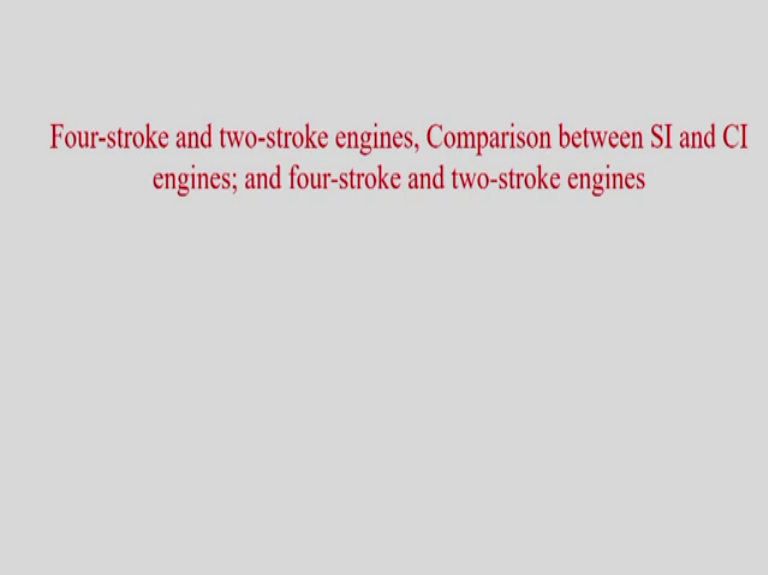
**IC Engines and Gas Turbines**
**Dr. Pranab K. Mondal**
**Department of Mechanical Engineering**
**Indian Institute of Technology, Guwahati**

**Lecture – 02**
**Four-stroke and Two-stroke engines, Comparison between SI and CI engines; and Four-stroke and Two-stroke engines**

So, we will continue our discussion on IC Engine and Gas Turbine, but as I said that I will be discussing about the operational principle and different components and other different features of IC engine.

(Refer Slide Time: 00:49)

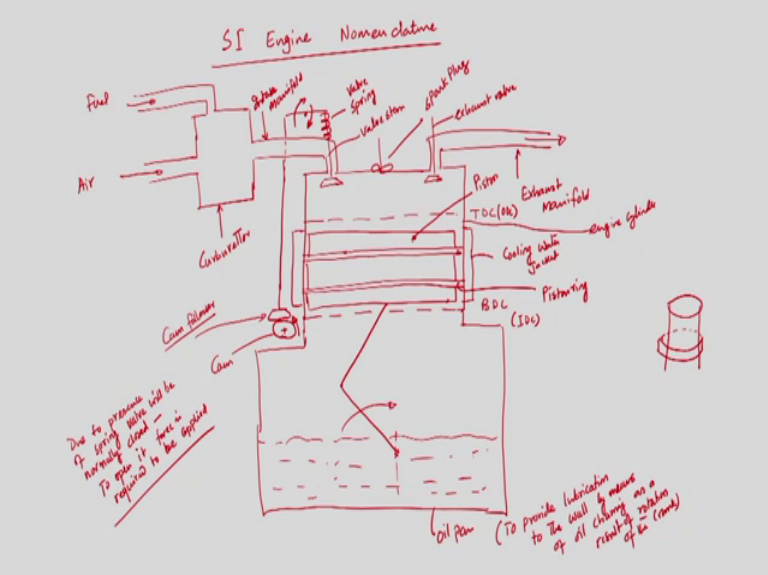



So, today I will discuss about, today I will discuss about four-stroke two-stroke engines, what are the fundamental difference between four-stroke two-stroke engine. In fact, I have discussed about the you know comparison between SI and CI engine; as well as I also discussed about the you know engine classification based on several issues like types of combustion and types of ignition. That is what we have discussed the types of combustion and types of stroke, we have discussed about the classification of IC engine.

So, today we will discuss about four-stroke two-stroke engine comparison between SI and CI engine that we have discussed in the last class. And what are the you know operational principle and what is the operational principle of a four-stroke engine of it on a or a two-stroke engine. Before I move to discuss about the difference between four-

stroke and two-stroke engine let us first you know discuss about the components that are there in a SI engine and CI engine, because we have discussed that in a SI engine are specific parts are there which are not present in a CI engine. So, let us first draw a schematic and rather a nomenclature of an SI engine.

