickshaws, as ~~per~~ replacement.

The Punjab Transport department banned the registration of two-stroke engine motorcycle rickshaws as per public transport in Lahore, Gujranwala, Rawalpindi, Faisalabad.

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and Mullan since
September 1, 2005.

According to sources,
40 percent of the total
auto rickshaws were playing
illegally on city roads.
as they were not
registered with government,