(Refer Slide Time: 01:57)

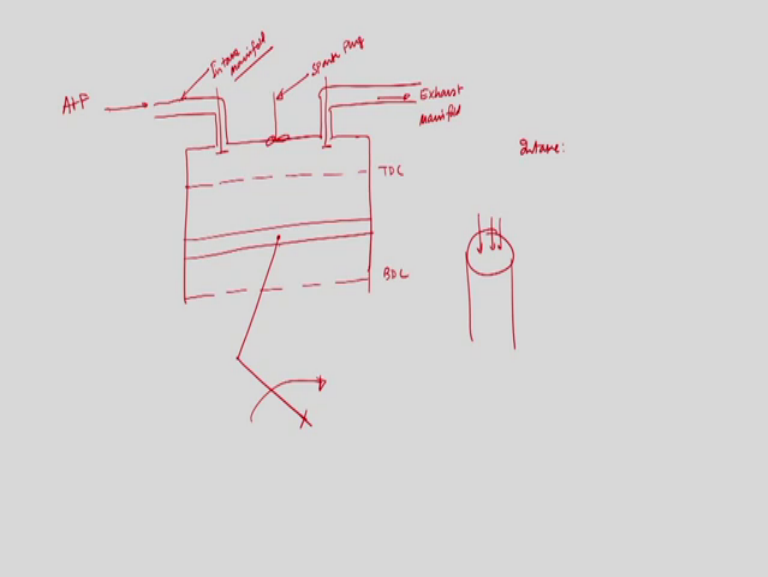



So, today I will discuss about a nomenclature of SI engine. So, that is SI engine normenclature right. So, I will draw the schematic. So, this is very important because we need to draw this schematic very often while we discussing about different other features of a four-stroke and two-stroke engine. So, I will discuss about so you know then there will be valve and also you have valve, you know there will be a spark plug; an important part of a SI engine is carburetor that is here right. So, this is carburetor, this is exhaust manifold and this is spring loaded valve, but in piston is operating between these two points.

First one is known as top dead center and bottom one is known as BDC sometimes ODC and IDC Inner Dead Center and Outer Dead Center. So, this is known as inner dead center and BDC outer dead center, but TDC BDC. Now we will have a piston, but we will have a ring piston ring, but I will tell why piston rings are provided. So, we will have a piston ring right, and this piston ring is connected with you know crank and connecting rod mechanism. And so, this is you know oil pan oil, this is oil pan I will discuss one by one and this is rotating like this.

Now, this valve is spring loaded. So, there will be a, this valve is always spring loaded and connected with cam and follower, this is valve, no valve spring, this is valve stem this is rocker arm.

(Refer Slide Time: 16:15)




So, this is spring, you know spring you know valve spring; valve spring, this is valve stem, this is valve stem. This is known as spark plug, this is exhaust manifold through which exhaust gas is exhaust gas goes out from the engine cylinder. This is cylinder valve, but in the cylinder valve we normally have one cooling water jacket to reduce the temperature of the cylin engine cylinder right. So, this is cooling water jacket.

And this is piston, this is piston and these are piston rings, these are piston ring. So, this is piston ring and through which this is carburetor, this is air and this is the in a fuel path. So, air fuel is coming to the carburetor. It is mixed toward there because as I said you the in SI engine normally air fuel mixture is introduced in the cylinder in a gaseous, in a gaseous form.

So, this is cam and follower mechanism by I have just connected with the you know this connecting rod so that and also it is connected to spring valve, this is valve stem and this is spark plug. So, this is cam and this is cam follower. So, this is cam and this is cam follower, this is cam follower and this is intake manifold, this is intake manifold through which air fuel mixture is introduced in the engine cylinder.

Now, of course, this is the engine cylinder; so, this is the engine cylinder. So, there in the reciprocating motion of the piston within the engine cylinder that is converted to the rotary motion by means of crank and connecting rod mechanism, this is oil pan and here we are having lubricants. So, this is essentially sub it given, this is essentially attached to this because to provide lubrication to the valve by means of oil churning, by means of oil churning as a result of rotors of the crank; as a result of rotation of the crank right.

Due the presence of spring, due to the presence of spring valve will be normally closed. So, I am writing here due to the presence of spring valve will normally, valve will be normally closed, normally closed and to open it we need to apply force. So, to open it force is required to be applied right, and since this cam follower mechanism is there. So, cam follower again a cam is connected with this somehow with the engine; you know that rotary motion that we are converting from reciprocating motion to the rotary motion.

So, it would be connected to the engine this wheel. So, and a spark plug is provided because is as I said you this is a very much essential for SI engine, because in SI engine fuel is not; I mean we are not utilizing the high pressure and temperature of the fuel itself. I mean high pressure temperature of the air at the end of the compression stroke and we need to which is done in case of a CI engine.

Because, in a CI engine at the end of the compression stroke the thermodynamic state of the air is such that the when fuel is injected the combustion starts automatically. But, in case of a SI engine we need to supply an external agent which is known as spark plug, because these spark plug ignite the fuel. So, this is known as carburetor because, carburetor supply air fuel mixture in a schematic ratio and it supply air fuel mixture in the engine cylinder in a gaseous form. And there is excess manifold through which the combustion product comes out of the after the combustion.

So, now and piston moves between two points, one is to top dead center other is bottom dead center. Because, the piston movement is restricted between these two points and above the top dead center there is there is a space which is known as combustion space of course. And, cooling water jacket is provided only to cool the engine cylinder because, if it because upon com you know combustion because, of the combustion there will be excessive heat generation and that will increase the temperature of the engine cylinder. So, we need to supply some coolant to you know bring the temperature of the engine

cylinder to a level. So, that the you know there should not be any thermal crack or engine cylinder life would be in increased.

And oil pan is provided to supply lubricants because of the by means of chirming, oil chirming because of the rotation of the crank this is what now piston ring is provided. So, piston is if I draw the you know piston, piston is essentially cylindrical piston right. So, piston ring is provided at the periphery of the piston, because if there will be always frictional friction between piston and the engine cylinder piston is very costly.

So, piston cylinder is provided this is also leak proof it would not allow combustion product to come down anyway so and fuel to come down. So, it prevents piston because whenever friction is there piston is there between piston ring and the cylinder. So, instead of replacing piston after some time we can replace another piston ring. So, that the piston life is increased, this is what; and cooling water jacket is provided that is to provide the you know temperature. Now, very important thing is that sometimes as I said you that BDC is known as IDC inner dead center and TDC is known as outer dead center ODC. So, piston movement is restricted between this two. So, this is all about the SI engine nomenclature.

Now, if you lead to have nomenclature of a CI engine, only thing is that there should not be spark plug rather we have a fuel injector through which fuel will be introduced. Instead of spark plug we will have a fuel injector and there will not be carburetor rather I will come through intake manifold. So, this will be the different between SI and CI engine nomenclature. So, I am not going to draw the again Normen an engine components so that nomenclature of the CI engine can be you know understood.

But I am telling that the instead of spark plug there will be a fuel injector through which fuel will be supplied to the engine cylinder and instead of carburetor there should be only you know air intake manifold through which air will be introduced. So, this is the difference between now even now a day I am telling nowadays there is no cam follower mechanism. So, I mean this valve intake valve and out you know this is the intake valve this is exhaust valve. So, this is exhaust valve. So, this valve opening times are controlled electronically so, but still only to have a understanding how you know an engine is operating and what are the different parts and we are we have given this cam, I have given this cam follower and cam mechanism since it is spring loaded valve. So, and the

normal tendency will be remain seated and always will be closed, but upon if you pull it to open this we have to apply force.

So, this is the you know nomenclature of the SI engine and now we will discuss about the strokes. So, what are the four-stroke and two-stroke engine. So, I am not again I am telling you I am not going to discuss about the CI engine nomenclature. Nomenclature of the CI engine will be same except there will be you know instead of spark plug there will be a fuel injector through which fuel will be injected in the cylinder and there only carburetor because air will be taken into cylinder through intake manifold. So, this is all about the you know nomenclature of SI engine and CI engine

So, now we will discuss about the four-stroke and two-stroke engine. So, what are the different strokes in four-stroke and two-stroke let us first discuss about four-stroke engine very important. As I said you that in a four-stroke engine I mean there are two revolution of the crank per 1 cycle; that means, piston will move, crank will have a two regulation for one cycle. So, in one revolution it you know rotates 360 degree. So, there will be two revolutions per one cycle and piston will have will move from BDC to TDC, TDC to BDC like this.

So, now let us draw again a schematic of a you know SI engine like that whatever it is may engine SI or CI. The fundamental difference between SI and CI engine is that there should not be spark plug in a CI engine, SI engine sorry CI engine and there will be a fuel injector and there should not there will be carburetor. So, this is if I draw the, if I take if I draw the you know again schematic of a SI engine. So, this is TDC, this is BDC just I am drawing. So, this is piston and piston is moving like this.

So, this is exhaust manifold this is I am writing air plus fuel, it is supplied air fuel mixture is coming from carburetor and there will be a spark plug. So, this is essentially a is SI engine. So, if I would like to discuss about four different strokes for SI engine and that will be same for the CI engine only in case of a CI engine we do not have spark plug and we will fuel injector and only air will be introduced to the intake manifold. This is an we will have a intake valve and this is exhaust valve. So, this is you know intake manifold. So, this is intake manifold, this is exhaust manifold.

So, here what are the different stroke? So, I will discuss and I will write in detail. So, initially piston is coming from TDC to BDC getting intake stroke. So, let me first discuss

I would intake stroke. So, what is the intake stroke? During intake stroke piston is coming from TDC to BDC, inlet valve opens exhaust valve remaining closed. So, a vacuum is created inside the engine cylinder and because of the pressure difference fuel and air in case of a SI engine, only air in case of a CI engine will be introduced into the cylinder.

So, I will write in details. So, what are the different stroke, I mean the you know different processes I mean involved with different strokes. So, the in the intake stroke exhaust valve we leave enclosed, intake valve opens piston comes from TDC to BDC and a vacuum pressure is having a vacuum is created inside the engine cylinder. Since a vacuum is created there will be a pressure difference between you know ambient. And, the engine cylinder which will allow air plus fuel mixture to be introduced in case of a SI engine or in case of a CI engine had to be introduced in engine cylinder.

So, piston is coming from TDC to BDC in the intake stroke and at the end of the intake stroke cylinder is filled up with the air plus fuel in case of a SI engine. But, in case of a CI engine it is filled up with only the air and next stroke is called compression stroke. So, in the compression stroke so, what we what you understood I will write again I am telling I will write in details, but what is done in intake stroke? Exhaust valve is remaining enclosed, intake valve opens a vacuum is created inside the cylinder. And because, of a pressure difference that is vacuum pressure inside the cylinder and at the outside will atmospheric pressure.

So, air fuel mixture in case of SI engine or only air in case of a CI engine will be introduced in the engine cylinder whenever and this process will continue as long as piston reaches up to the BDC. So, at the end of the intake stroke piston will be at BDC and cylinder will filled up with the air plus fuel. In case of SI engine, only in case of a CI engine and then whenever piston reaches at BDC exhaust valve will remain closed, that was there that was initially closed. Now intake valve will close.

So, next stroke is compression stroke. So, at the end of the intake stroke, intake valve closed exhaust valve is remaining closed now piston will move from BDC to TDC, the process is very is the process is instantaneous because this will rotate. So, both the valves are closed, piston is coming from BDC to TDC the amount of air in case of a CI engine

or the amount of air fuel mixture in case of SI engine that was introduced during the intake stroke will be now compressed.

So, whenever piston is coming from BDC to TDC at the end of the compression stroke. So, the earlier space which is known as combustion space, I will discuss about that is known as you know and its volume. So, air will be compression in case of a CI engine it in a temperature and pressure will increase and in case of a SI engine the air fuel mixture will be compressed and then whenever piston is reaching towards the TDC both the valves are closed. In case of a SI engine spark plug is ignited essentially to initiate combustion, but in case of a CI engine since we have compressed the air and air temperature pressure is high. So, when fuel is injected through fuel injected then the fuel itself with the contact of high pressure temperature air the combustion will be initiated.

So, now what is the out what is the you know conclusions in this stroke that is compression stroke, piston is coming from BDC to TDC both the valves are remaining closed air plus fuel mixture will be compressed and spark plug will be ignited to initiate combustion in case of SI engine. In case of a CI engine only air will be compressed and towards the end of the compression stroke, we have to supply fuel through fuel injector and it will start it will initiate combustion on account of a high pressure temperature of the compressed air. So, this is all about the compression stroke.

So, now as I said you the process, the process is instantaneous. So, piston will no longer remain there at the TDC. So, piston will come again from TDC to BDC. So, whenever piston is coming from TDC to BDC again then this is known as power stroke; that means, we had combustion already, high pressure air was high pressure air in case of a CI engine or air fuel mixture in case of SI engine was there.

We have initiated combustion by igniting by you know switching off the switching on the spark plug or by introducing fuel in case of a CI engine. So, there will be a combustion, because of the combustion there will be huge pressure and temperature again and that pressure will try to create a thrust on the piston phase. So, as I said you there will be a piston is essentially a cylindrical shape. So, at the piston phase that high pressure will create a thrust and it will allow piston to come down from TDC to BDC and this is known as power stroke.

Since at the end of the compression stroke td the piston was at TDC, now there will be a combustion as a result of combustion there will be a high pressure and temperature of the combustion product I mean air fuel mixture into that is combustion product, now it will be combustion product. The combustion product will create a thrust on the piston phase and which will allow, which will create a, which will allow piston to come down from TDC to BDC and that is known as power stroke and both the valves are evenly closed. So, during power stroke both the valve. So, at the from the aim, from the beginning of the compression stroke till the end of the power stroke for the time being you should know that all the valves are remaining closed, rather both the valves are remaining closed fine.

So, piston has now reached at BDC at the end of the power stroke next stroke is known as exhaust stroke. So, what is done? So, piston will come from BDC to TDC again and in that in the whenever piston is coming from BDC to TDC exhaust valve will now will be, we will need to open exhaust valve intake valve will remain closed, but exhaust valve will open. So, as the piston is coming from BDC to TDC it will allow all the combustion product that was there in inside the engine cylinder to go out from the engine cylinder through exhaust manifold.

So, what is the you know conclusion from this stroke? Exhaust stroke exhaust stroke piston the at the end of the power stroke piston has reached at BDC exhaust stroke piston is coming from BDC to TDC right and whenever piston is coming from BDC to TDC both the I mean to a up to the end of the power stroke both the valves are closed. So, the moment when piston is coming from BDC to TDC at the beginning of the exhaust stroke intake valve will remain closed, but the exhaust valve will open. And the opening of the exhaust valve will allow piston is coming up so it will create pressure on the combustion folder because of that pressure since exhaust valve is closed open. So, all the combustion product will try, will go out through exhaust manifold to the ambience.

There are some issues, I will discuss in towards the end of this course that whenever we are taking exhaust manifold we may have some arrangement that are different in those are different we will discuss. So, these are four different strokes in a four-stroke engine, no matter whether SI or CI engine. So, out of this four stroke; so, far you understood that out of these four different strokes. One stroke is power stroke, other three other strokes that is intake stroke compression stroke and exhaust strokes are idle strokes.

So, 1 power stroke versus 3 idle strokes. So, in a four-stroke engine there are you know merits and demerits. Also we will discuss because since, only power stroke only the temperature high pressure temperature is generated during combustion that is in the power stroke and there are three ideal strokes. So, engine is getting enough time to cool down.

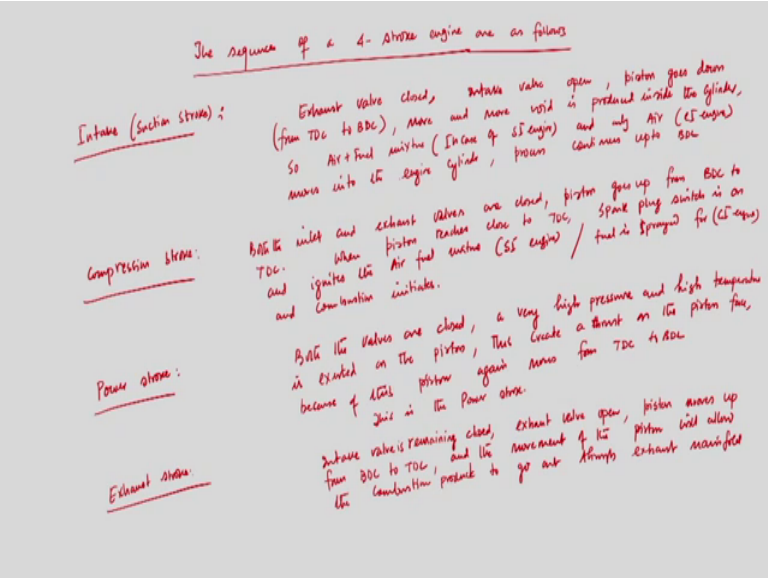
So, as compared to the two-stroke engine I will discuss: what are the different strokes in a two-stroke engine. So, in as compared to the two-stroke engine, four-stroke engine gets enough time to cool down the engine cylinder, not only that since there are three ideal strokes and one power stroke. So, the fly you just connected with the you know with the engine should be will have a higher you know re-higher mass.

Because, there only power stroke is I can give you the you know an example, suppose whenever you are having huge money normally go to the back to deposit the money and when you need money then we go to the bank and we withdraw money. Similarly what is happening over here during the power stroke whatever energy is getting that energy is stored in the flywheel, but to run the piston from BDC to TDC or TDC to BDC whatever it is during intake compression and exhaust stroke, we need to borrow energy from the flywheel.

So, we are getting power for energy during the power stroke that energy is stored within the in the flywheel, excess energy because in the power stroke you know we are getting energy. So, some part of the energy will be used to rotate the wheel, I mean that is why you are getting we are running the engine, we are getting whether it is four wheeler or two wheeler, we can move from one place to other place it will try to rotate the wheel. Certain portion of the energy will be stored in the flywheel so that we can borrow energy which is required to operate or to run three other strokes, that is intake stroke compression stroke and the exhaust stroke.

So, this is all about the four-stroke define strokes in a four-stroke engine. And, now I will write in details about what are you know different strokes and what is done and that will help you I mean as a note.

(Refer Slide Time: 27:41)




So, now I will write in details about the different you know different you know you know four-stroke engines that their sequence of a four-stroke engine; so, the sequence the sequence of a four-stroke engine. So, what are the sequence? The sequences of the four-stroke engine are as follows rather I am writing. So, I have disused now I am writing first stroke is intake stroke, sometimes it is known as suction stroke.

So, intake comma suction stroke, what is done? I will write in details exhaust valve is closed exhaust valve closed, intake valve open, piston goes down piston goes down from BDC to TDC from TDC to BDC more and more void is produced, I have discussed but I am now writing only two I mean that will remain. So, you can also it will remain as a note. So, I have already discussed about those.

More or more void is produced inch inside the cylinder right. So, air fuel moves into the chamber cylinder. So, air plus fuel mixture in case of CI engine, in case of SI engine and only air for CI engine you know moves into the, moves into the chamber in a ss oh engine cylinder and this process continues up to BDC. So, process continuous up to BDC. So, this is the you know the sequence in a intake, stroke exhaust valve is closed intake valve opens piston goes down from BDC to TDC, TDC to BDC more and more more and more void is you know produced into the cylinder. Air plus fuel mixture is introduced in case of a SI engine only air is introduced other moved into the cylinder and this process continuous up to the BDC ok.

Next stroke that is what I told you that is compression stroke. So, this is compression stroke. So, this is compression, what is done? Here inlet and exhaust valve are closed, rather both the both the inlet and exhaust valves are closed both the inlet and exhaust valves are closed right when piston TDC, closed. Piston goes up from BDC to TDC right, when piston reaches close to TDC right spark plug ignites the air fuel mixture, spark plugs which is on and ignites the air fuel mixture in case of a SI engine in case of a SI engine and fuel is sprayed for CI engine. So, piston is coming, goes up from BDC to TDC piston which is close to TDC, spark plugs which is on and ignites the air fuel mixture in case of SI engine.

Now, fuel is introduced whenever piston is close to TDC, rather at the end of the compression stroke and it initiate combustion product fluid if sprayed for CI engine and combustion initiates right, this is what important. Next stroke is power stroke this is very important. So, whenever at the end of the compression stroke, at the end of the compression stroke piston is close to TDC we have initiated combustion and combustion will be completed within a brief you know small time period. And very high pressure rather both the valves are closed both the valves are closed, both the valves are closed right are high pressure a very high pressure and high temperature, high pressure and high temperature is exerted on the piston.

So, as I said you that this is important that both the valves are closed and during the, at the end of the compression strokes already we had high pressure of the air fuel mixture or only air and then on the top of that we have injected fuel in case of a CI engine or we have switch on the spark plug in case of SI engine. So, it will initiate combustion and combustion will be completed in a small time period and as a result of which a very high pressure. And temperature it will be there, will be there in the in that space which is not, rather on the top of the piston and that is why it clears volume rather and as I said you that the movement of the piston is instantaneous. So, it will not remain rather at the TDC to complete the combustion.

So, it is not true that the combustion will be completed as long as piston is there very close to TDC rather it may happen that rather it is happening that the even when piston is coming from TDC towards BDC combustion will continue. And, combustion will complete and wherever, when whenever that the when the piston is little bit away from the TDC. Whatever it is I mean the case. In fact, it requires a finite amount of time

although it requires very small time period, but it requires finite amount of time to complete the combustion. So, it is not true that the combustion, entire combustion will be completed when piston exactly at the TDC. So, may be piston continuous to travel from TDC towards BDC and combustion will be completed.

Now, power stroke is both the valves are closed a very high pressure and high temperature is exerted because of the combustion on the piston phase, on the piston this is very important and these create a thrust on the piston phase, a thrust on the piston phase and because of this because of this piston again moves from TDC to BDC. So, piston movement is instantaneous. So, I cannot say that the piston will leave in about the TDC, but may be piston is coming started joining from TDC towards BDC at you know beginning of the power stroke.

But whenever piston is coming from you know TDC to BDC already combustion has initiated and combustion will be completed may be whenever piston is little bit away from the TDC. So, that high pressure and temperature that is generated because of the combustion it will create a huge thrust from the piston phase and which will allow piston to move down, I mean that is create a power. So, this is an from TDC and this is the power stroke and this is the power stroke this is the power stroke right this is important.

Now, last stroke is you know known as exhaust stroke; this is very important exhaust stroke. So, we have discussed about all these strokes a few minutes back, but still I am writing. So, till now we have discussed about intake stroke compression stroke power stroke. So, we have seen that I will discuss again exhaust stroke you know intake valve is closed, intake valve remaining closed exhaust valve open right this simultaneous.

So, processes simultaneous that is intake valve remaining closed the exhaust valve open simultaneous which means that and exhaust valve open piston moves half from BDC to TDC intake valve remaining closed intake valve is remaining closed, exhaust valve open. And, the process is simultaneous I mean these two are ha you know when a valve opening are simultaneous and as I said you the nowadays all these valve opening times are controlled by elect controlled electronically. Piston move some piston moves up from BDC to TDC. So, from BDC to TDC piston is coming up and. So, whenever piston is coming up and whenever piston reaches at the TDC at the BDC then end of power stroke

entire combustion is completed. Now the cylinder space will be filled up with a combustion product.

So, at the beginning at the power exhaust stroke when piston is coming from BDC to TDC it will allow the combustion product rather it will expel combustion product to go out through intake through exhaust manifold, BDC to TDC and the product of combustion. And the movement of the piston and the movement of the piston and the movement of the piston will allow rather will expel will allow the combustion product, combustion product to you know go out through exhaust manifold right. So, this is what so, this is there is a difference between an exhaust stroke and there is a difference between is two-stroke and four-stroke engine for the exhaust stroke. So, this is happening. So, I will discuss in two-stroke engine.

Two stroke engine there is there are no you know intake power stroke is there because you will power, but intake compression and exhaust strokes are you know I mean in one stroke we have to complete all three stroke in a one all three different strokes in a one stroke. So, we will discuss in detail about it is very interesting and you know. So, only you will have a one idle stroke versus one power stroke. So, the power stroke will be there, but remaining three strokes will be completed in one stroke only. So, the sequence so, the sequences of the two-stroke engine we will discuss, but now we have understood that the what are the four different strokes in a four-stroke engine whether it is SI or CI engine.

So, intake valve is remaining closed exhaust valve open piston moves up whenever piston is moving up the cylinder phase was filled up with the rather that is a beginning of the exhaust strokes or end of the power stroke entire cylinder space is filled up with the combustion product. So, the movement of the piston from a BDC to TDC will expel, all that exhaust gas or combustion product to go out through exhaust manifold.

So, these are the four different you know sequences are for different strokes and the process continuous this is a, it is a cyclic. So, cyclic you know in a cyclic manner. So, the process continuous the process repeat again from intake compression for an exhaust so, as the end of the exhaust stroke piston you know cylinder space is let it be empty, there is no combustion product I can say that there is there would not be combustion product there will be a residue, but again we have we will have a suction stroke intake stroke. So,

we will have again we will introduce phase here and again the all the process will be repeated and you know it will continue.

So, these are the four different stroke in a four-stroke engine, but I will like to discuss a few points in the context of this that may be as I said you that the it is not the, it is not possible that the entire combustion will be completed. So, whenever piston will be exactly at the TDC combustion will be initiated and it will be completed whenever piston is you know, it suppose to departure from TDC towards BDC, it is not the case. So, there is a deviation may be we have to initiate combustion when the piston is a little bit away from the TDC and the movement when piston reaches at TDC may be entire combustion will be completed. And it may not be case that the entire combustion will be completed exactly when piston is at TDC rather whenever piston is again travelling back from TDC to BDC combustion continuous and combustion will be completed when the piston is away from TDC.

So, that is the case and because of that there will be certain you know problems that is what I will discuss in details and not only that this exhaust stroke it is not possible that the all the combustion product will go out rather will be, can be expelled out from the engine cylinder, there are remote areas from where combustion product will be there. So, whenever again you are taking phase here in the intake stroke in case of a CI engine or in case of a SI engine where I have introducing again phase air fuel mixture that phase air fuel mixture will be you know mixed with the residue of the combustion product and as a result of which engine efficiency will drop. So, that is what we discuss in detail again.

But for the timing you should know that in case of the four-stroke engine since only one power stroke only one power stroke that is from where you are getting energy or power and that power will remain, power will be utilized to rotate the wheel. And, we can run a you know our vehicle four wheelers two wheelers whatever it is, but a part of the energy will be stored in the flywheel because we need to run intake compression and exhaust stroke for which you will need energy.

That energy will come from the flywheel; that means, in a power stroke we are getting power that is when it is stored in the flywheel and for three different other strokes we are again borrowing energy from the flywheel. So, this is the four-stroke engine and another important point is that since in a four-stroke engine only we have we have only one

power stroke versus three ideal stroke. So, energy rather engine cylinder is getting enough time to cool down whereas, in case of two-stroke engine we will have only one power stroke versus one idle stroke. So, engine not engine is not getting enough time to cool down. So, the in the four-stroke engines is relatively safer from that prospective.

Not only that we will discuss in detail that in case of a two-stroke engine a highly possibility is there key that you know some amount of phase air fuel mixture will be will go out if the exhaust product and that is not the case in case of a four-stroke engine. Because, four-stroke engine once the exhaust valve exhaust stroke is completed exhaust valve will be closed immediately and then only will intake valve will open and will introduce air fuel mixture.

May be we all have loss of phase air fuel mixture of phase air with the exhaust stroke, but still probability is there that the some portion of the some portion of the combustion product residue of the combustion product will be there in the engine cylinder at the remote areas. And, which will be mixed with the air fuel mixture that is coming during intake stroke in case of a SI engine or phase air in case of a CI engine.

So, this is all about the sequence of a four-stroke engine, but we will discuss about the two-stroke engine in the next class and we will see that how the two-stroke engine is different from the four-stroke engine. And nowadays why two-stroke engine are, is not a you know are not preferred two-stroke engine are not preferred that the all engines are four-stroke engines.

So, those issues we will discuss in the next class. With this I stop here today and we will continue our discussion in the next class.

Thank you very much.